QUALITY SUCCESS STORIES

FROM

Canadian Chemical Sector Companies

Industry Canada
Chemicals, Plastics and Advanced Materials Directorate
September 1994

Industry Canada Industrie Canada

Canada

Quality Success Stories from Canadian Chemical Sector Companies

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Advanced Materials Directorate
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Cover Photo: Courtesy of Albright & Wilson Americas Limited of its plant in Port Maitland, Ontario.

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Foreword

In May 1992, an industry-led advisory group, the **Chemical Sector Grouping Consultative Committee** issued a report to the Minister of Industry titled *Toward an Internationally Competitive and Responsible Canadian Chemical Sector Grouping*. The report identified several issues that the chemical sector in Canada must address in order to remain competitive. Prominent among them was the issue of total quality. The report recommended that all company personnel must commit themselves to continuous quality improvement.

In response to this identified need, Industry Canada conducted further consultations with representatives of chemical sector companies concerning ways in which industry and government could work together to advance quality. Raising the profile of quality and sharing quality-related best practices within the industry through a publication of success stories of individual companies was selected.

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Part 4 — Process Improvement Using the Total Quality Approach

Introduction

In October 1993, Industry Canada began contacting managers and quality specialists in the industry to gauge their interest in sharing best practices. A total of 55 companies were contacted, 22 of whom have since provided articles suitable for publishing. Interest was also high among those companies not providing articles. Several of these companies expressed an interest in participating in similar projects at a later date.

The consulting firm of A. Underdown & Associates, under contract to the Chemicals, Plastics and Advanced Materials Directorate of Industry Canada, supplied editing and project coordination services. Industry Canada has undertaken the publication and distribution of this volume.

To ensure the relevance and quality of the articles, an editorial board of four individuals with extensive experience in the chemical industry have reviewed the articles. They have provided valuable observations and insights, many of which have been incorporated in the publication. These individuals are:

- **Daniel Corbett**, president, St. Lawrence College, Brockville, Ontario
- **John Hagerman**, consultant and former vice-president and general manager of Canada Cup Ltd., Toronto, Ontario
- **Duncan MacIntyre**, president and CEO, the National Quality Institute, Ottawa, Ontario
- **John McAdam**, Chemicals, Plastics and Advanced Materials Directorate, Industry Canada, Ottawa, Ontario.

The objectives of the publication include:

- raising the profile of and increasing commitment to total quality in the Canadian chemical industry grouping
- sharing best practices related to total quality within the industry and with customers and suppliers
- demonstrating the industry's quality-related achievements to its customers, investors and other stakeholders.

The articles bring the knowledge of industry quality experts and managers to bear on practical implementation issues. While they are primarily success stories, they also discuss some of the problems encountered during the quality journey and how companies have modified their approaches to solve them. We anticipate that this publication will be a valuable information source for quality

planners, implementers, trainers and line managers, and above all, that it will be highly relevant to Canadian companies.

One cannot learn everything from publications, videos or even talking to experts. There is no substitute for the practical experience of applying quality principles and methods in one's own organization. The articles in this publication, however, will allow readers to access some practical experience of the authors. This should result in more effective planning and implementation of total quality.

Quality in the Chemical Sector Grouping

The chemical sector grouping is one of the five largest industry groupings in Canada with sales of $37 billion in the manufacturing sector and $2 billion in the distribution sector. The industry employs approximately 155 000 Canadians. Increasing globalization of industry and markets is leading to increased competition for companies in the sector and increased complexity in doing business. Exports approximately doubled to about $8 billion between 1982 and 1992. Imports, however, have climbed at a higher rate and totalled $10.1 billion in 1992.

In response to international competition, companies are increasingly focusing on quality as a key element of business strategy. Over the past few years, there has been considerable interest in Total Quality Management (TQM) as a process to achieve quality objectives. TQM is a management philosophy which endeavours to continuously improve all of a company's products, services and processes. Successful TQM implementation results in increased product and service quality, reduced costs in all areas (including production, distribution and administration), reduced product development time, increased customer satisfaction and improved relationships with external stakeholders.

Not all of the companies represented in this publication have formal processes called Total Quality Management, Total Quality (TQ) or Continuous Quality Improvement (CQI). The degree of process formality and the terminology used varies considerably throughout the industry. For example, continuous improvement is sometimes taken to mean a series of small, incremental improvements. In this publication, however, **continuous improvement means not only ongoing incremental improvements but also occasional step function improvements**. In either case, the company *continuously* works to improve its processes from the perspective of its customers.

During the course of developing this publication, the profile of TQM as a management buzz word has noticeably declined. Other terms, such as benchmarking and business process re-engineering, have become more prominent in both the management literature and business press. These terms refer to management methods. **Total quality, on the other hand, is a management philosophy which emphasizes management leadership, employee involvement, focus on the customer and continuous improvement.** It is not in competition with the latest management techniques, but provides an

overall environment for their use. The articles in this publication provide ample evidence of continuing commitment to the TQ approach.

The majority of large, multinational companies operating in Canada are familiar with TQ and have been implementing it in one form or another. In many of these cases, the TQ approach, implementation methods and specialized external assistance have originated from the parent company outside Canada. Among Canadian-owned companies, many of whom are small to medium-sized enterprises (SMEs), the situation is less clear. Some companies have been implementing TQ with significant positive results. It appears, however, that many SMEs may be relatively less advanced.

Some themes that emerged from the articles are summarized below:

Quality is applicable to all businesses. The variety of cases involve large, multinational companies, small independents, integrated manufacturers, single-product producers and distributors. They all have success stories to tell.

Quality involves a focus on the customer. The articles in this publication deal with improving the quality of all products, services and processes. The measurement of quality relates to customer needs and satisfaction.

Quality is evolutionary. Several companies started with an emphasis in a single area that needed improvement and gradually spread the principles and process of TQM throughout their organization. TQM initiatives usually began with the use of a particular expert's approach. Other concepts and methods were added later, often in response to limitations encountered with the original approach. Continuous improvement is evident in the evolution of the quality process.

Quality has many dimensions, from being an integral part of the corporate structure to empowering the work force on the shop floor. The success stories deal with topics as diverse as statistical methods, quality standards and changing peoples' attitudes. There is also a constancy of fundamentals used to advance quality issues throughout the organization.

Quality is not quick fix — it takes time. Many companies that now have a quality culture started implementing TQM several years ago. Those companies realized the importance of education and training in TQM principles and processes for all employees. Successful adoption of TQ requires changing the mindset of all employees. Time is needed to make this transition.

During discussions leading to this publication, potential authors were given a wide list of quality-related topics to choose from. The topics chosen reflect the areas of current interest where sufficient progress has been made to report on. The following four main subject areas emerged and have been used to organize the publication:

- the evolution of the quality process within companies
- the planning and implementing of ISO 9000
- the organizational culture and employee involvement
- the process improvement using the TQ approach.

The success stories in this publication demonstrate that companies in the chemical industry grouping have made considerable progress in quality in recent years. This is true not only for the large multinationals, but also, in many cases, for small to medium-sized businesses.

Quality, however, is a direction, not a destination. Most of the articles point out that the company's quality improvement processes are ongoing. There are many challenges ahead.

Part 1

Evolution of the Quality Process within Companies

Part 1

Evolution of the Quality Process within Companies

Overview

Most large companies began a formal quality process in the mid- to late 1980s. These initiatives typically started with one quality guru's method. They later added elements from other sources and developed a customized approach. The main elements of the quality process include an initial assessment, developing a quality vision and goals, setting up a quality infrastructure, identifying improvement priorities, communicating the quality initiative throughout the company, mobilizing process improvement teams, reward and recognition, ongoing measurement of progress and improving the quality system.

Most of the companies represented here have added or are in the process of adding ISO 9000 registration to their quality process. These companies, as well as those featured in the Part on ISO 9000, emphasize that the ISO 9000 standards are compatible with the Total Quality (TQ) approach to continuous improvement.

Another trend involves an increased emphasis on linking TQ to business strategy. This requires management leadership in setting the company's goals and identifying priority areas for improvement. This top-down approach is fully compatible with the bottom-up identification of problems and opportunities, often associated with Total Quality Management (TQM). The approaches can co-exist and achieve synergy since management leadership and employee involvement work best when practised simultaneously.

The articles in this Part are summarized below:

The Quality Improvement Process at 3M Canada Inc: 3M Canada Inc. is well-known for its commitment to innovation. Supporting this is a long-time dedication to customers, defined by a TQ process that unites all 3Mers in determining customer specifications — and then exceeding them. 3M has developed a worldwide blueprint, called Q90s, to improve its ability to satisfy customers. The process incorporates TQ attributes such as customer-driven, process-oriented, management-led and employees-involved. The Q90s process links all 3M's processes to its corporate objectives.

Port Maitland Plant Sets Sights on World-class Status: This Albright & Wilson Americas Limited plant has identified three major challenges: simultaneously addressing the productivity and quality demands of a rapidly expanding marketplace resulting from free trade and industry rationalization; creating a team-related, barrier-free work environment within a unionized, traditional,

departmentalized operation; and ensuring that site efforts are integrated and aligned with key business issues. The achievements already made in these areas, as well as future directions, are discussed.

TQM in a Medium-sized Enterprise: This article discusses the experience of BIO-LAB Canada Inc. as a 40-person company with the TQ approach. Employee training, which involved simulated and actual problem solving, is discussed in detail and examples of process improvement projects in the plant and office are provided. In the plant, waste reductions have resulted in lower costs and improved environmental factors. Improvements in the office have resulted in better customer service. TQ has given managers the ability to make better decisions and employees a greater feeling of control and contribution.

The Quality Process at Hoechst/Celanese Canada: At Hoechst/Celanese Canada, quality is considered a business process and an essential element of business strategy. This article discusses the evolution of the process within the company, which began in the mid-1980s, using the Philip Crosby approach. It was later customized to fit the Hoechst/Celanese culture, as well as drawing on the experiences of Juran, Deming and others. The starting point of this approach is a set of quality values dealing with performance, people and process, and a quality policy. The article also discusses five core principles used to integrate quality into the company's business process and provides some examples of results achieved.

The Nalco Canada Quality Journey From Crosby to Baldrige — A Management Perspective: Nalco Canada's quality journey began in 1989 with use of the Philip Crosby approach. Its major strength was that extensive management involvement demonstrated commitment to all employees. Weaknesses were also identified, for example, the Crosby approach was not always helpful in working with customers. Better approaches to identifying priorities and team problem solving were also needed. Training in Juran's methods resulted in significant improvements. Further developments have included self-assessment using the ISO 9001 and Baldrige criteria. As Nalco's quality process continues to evolve, the only constant has been management's commitment to make it happen.

Evolution of Total Quality at Sterling Pulp Chemicals: The quality process at Sterling Pulp Chemicals, Ltd. started with management creating the environment necessary for change. Internal and external customers were then identified, along with their needs. The needs were prioritized, key measures identified and measurement systems implemented. Everyone in the organization continuously compares process output to customer needs. When data reveal that a process is not capable of meeting requirements, the process is improved. A number of quality procedures, actions and results are discussed in terms of management leadership, employee involvement, focus on the customer and continuous improvement.

Business Regrowth through Total Quality: In response to an increasingly competitive environment, The Upjohn Company of Canada invested in *Regrowth:* restructuring, re-engineering and adopting a strategy based on TQ. This article describes Upjohn's TQ process, beginning with a company-wide assessment, the adoption of the Philip Crosby approach and the development of systems for process improvement, employee involvement and measurement. A key measure of process quality, the Price of Non-Conformance (PONC) is discussed. Examples of process improvements and resulting financial benefits are given which demonstrate that TQ can be a winning business strategy.

The Quality Improvement Process at 3M Canada Inc.

by Herman Sahrmann
Senior Corporate Quality Specialist

The Company

3M is a global company with sales in excess of $14 billion, employing 87 000 people in 57 countries who manufacture and market about 60 000 products. 3M Canada Inc. is the company's first international subsidiary and the sixth largest. Established in 1951, the company now employs over 2 000 Canadians, with sales of more than $600 million and assets over $400 million.

Our head office and main manufacturing site is located in London, Ontario, and five other plants are located throughout Canada: at Brockville, Havelock and Perth in Ontario; and at Morden, Manitoba. Our customers are supported through a national service network which includes sales offices in major cities across the country. The six 3M Canada manufacturing plants export up to 80 percent of their production to the United States and other 3M subsidiaries worldwide, for total export sales of about $188 million.

The 3M Quality Philosophy

Innovation is a key ingredient of 3M's continued growth. Product research and development (R&D) is important throughout 3M and has been carried out at 3M Canada since the beginning, with emphasis on development of unique Canadian products for sale at home and abroad. But behind it all is a long-time dedication to customers, defined by a total quality process that unites all 3Mers in the task of determining customer expectations — and then exceeding them. This article provides an overview of our total quality process and how it is linked to our corporate strategy.

The 3M Q90s Process for Total Quality

3M has developed a worldwide blueprint to improve its ability to satisfy customers. We call it the Q90s process. Q90s incorporates attributes that are common to all Total Quality Management (TQM) organizations in that it is:

- customer driven
- process oriented
- management led
- employees involved.

Each of these attributes is discussed in the following sections.

Customer Driven

The concept of delivering products and services that exceed customer expectations drives the Q90s process. Listening to customers, then doing what it takes to exceed their expectations explains what quality is all about at 3M Canada. Customer satisfaction measurement assumes a much larger role when quality is directly linked to the customer. We conduct extensive customer surveys to find out what we are doing right and where we have to improve. Examples of factors contributing to customer satisfaction which have been addressed in 3M surveys include:

- product performance
- extent of product range
- quality of technical service
- delivery service
- packaging
- pricing policy
- ease of contact
- communications with head office sales and marketing
- sales terms and conditions
- complaint and problem handling
- product promotions
- professionalism of sales reps
- management's policy flexibility
- suppliers' reputation.

Information from customer surveys has created a strong spirit of cooperation and focus. Things that stand in the way of customer satisfaction are being eliminated, even where this requires significant changes in the way we do things. The concept of **customer driven** can be brought into every facet of the organization and applies to internal customers as well.

Focusing on customer expectations leads to continuous improvement as needs and expectations change with time. A few years ago, our customers were willing to wait 13 seconds before they hung up. Now it is just eight seconds — a typical example of changing customer expectations concerning what is good enough.

Below, are some examples of how 3M has responded to changing customer needs and expectations by improving our products, services and processes.

Saving customers' time. In response to customer needs for faster service, 3M changed its shipping and delivery schedule. Over 95 percent of our customers' adjustment claims are now satisfied in a

quarter of the time previously required thanks to changes that speed internal communications and require only essential authorizations. One 3M group's advertising and promotion allowance system was changed dramatically to give their distributors credits in two or three days, rather than two to three weeks. A summary invoice system was developed for customers who submit a high number of individual orders for stock and non-stock items. For some customers, this eliminated up to 200 separate invoices per month.

Making it easy for customers. Some customers have unique needs created by unusual ordering habits and other logistical factors. We analyze these situations and suggest ways we can tailor our systems to match the way these customers do business, thus increasing their productivity. We help customers meet environmental goals by using recyclable and returnable packaging and are constantly seeking ways to produce products that minimize or eliminate damage to the environment during their eventual recycling or disposal. We have changed our procedures for handling government orders to make it easier for government customers to do business with us, reducing processing time from what could have been months in some cases, to two or three days.

Customer-linked quality systems. Quality at 3M has been an evolutionary process. We now concentrate not just on manufacturing products to specification, but on ensuring that those specifications remain relevant to customer needs. For example, product field tests and customer feedback are critical components of the quality system at our new tape plant in Brockville, linking the production process and customers' perceptions of the end result. Several 3M plants have earned the internationally recognized ISO 9000 quality registration — assurance that they maintain consistently high standards.

Building customer relationships. We have formal quality partnering agreements with several major Canadian customers in which relevant resources and information are shared to improve existing products, services and business practices, and to explore new opportunities such as product development. Valuable relationships of a similar, but less formal, nature exist with many other customers.

We share delivery documentation in a quality partnering program with our major carriers. The trucking companies that deliver our products visit 3M customers and find out first-hand what they like about delivery services and what needs improvement.

The way we purchase raw materials has a major impact on our ability to give our customers consistent, quality products, on time and at competitive prices. We have developed a fully integrated procurement system that links the entire supply side of our business and interacts with related areas within the company.

Process Oriented

Every product or service is the result of a process. This concept, often ignored in traditional approaches to quality, is an essential part of the 3M approach. Customer expectations created by 3M's products and services must be linked to internal processes. These include all processes making up our business — from manufacturing a roll of sandpaper to organizing a sales meeting.

To be effective at continuous improvement, it is essential to set relevant and realistic goals. Two major roadblocks which must be dealt with include:

- losing focus to the many demands on our time
- refusing to face reality about our quality processes.

Ultimately, the right processes must change to obtain increased customer satisfaction. As Ralph Nader pointed out in 1961: "It's easier to set up toll-free telephone lines so consumers can rid themselves of their anger than it is to improve the product which caused the problem." In the long run, such a strategy — treating a performance problem as if it were a communication problem — will not succeed.

Below is discussed the continuous improvement process at 3M and how it is linked to customer needs and satisfaction.

Continuous improvement of processes is a process itself. Although there is no single method to bring about change, there is agreement that the improvement process:

- always begins and ends with the customer
- includes a thorough analysis of the selected process
- involves a substantial amount of discipline and time
- involves teamwork and taking ownership.

3M Canada has developed an 11-step model that has had an impact on our company-wide understanding of continuous improvement concepts such as focusing on the customer and on process change.

The steps are:

1. Identify the specific product/service you want to improve.
2. Identify your customers, their expectations and current level of satisfaction.
3. Identify the steps you currently take to provide your product/service.
4. Identify what you now depend on others to provide.
5. Combine (steps 2, 3 and 4) into a process flow chart to illustrate all the steps and their relationships.

6. Identify key measurements of your process that will reflect your customer's satisfaction.
7. Evaluate how well your process performs in terms of these measurements.
8. Establish target levels for these key measurements.
9. Identify the gaps in performance (comparing results of steps 7 and 8) and review the process flow chart for opportunities to reduce these gaps.
10. Act to improve performance of your process.
11. Evaluate improvement in customer satisfaction.

Steps 1 through 4 primarily involve information gathering. Most of the information required to complete these activities is often available to process improvement teams or can be obtained with relatively little effort. In some cases, these is a need for more involved surveys.

Step 5 provides a visual description of the process, based on information gathered in the previous activities. This is the easiest way to document, or map, a process. It is also the most easily understood because it shows relationships at a glance.

Steps 6, 7 and 8 involve considering the things customers want in terms that we can measure, determining current performance, and setting new targets for these key measurements.

Step 9 examines the gaps between current and target performance, and steps 10 and 11 involve action and evaluation.

This approach has created a strong spirit of cooperation and focus. Things that stand in the way of customer satisfaction are not just fixed, waiting to reappear — they are eliminated, even if it sometimes means big changes in the way we do things.

The above model can be used to address both localized and company-wide processes. It is currently being used to address the communication process at 3M Canada.

Management Led

Management leadership is essential to these key components of the quality improvement process.

- **Creating and sustaining customer focus**

  This has been accomplished by sponsoring extensive customer surveys, communicating results of the surveys and implementing the findings by changing the appropriate processes.

- **Creating a climate of continuous improvement**

  In 1990, we undertook a thorough self-assessment against credible criteria. This started the process by identifying opportunities for improvement.

  Continuous improvement means continuous assessment of improvement opportunities in 3M processes. It is not limited to small, incremental changes. At times it may require major breakthrough changes.

Doing what it takes to exceed customer expectations will be the yardstick. The cure may range from increasing productivity of an existing process to replacing an obsolete process with a new one. The continuous improvement climate encourages improvements when there are no problems. It challenges complacency and the attitude, "we are very successful . . . we must be doing it right."

- **Providing clear corporate objectives**

  Much criticism of TQM efforts has focused on their failure to link improvement efforts to corporate objectives and results. 3M Canada has clearly spelled out a relatively simple formula for success: growth; productivity; customer satisfaction; employee satisfaction; and corporate image.

  Everyone in the company must be sure that everything they do contributes directly to one or more of the goals.

  In terms of improvement, it simplifies process selection: a right process for improvement will be one that has a measurable impact on one or more of the corporate goals. It is essential to select the right process before we start the improvement efforts. Having clear objectives removes some of the mixed messages about process selection.

Employees Involved

LONDON BUSINESS magazine's second annual survey (January 1994) named 3M Canada as one of the best places to work in London. The article lists policies of empowerment and implementation of the principles of TQM as the main reasons.

Yet, at the same time, 3M introduced new training that recognizes the importance of preparing employees to adapt and contribute to change and to develop an attitude of process ownership. The training is designed to provide greater understanding of the need for change and to provide the skills that are key to the change process. Like other total quality companies, 3M believes that the greatest challenge in TQM involves changing human behaviour, not mastering technical skills.

The move toward formal quality improvement teams started in 1983 at a new tape manufacturing plant. Within six months, a management team reported that the team approach to process improvement provided excellent results, and the team approach became the norm for manufacturing processes. During the Q90s assessment in 1990, however, it became clear that this approach was not used on a company-wide basis. Less than one-third of the people involved in the assessment had ever been on a team. This included many employees with more than 10 years service at 3M. The self-assessment did more than reveal opportunities for improvement; it enabled many employees to become involved in the improvement teams that were established as a result of the assessment.

So far, several hundred quality teams involving 3Mers at all levels and in all areas of the company have emerged to drive our improvement process. Many of these teams have received recognition and some became winners of the international 3M Quality Achievement Awards presented in St. Paul, Minnesota.

Q90S: Linking Processes to Corporate Objectives

3M has developed a worldwide blueprint to help continuously improve its ability to satisfy customers — the Q90s process. **Figure 1** provides an overview of the concepts and ideas that are involved. They may be summarized as follows:

- processes are the key links to our customers
- the customer's perception of the quality of the product or service determines the level of satisfaction
- processes have to be linked to corporate objectives to assure that the right processes are changed
- process ownership is essential as people drive change and improvement
- management has to provide the structure that is conducive to listening to the customer (empowered customer)
- self-assessment of the 3M quality process is necessary to sustain TQM efforts and to monitor progress.

Conclusion

In developing a continuous improvement process, one encounters mixed messages on what TQM practices to adopt. At 3M Canada, we have learned that there is no single magic formula for all organizations. Each organization has to develop its own action plan for improvement and integrate it with its corporate strategy.

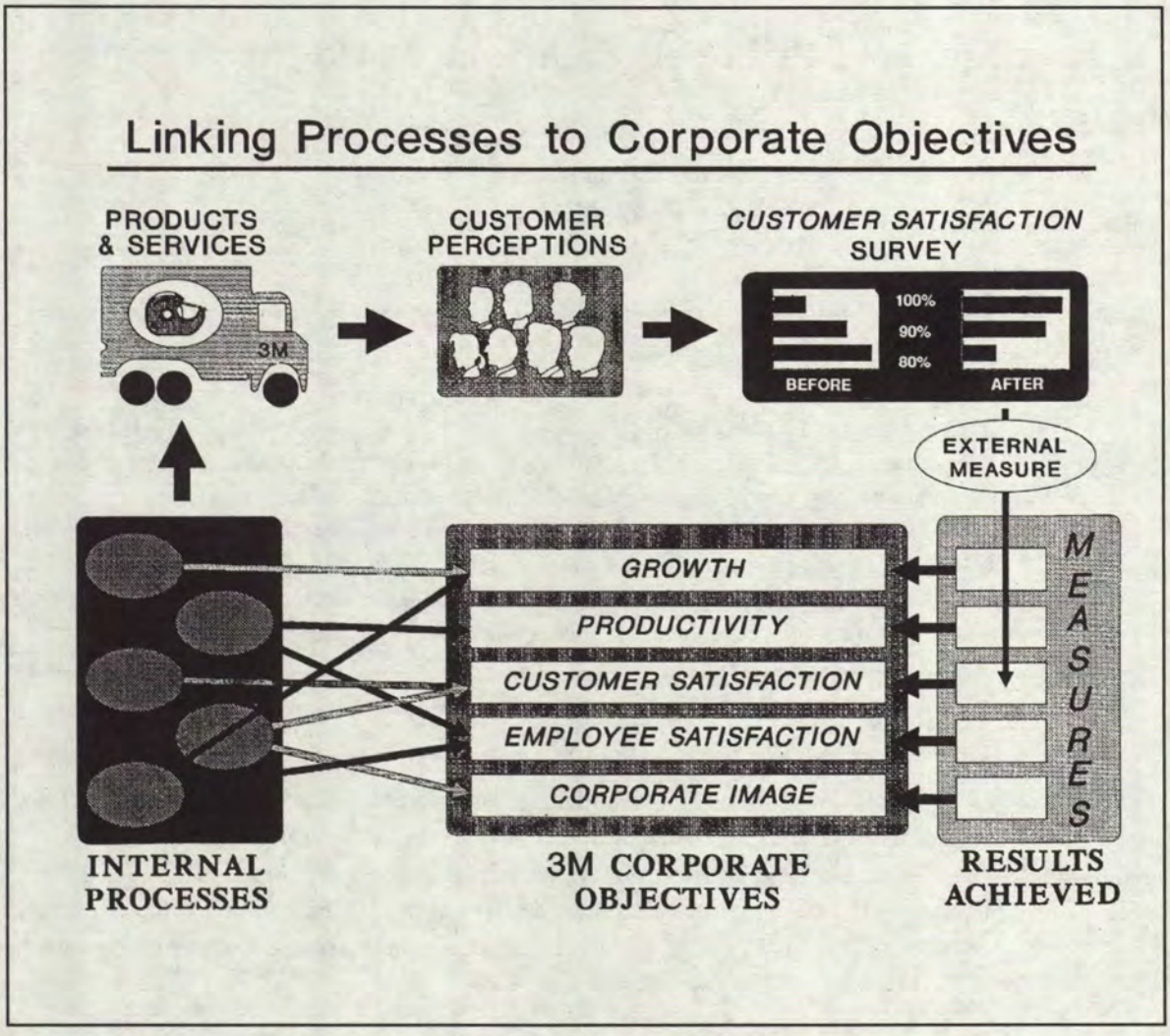

Figure 1 — 3M Canada Inc.

Port Maitland Plant Sets Sights on World-class Status

by Peter Vrba, Manager, Special Projects
Eric Williams, Production Coordinator
Kevin Ryan, Plant Manager
Albright & Wilson Americas Limited

The Company

Albright & Wilson Americas Limited is a wholly owned subsidiary of Tenneco Inc., a diversified company with headquarters in Houston, Texas. Albright & Wilson's Port Maitland, Ontario, plant consists of three main process areas: the thermal phosphoric acid plant, the sodium tripolyphosphate plant and the liquid phosphate processing plant. The primary manufacturing area is the tripolyphosphate plant, producing various grades of technical and food grade product on two systems, a High Density System and a Low Density System. These products are commonly used in industrial, institutional and domestic cleaners, food applications and fertilizers.

Our World-class Goal

The Albright & Wilson Americas Limited Port Maitland plant is going to become world class. To reach our goal, we must overcome the scissor curve of rising costs and falling prices. We must accelerate positive change across the organization. As part of Tenneco's organization, we have embraced their company-wide vision and adopted their strategies and systems. One of these strategies is operating cost leadership. Our total quality initiatives and disciplined management processes are the keys to operating cost leadership.

We will succeed because we focus relentlessly on achieving results and on serving our customers. We lead change and achieve continuous improvement in our work. We work horizontally across functions to get work done quickly and well. We communicate consistently and clearly about goals, expectations and results with internal and external audiences. We insist on excellence in everything we do. This article describes our progress to date.

Early Development Years of the Quality System

The total quality initiative at Port Maitland began in the mid-1980s. During the first four years, all employees (unionized and non-unionized) received training in Statistical Process Control (SPC). In parallel, specific segments from Juran, Deming and Feigenbaum were integrated into the plant/divisional customized quality system. Staff were educated in the seven-step process to creating a

quality system utilizing the approach marketed by Conway Quality Systems. These steps are education, leadership, identify the waste, human relations, training, projects and major management projects.

Major changes did not occur immediately. SPC was primarily an SQC exercise and was not particularly proactive. The primary activities were the formation of Continuous Improvement Projects (CIPs) and building the overall infrastructure. In addition to enhancing efficiencies, the CIPs helped members to gain experience with problem-solving methods. The problem-solving methodology utilized, illustrated in **Figure 1**, was developed jointly by Productivity Development Systems and Tenneco Inc.

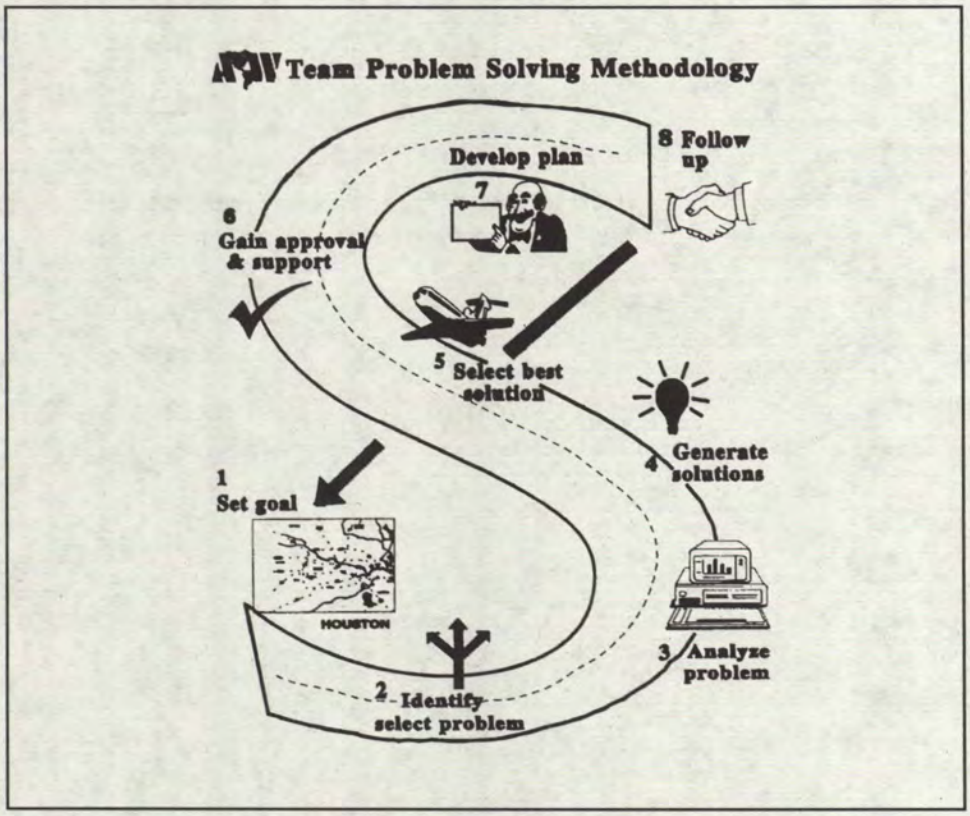

Figure 1 — Albright & Wilson Americas Limited

Dealing with the Changes

The Canada-U.S. Free Trade Agreement and a major rationalization in the industry, reducing the North American producers from six to four, created tremendous opportunity for growth and also major operational problems. The challenges facing the plant were in three areas:

- simultaneously addressing the productivity and quality demands of a rapidly expanding marketplace resulting from free trade and industry rationalization
- developing the knowledge, skill and ownership of all employees in a unionized, traditional, departmentalized operation to create a team-related, barrier-free work environment
- insuring that site efforts are integrated and aligned with key business issues.

The magnitude of the first challenge is illustrated in **Figure 2**. The chart shows that, from 1990 to 1992, volumes on the High Density System increased more than fivefold. At the same time, Low Density System volumes increased 64 percent in one year.

It became evident that in order to address the challenges outlined above, all employees on-site had to become involved. This was achieved through their participation in individual projects, designed to contribute to the overall objectives.

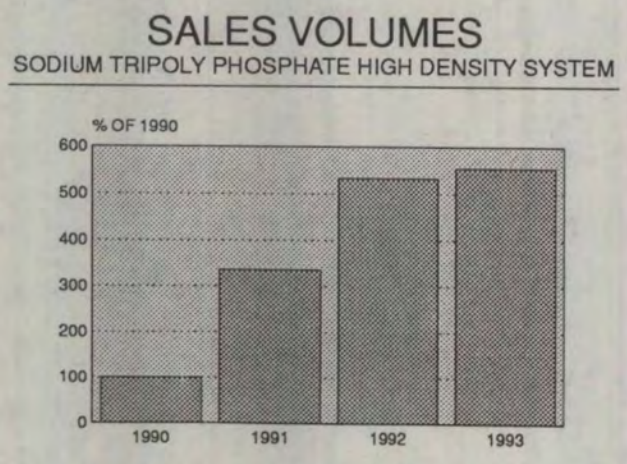

Figure 2 — Albright & Wilson Americas Limited

Productivity and Quality Improvement Projects

The first, relatively smaller, project to include plant operators dealt with liquor filtering problems. Time was spent up front to explain the Total Quality Management (TQM) methodology and team meeting format. Goals were set, problems identified through brainstorming, problems prioritized, solutions suggested and prioritized, actions assigned, trials run, further discussions held, adjustments made, and finally, the problem was solved successfully.

Another team was set up to deal with how the massive data associated with the production volume increases would be managed. Once again, hourly employees had a major impact on the team. The success of this team resulted in the implementation of a local area network system and a Laboratory Data Information System. It is now inconceivable as to how the facility could operate without the data now available at one's fingertips via these system improvements.

The first major management-directed project team was put together to address the High Density supply problem. In order to understand the problem properly, a mass balance of the system was conducted prior to the kickoff meeting. The team included a team leader, a process engineer, three process operators, two production supervisors, the production manager, maintenance manager and plant manager.

The first meeting was conducted 21 June 1991. The agenda covered the following items:

- introduction of project background and objectives
- review of the team memberships, roles and ground rules
- development of the goal
- review of the mass balance
- brainstorming of system problems
- discussion of items brainstormed
- development of an action list.

The goal agreed to was: Increase High Density System capacity by 30 September 1991 by increasing rates of production by 50 percent and operating at 90 percent on time, 350 days per year, while maintaining quality and safety standards.

Twenty-seven different problem areas were identified which were prohibiting us from realizing this goal. Actions were assigned to determine equipment capacity and to characterize the various feeds of the system. It was also concluded that control charts were needed to monitor the system.

Meetings were held every other week with assignments completed in between. The team's life span was targeted at three months. A trained external facilitator was used to ensure that we stayed focused.

At the second meeting, additional information on system component capacities was presented. The facilitator assisted the team in identifying five priority items from the original list of 27 suspected problems using a priority matrix. Actions were assigned to investigate the five problem areas, maintain the production rate control charts and investigate out-of-control conditions.

Meetings continued regularly. Theories for rate restrictions were forwarded, causes found, remedies developed and trailed in the field. Equipment and process variables were adjusted and new controls were implemented to achieve and maintain the gains.

Figure 3 shows the accomplishment of the team. The results enabled us to meet sales on a five-day operation with minimal overtime and adequate downtime to conduct preventative weekly maintenance in a planned manner. The team's success has provided us with the capability of meeting future market opportunities.

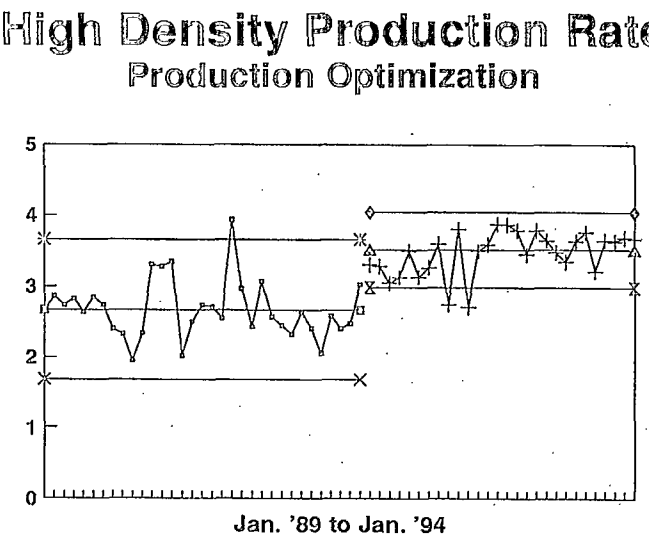

Figure 3 — Albright & Wilson Americas Limited

During the process, product quality was continually monitored to insure customers were not adversely affected. The changes did cause product upsets/rework. The improved process produces consistently high-quality product (as evidenced by a capability of 1.33 C_{pk} or better for key parameters). Once the above improvements were in place, the team gradually wound down. We are still chipping away at additional opportunities but not investing significant time and effort.

The High Density team's success resulted in the formation of a second major management-directed team to optimize the Low Density System, which also was approaching its capacity limits. The skills

gained by many of the participants in the initial team were leverageable. This team, using an in-house facilitator, has managed to increase hourly production rates by 13 percent to date. This has resulted in the plant moving from a sold-out position to one with excess capacity available for new market opportunities.

Union/Management Relationships

The Port Maitland site is unionized. Of the 88 full-time employees, 74 are members of the United Steelworkers of America (USWA — Local 6304). Two important joint committees function at the plant:

Joint Labour Management Committee: Historically, plant management would focus on business issues, while the elected union executive tended to focus on people issues. The thrust of the recent meetings has been to ensure a much greater degree of overlap in these areas so that both plant management and union executive *jointly* address business and people issues simultaneously.

Joint Health & Safety Committee: This committee, co-chaired by an hourly employee and a staff employee, coordinates the plant health and safety initiative. In 1993, the plant celebrated its 22nd consecutive year without a lost-time accident.

None of the accomplishments outlined above would have been possible without the commitment and contributions of our most important asset — our people. Leadership at Port Maitland is not confined to staff. Many of our unionized people have taken on leadership roles in production, shipping, maintenance, laboratory, safety etc. As early as 1974, the lead hand position (a unionized one) was extended to around-the-clock without staff supervision. This evolution of empowering and entrusting the employees has paved the way for experimenting with natural work groups and self-managing work teams.

One such experiment is taking place in the Acid Plant and Liquid Phosphates area, using the first six of Conway's seven steps to creating a TQM system as a guide. The group works in a spirit of continuous improvement, continuously looking for ways to improve quality, productivity and quality of work life. One major success occurred in 1992 when the group played a major role in reorganizing their department and reduced the structure from two job levels to one. Operators now perform all jobs, eliminating unproductive barriers. Many process improvements have been made with minimal capital. Innovative ideas are analyzed by the team, usually using a force field analysis, and implemented where justified.

Integrating the Quality Process with Business Issues

The third major challenge has involved integrating the quality process with ongoing business issues. We have identified six key business issues which must be advanced simultaneously. They are:

- quality and productivity
- quality and cost optimization
- quality and safety leadership
- quality and environmental excellence
- quality and customer satisfaction
- quality and committed employees.

Each of the issues is critical to our continued success. Advancement in any one area will not be allowed to occur at the expense of any of the other issues, or at the expense of quality.

Other Initiatives

There are a number of other quality initiatives ongoing at the Port Maitland plant. We are pursuing the International Organization for Standardization's ISO 9002 certification and have targeted 1995 to become registered. ISO registration has not been mandated by our customers but there is strong pressure to demonstrate good quality policies and practices. The key objective is to formalize and insure quality, however, we must do this without hindering continuous improvement.

We are also recording, analyzing and reducing our Cost of Quality with the goal to assist Tenneco in accelerating business results in profitability, cost reduction and manageability for growth. Quality costs are categorized into the following categories: prevention; appraisal; internal failure and external failure.

Controls, reduction targets and measures are instituted with the emphasis on both short and long-term business results.

Conclusion

At Port Maitland, total quality is not a program — a program has an ending. It is not a separate issue, but a continuous improvement process. We have made considerable gains in the areas described above but recognize that we have a long way to go in each of them, especially employee involvement. We look forward to future chapters in this adventure.

TQM in a Medium-sized Enterprise

by Paul Hoover, Plant Manager
BIO-LAB Canada Inc.

The Company

BIO-LAB Canada Inc. is a medium-sized company of 40 employees that produces water treatment chemicals. In the past two years, the number and sales volume of our products have increased by a factor of 1.6 and 1.8, respectively, due to a combination of new product development and expansion of brand-name product lines. During this period, the number of employees has increased by 20 percent.

Because we deal with several market niches, understanding and adapting to our customer's needs is paramount. The business is characterized by high numbers of very small orders to customers who are operating on a just-in-time basis. If they do not have stock, they usually lose the sale. We distribute Canada-wide and the needs vary among geographic and cultural regions. On the other hand, many of our competitors are located in, and focus on, particular geographic regions.

Seventy percent of our sales occur in a six-month period each year. This provides a natural yearly cycle for continuous improvement studies and sufficient time for analysis of results.

Due to the small number of BIO-LAB employees, most people wear many hats with managers' responsibilities overlapping. Management felt that the teamwork and employee involvement aspects of Total Quality Management (TQM) would be very suitable for our environment.

Beginning the TQM Process

BIO-LAB executives announced their commitment to TQM in 1991 and sent three people, from plant management, computer services and office management, on an extensive course. They then met as a steering committee but seemed to show no movement. I believe the main reasons that the steering committee did not work were lack of skills in teaching, organizing meetings and making the cultural change. TQM requires an open environment in which managers must present their departmental and personal weaknesses in a frank manner to peers, superiors and subordinates. They must then develop improvement strategies and plans and gain the confidence of all involved in the idea that improvement is both feasible and worthwhile. Developing these skills has been a challenge.

Recognizing that gains could be made, the plant decided to go it alone and provide its personnel with two eight-hour TQM training sessions. Office personnel were invited and a few initially accepted. As

interest spread, all office staff subsequently joined. Training was then split in two groups — half office, half plant — each of which would attend two eight-hour sessions.

Our TQM Training Process

First Session:

8:00 – 9:00 a.m.: Learning the language and concepts of TQM (e.g. internal/external customers, suppliers, customers' needs, expectations, exceeding expectations).

9:00 – 10:00 a.m.: Use of flow process charts and interrelationship diagrams.

From 10:00 a.m. on: Employees were provided with a hypothetical model of a hotel, including its history, capacities, clientele, surveys of customer needs and satisfaction, etc. Since almost everyone has stayed in a hotel, the material was easily assimilated. Participants were asked to imagine that they had just bought this hotel and were going to develop a five-year plan for its operation. They were put into three groups of five, given post-it notes and taught to brainstorm all ideas to serve customer needs using affinity diagrams.

Within an hour, each group had 60 to 100 suggestions for improvement. The use of a hypothetical problem facilitated their learning to work together. The enthusiasm and harmony was incredible considering how these people normally worked together.

Participants were then asked to group their ideas into classes (transportation, communication, service, entertainment, accessibility, organization, training, etc.). Then they organized each group of ideas into a customer matrix, which allowed them to identify and rank improvement opportunities. The customer matrix takes almost all factors into account and indicates a clear direction for improvement efforts. Many participants quickly realized the power of these tools.

After lunch, participants were ready to analyze all areas using the basic and management tools of TQM. At the end of the sessions, most people had comments such as: "This stuff is fantastic, but I can't see how it applies to my job."

Second Session:

Participants were presented with a simple goal for the next five years. BIO-LAB's goal over the next five years is to show an x percent annual sales increase, a margin of y percent, and be more environmentally friendly.

The company would move towards its goal while ensuring the needs of customers were met. They were asked to assume specific increases in the product line, orders, phone calls, faxes, production,

etc. Each area was to express *all* customer and supplier needs or expectations and group them using affinity diagrams. This resulted in a lot of finger pointing, but because they had worked together in the previous session, it went well.

To reinstate group harmony, we did flow and root cause analysis on each area. For example, about 10 fingers were pointed at computer services. The root cause of these problems, however, was failure of each department to set standards on their needs and spend time on their own computer training. Setting quality standards on needs was also identified as important in many other cases. We also determined that existing standards for procedures needed to be upgraded.

The groups broke up and formed new ones, based on peoples' involvement in specific areas. The groups spent about an hour working on new standards for process outputs. They were then given the hypothetical question: If, in two years, the new standards no longer serve the needs, how can they be corrected? At this point, participants were taught the PDCA cycle and concepts of continuous improvement. It was explained that the number of cycles per year should be related to needs.

At the end of the session, the office personnel put a question to the plant manager who was teaching the course: If we know our needs and standards, who will allow these changes since our managers did not take part in this training? The answer was: You are the manager of your job and you know the expectations placed on you. If you cannot fulfil them without help, budget or major policy change, then write them up, showing your justification, and give it to your manager — even if your manager has not had the training.

TQM in the Office

TQM training of office employees has resulted in many positive results. The credit department has improved its invoicing process. The order desk has shown great improvement in accuracy and in implementing a system to help customers order correctly. Customers' special needs are now transferred to departments more efficiently. Computer services has shown improvement in handling demand and responding to customer needs. Although the office is not using a formal TQM process, the TQM training has improved the ability of its staff to contribute to and handle change.

TQM in the Plant

Over the past two years, improvements have taken place in every area of plant operations. When a problem arises, solutions are developed by teamwork with little disharmony. The response time for corrective action has gone from years to months, and sometimes even hours. Problems are solved by analyzing statistics, needs and detailed interrelationships. The my-area-is-my-kingdom attitude no longer exists. People now acknowledge that their actions affect others. I have the responsibility of reviewing their analysis to ensure that proposed changes are justified and address all customers' needs.

Many teams have been set up to investigate potential improvements. One area studied was how to become more environmentally friendly. During discussions, the teams identified three different aspects of this goal: improve the working environment; reduce waste; and improve our interface with the public. Below is discussed how the waste reduction goal was addressed.

Each of the six areas within the plant was asked to provide data on waste being generated and associated disposal costs. The combined disposal cost, reduction goal and the reduction achieved in the first year are shown below:

Total disposal cost from all areas:	$53 573
Reduction target:	27% or $15 000
Reduction achieved after one year:	61% or $33 000

We had exceeded our waste reduction goal by more than a factor of two. Below is an example of how these results were achieved.

A team consisting of the plant manager, liquid operator and maintenance worked on ways to reduce wastes in the liquid filling department. Normal quality controls such as standards for fill levels were already in place. Batch yield had been consistent and production per person had doubled as a result of changes made several years earlier. In short, the department appeared to be doing great. Examination of operations data, however, indicated that 9 000 litres were missing per year, a value of $10 600. Further details showed that 75 percent of the loss was due to overfill and 25 percent was due to material left in the system and not accessible. The following causes, method of attack, suggestions and results were identified:

Causes:

- trial and error set up of filling heads and rails
- overfill due to air escape around seals because of poor bottle fit — varied with liquid flow pressure and filling time
- pump would lose prime, leaving material in system.

Method of Attack:

- eliminate trial and error set-ups
- stop air escape causing overfill
- change pumping system so that no material is left.

Suggestions:

- make spacers for each head and the correct height for each type of fill
- remove adjustment bolts and put holes and simple locking pin for each position
- put system under vacuum so any excess fill is sucked up
- vacuum system will also suck up any excess in system.

Results:

These suggestions were analyzed with respect to capability, cost and payback, and then implemented. This did not require a major decision since the implementation costs were small and payback would come quickly. The waste reduction calculated after one year was 83 percent. The greatest percentage of waste reduction occurred due to elimination of poor set-up and reduction of process variability. Another benefit of the new system was elimination of floor spills and, since the system was under a vacuum, the probability of chemical spraying was reduced. Set-up time has been reduced from 1 1/2 hours to 10 minutes.

Our results to date in waste reduction may be only the tip of the iceberg. For example, we are now looking at other forms of wastes, such as mould release lubricants, where we can reduce the use of excess quantities.

Many things that we have taken for granted in the past are now analyzed for potential improvement. For example, we have several older product lines which, while still profitable, could benefit from a detailed analysis to look for potential improvements, with respect to both profit margin and meeting customer expectations.

A study on one product line indicated that the profit margin was too low due to high cost. The initial reaction was to eliminate the product, however, analysis showed that the high cost was mainly due to use of high-quality packaging. Discussions with customers revealed that their priority needs were high product quality and low price, not packaging. Changes based on our improved understanding of their needs have resulted in a tenfold sales increase with no margin decrease. This example illustrates the importance of linking process costs to value, as seen by the customer.

TQM in Communications

TQM training has benefited all BIO-LAB personnel by improving communications throughout the company. All paperwork flows were analyzed with respect to internal and external customers' needs. Some forms were produced in quadruplicate when only two copies were needed. Within a month, over half the forms were subsequently changed. The time from order placement to shipment was reduced and procedures were put in place so that even orders that got stuck would have information content transferred, allowing release to proceed smoothly.

Priorities for Improving Our TQM Process

One problem which we need to address is the lack of TQM facilitators. There is no one person to coordinate improvement projects throughout the business, ensure that the application of TQM methodology is consistent and that all relevant customer needs are considered. This makes it difficult to bring studies to completion or to achieve a broad consensus on problem definition and goals.

Because we operate in many regional and niche markets, finding a true consensus on the nature of a problem, or on its solution, is a challenge. In the future, we intend to broaden our use of surveys to take into account the needs of individual departments, the entire company, our customers and their customers.

Conclusion

Based on our experience at BIO-LAB, TQM can produce significant benefits in a medium-sized company. It has improved our ability to respond to changing customer needs and to control costs and prices. This has contributed to continued sales growth and profitability.

Our employees have gained a greater feeling of control and contribution to the company. They are now planning their own work and are not relying on the system or the manager to catch everything. They are far more willing to consider new concepts, often identifying how they can be strengthened.

TQM has given our managers the ability to make better decisions because they receive input from all sources, including employees, much more easily. The nature of the input shifts from gut feelings and emotions to facts, used to perform goal-oriented analysis. If improvement objectives are not met by an initial change, the situation can be re-analyzed and further improvements made. Decisions based on panic are thus avoided. TQM does not guarantee that the best decision will be made the first time, but it provides the means for systematically making corrections.

The Quality Process at Hoechst/Celanese Canada

by Michael P. Dailey, Director, Quality Management

The Company

Hoechst and Celanese Canada operate in eight major locations across Canada employing 2 100 people and having combined sales of approximately $700 million. Both companies report to one corporate head office located in Montreal. Celanese Canada is a publicly traded company of which 56.2 percent of the common stock is owned by Hoechst Celanese Corporation of New Jersey. Hoechst Canada is a wholly owned subsidiary of Hoechst AG.

The Quality Process

At Hoechst/Celanese Canada, quality is considered a business process and an essential element of our business strategy. This article discusses the evolution of the quality process within the company.

Our quality process began in the mid-1980s and was initiated using the Philip Crosby approach. Within a year, the process was being customized to fit the culture as well as draw on the experiences of Juran, Deming and others. One of the first company-wide initiatives was to provide quality training to all employees, in mixed groups, throughout the corporation. This initiative, called "Road Map to Problem Solving," provided training in problem-solving methods, supplemented with the vision of quality, based on Crosby's four absolutes of quality: quality is defined as conformance to requirements; the system for causing quality is prevention; the performance standard is zero defects; and the measurement of quality is the Price of Non-Conformance (PONC).

Training was also provided in Statistical Process Control (SPC) and applied throughout the company. Quality days were initiated which were aimed at identifying and resolving issues which prevented the quality initiative from becoming part of our corporate culture. Later, they became days where cross-functional teams looked for improvement initiatives.

During the initial stages of our quality initiative, senior management posed the following question to the quality management of the organization: What would a perfect quality company look like? The response led to a list of 28 statements representing what a perfect quality company might stand for.

An employee survey was initiated and we began to measure ourselves against those criteria, always looking for ways to improve. This list later evolved to become the company's **Quality Values**. These values (shown in the Table 1), guide all our activities, from strategies affecting the entire business to

the tasks within an individual work group. Our efforts are focused on meeting the needs and expectations of our customers and other stakeholders by continually improving our way of doing business. Closely related to the above Quality Values is our **Quality Policy** (see Table 2).

Quality Activities

The quality process is currently driven by three events, held on an 18-month cycle. First, there is a **Quality Conference** to which the company's top 250 executives, directors and managers throughout North America are invited. The company's quality performance is discussed at this conference, new initiatives are introduced and new milestones are set.

Second, there is an **Employee Involvement Sharing Conference**, which is intended to demonstrate the current quality improvement initiatives. It provides opportunities for both recognition of outstanding teamwork and sharing of ideas and practices among participants. Four to five tracks (subject areas) are set and each location submits presentations on what they are doing in these areas. The presenters are then chosen to attend the conference by a selection committee composed of their peers who review the presentation for clarity and relevance to the tracks. One session is for formal presentations and one is a poster session.

The theme of the 1992 conference was **Performance Excellence through Involvement**. Six hundred employees, approximately 2 percent of the company's North American work force, attended this conference. There were four tracks in 1992: customer focus; changing roles; tools and techniques; and improvement in work processes, as well as a poster session.

Table 1 — Hoechst/Celanese Quality Values

Performance Values:

- preferred supplier, dedicated to understanding and meeting customer expectations
- preferred employer, creating an environment that attracts and retains quality people
- commitment to safety, employee health and protection of the environment
- responsible corporate citizen
- earnings to support long-term growth
- consistently superior to competition
- commitment to continual improvement.

People Values:

- respect for individuals and appreciation for the contribution each can make
- diversity accepted and valued
- concern and fair treatment for individuals in managing business change
- equal opportunity for each employee to achieve his or her potential
- employee pride and enthusiasm
- informed employees through open communication.

Process Values:

- openness and trust in all relationships
- innovation, creativity and risk taking encouraged
- teamwork throughout the organization
- participative goal setting, measurement and feedback
- decision making at the lowest practical level
- actions consistent with clearly understood mission and long-term goals
- recognition for quality achievements
- resources committed to ongoing training and development.

Table 2 — Hoechst/Celanese Quality Policy

- Quality is vital to the long-term success of Hoechst/Celanese in an increasingly competitive marketplace.
- Building quality into our workplace, products and services is essential to a successful future for our customers, employees, suppliers, communities and shareholders.
- Hoechst/Celanese will work with customers to provide products and services that always meet or exceed their expectations.
- Management will commit the resources and create an environment in which each employee can contribute skills, talents and ideas to a neverending process of improvement and innovation in all aspects of our business.

Presentations made by employees from Hoechst/Celanese Canada at the conference included:

Kingston, Ontario - Millhaven Plant
Employees Are Your Most Important Customers
Raise Your Praise
Who's Bright Idea Is This?
Partners in Quality

Regina, Saskatchewan
Responsible Partners

Edmonton, Alberta
The Zero Damage Process

Drummondville, Quebec
Training and Redesign: Absolutes for the Future

Winnipeg, Manitoba
Change and Evolution in Agricultural Marketing

Third, a **Quality Survey** is conducted every two to three years. Questions are formulated to measure the organization's progress against its quality values. The surveys are organizationally coded to the lowest point in the organization with no less than 10 respondents (i.e. natural work groups). The

organization code also allows for the pyramiding up from supervisors, to superintendents to managers, directors, etc., and to a total corporation result. The driver in the survey is the natural work group, each of which choose two to three areas for improvement as a result of the survey, and develop an action plan. These action plans are pyramided up through the organization and followed up, resulting in a broad range of improvement initiatives.

Our Quality Process Organization

When the quality initiative began, there was a Quality Steering Committee composed of the corporation's senior executive, which oversaw the process and set overall objectives. This group was supported by a council composed of the general managers of each division who were responsible for the planning needed to accomplish the objectives set by the steering committee. Each general manager was supported by a quality manager on his or her staff and each major site had a manager of the quality process.

Since the mid-1980s, both the quality organization and process have evolved at Hoechst/Celanese. Our current quality organization is a reflection of the North American business concept within which the business is operated. There is a Vice-President, Quality, who is a member of the North American Operating Committee. Only one senior committee exists in North America above the Operating Committee. This is the Executive Committee of which the Vice-President, Quality, is an ad hoc member.

The quality process is driven by the North American Quality Council which is chaired by the Vice-President, Quality. Each of the eight business groups is represented by a Director of Quality Management (DQM). There is also a DQM for Mexico and Canada as well as resource people (three). Each business unit has a quality council made up of quality practitioners from the various locations within the business (Canada, United States, Mexico).

The quality positions within the corporation are platform positions (i.e. high performers are placed in them to broaden their experience). The criteria used is that potential DQMs must possess the capability to advance two more levels in the organization.

Integrating Quality into Our Business Process

As our quality process evolved, the most significant pitfall encountered was that our emphasis on the quality process resulted in our developing two processes within the organization: the business process; and the quality process. The business process was focused on strategic development and deployment. Quality initiatives were not seen as providing the critical success factors to support these strategies.

In 1991, we began uniting these two processes into a single, coherent process. Using the Hanna Model (see *Designing Organizations for High Performance*), a process was developed where both

priorities were coupled together, supporting the entire business. The **Hoechst/Celanese Quality Process** later led to the five core principles which are described below.

Five Core Principles of the Hoechst/Celanese Quality Process

Customer-Driven Priorities

First and foremost, we focus on our customers' needs, defining our business goals through their eyes. Through close partnership relationships, we develop an understanding of customers' businesses. We then help them to succeed through continuous improvement of our products and processes. Our goal is total customer satisfaction, achieved by anticipating our customers' future requirements and exceeding their current expectations. We pursue opportunities for excellence throughout the customer/supplier chain — from our dealings with our own suppliers and internal customers to our customers' customers.

Value-Based Leadership

As discussed earlier, a key step was the articulation of our values. These values form the design criteria for all our business systems. From the corporate level to individual work teams, leaders provide direction which results in strategic goals, short-term objectives and daily actions consistent with our values.

Continuous Process Improvement

Recognizing that process improvement is the avenue to long-term business improvement, we view all work as a process. Some processes cross organizational boundaries, while others are performed within work groups or by individuals. In this approach, we identify core tasks that add value towards the implementation of our strategy, ensure that we have people with the competencies and skills to carry out those tasks, and provide support systems (e.g. for empowerment and recognition) and basic tools (e.g. SPC, group problem solving and self-directed work teams).

Empowered People Working Together

This is our vision for the individual and collective behaviour at Hoechst/Celanese. Our corporate culture, expressed in the values, is open and participative. Business units are encouraged to develop modes of operation, suited to their needs, within the common framework which the values provide. Groups and individuals take responsibility for the success of the business because it is *their* business. There is an emphasis on teamwork and continual learning, and individuals from diverse backgrounds are encouraged to contribute their ideas, perspectives and experiences toward a common goal — the best results for our customers.

Excellent Performance

We measure our success in multiple dimensions, including:

- customer satisfaction with the performance of our products and services
- progress in environmental protection, health and safety
- our stature as a preferred employer
- financial returns.

We believe that when our treatment of individuals is consistent with our *people* values, when our organization and utilization of people are guided by our *process* values, and when their efforts are focused on our *performance* values, excellence will be the result.

Results Achieved

Over the past several years, the quality process at Hoechst/Celanese Canada has contributed to our being able to meet and exceed performance objectives. For example, our polyester business has achieved a 20 percent increase in Q-1 yields over the past 10 years, as a result of team problem solving. Over the past six years, quality improvements in our cellulosic acetates business have improved the bottom line by over $1 million. During the same period, the cost of non-quality product decreased by 9 percent. The number of customer complaints has decreased by 21 percent since 1988.

The quality process has also improved the quality of work life and labour/management relations. Contract negotiations between the company and unions have generally been shorter and more equitable, with more effort directed at producing "win-win" solutions for both parties. Our Edmonton plant has achieved an improved safety record as a result of employee involvement in running safety meetings and addressing safety concerns.

The Drummondville Cellulosic Acetate Group is implementing work redesign for its major processing areas which will result in higher productivity, reduced costs and improved quality of working life. The redesign is part of a common vision of the business and the challenges it faces in the 1990s, agreed to by both the union and management.

Finally, the collective knowledge of our employees has been utilized in achieving ISO 9000 certification in many of our businesses.

New Initiatives

Currently, the organization is directing its efforts toward customer satisfaction using the Baldrige Section Seven (Customer Satisfaction) as a guide, work mapping and benchmarking for continuing improvement toward best-in-class.

The Nalco Canada Quality Journey from Crosby to Baldrige: A Management Perspective

by Philip E. McManus, President
Shamel M. Shawki, Director of Quality

The Company

Nalco Canada is a wholly owned subsidiary of the Nalco Chemical Company of Chicago, Illinois, which has sales of approximately U.S.$1.5 billion and employs about 7 000 people worldwide. Nalco Canada employs about 270 people and provides a broad range of water treatment and process specialty chemicals through a network of sales and service representatives across Canada. The company has two manufacturing plants in Canada, one in Burlington, Ontario, and the other in Edmonton, Alberta.

Nalco Canada's Quality Journey

This paper describes our quality journey from 1988 to the present. In it, we discuss the major influences on quality at Nalco Canada, some of the challenges we encountered along the way and our progress to date.

Phase I: Crosby, Management Commitment and Employee Participation

The first question we asked ourselves in 1988 was why introduce a structured Total Quality Management (TQM) program in Canada? Our reasons to do so were numerous, and included:

- the Nalco Chemical Company was committed to introducing TQM to its organization worldwide
- our customers were demanding an organized commitment to quality
- management at Nalco Canada were looking for a system which would help the company deal with the challenges of customer satisfaction, productivity, employee morale and a wide range of operational issues in an integrated manner.

The Nalco Canada quality journey started in early 1989 and involved a major and exclusive commitment to the use of the Philip Crosby process. This involved the President and his direct reports participating in a five-day course at Crosby's Quality College, followed by a further five days during which the President, the Director of Quality and 10 other employees were qualified as instructors of Crosby's Quality Education System. Over a three-month period, all 270 employees

attended 10 two-hour sessions, introducing them to quality and involving them, in a hands-on manner, in individual and group problem-solving activities.

Two **Quality Improvement Teams (QITs)** were formed. The QIT at our corporate headquarters in Burlington, Ontario, involved the President and his direct reports. In Edmonton, a QIT team was formed with membership representation from the senior functional areas located at that facility. Each QIT member became a chairperson of a **Step Team**, of which there were six at each location, namely:

- the measurement team
- the corrective action team
- the awareness team
- the recognition team
- the price of non-conformance team
- the education team.

By the end of 1989, we were able to reflect back on the strengths and weaknesses of our newly introduced TQM process.

The major strength was the extensive involvement of management in the TQM process, both on the QITs and the Step Teams. There was no question in the minds of the employees that management was committed to TQM. In addition, 23 percent of employees were involved in the activities of the six Step Teams. This gave us the critical mass needed to successfully launch the quality improvement process.

A second strength was a substantial improvement in communication across the various functional groups at Nalco. In effect, a large number of individuals were working together in groups to resolve problems. This had a positive effect on morale.

Finally, the Crosby system brings with it a highly specific quality language, best reflected in the **Four Absolutes of Quality**. It presents quality as a process designed to eliminate employee hassles through an **Error Cause Removal/Corrective Action System**. These features helped create an employee-centred and company-focused, problem-solving system.

By the end of 1989, however, the weaknesses of our approach were as evident as the strengths. Over 50 percent of our employees are constantly involved in problem solving at our customers' plants. The internally reinforcing nature of the Crosby language in Nalco's organization had become a problem in developing a more broadly based quality improvement process with our customers. If a customer was a Crosby customer, things proceeded very satisfactorily, however, if our customer had chosen a different approach to quality, the Crosby language was decidedly unhelpful. For example, although

we were comfortable with the zero defects concept, we did not find it useful to spend a lot of time explaining it to customers who do not believe in it.

It was also very clear that there was a need for much more extensive training on group problem solving. This extended from the establishment of group mission statements, through the various elements of the problem-solving process, to the demonstration of control at the new level of improvement. There was also a need for improved understanding of team formation, team leadership and team facilitation.

Finally, our overdependence on bottom-up initiation of quality improvement projects, through Crosby's Error Cause Removal system, had us focusing on the **relatively many** as opposed to the **critical few** issues that should have been the focus of our quality improvement efforts. Top management leadership in identifying critical issues and setting the quality improvement agenda was probably the most important issue.

Phase II: Juran Tools, Management Leadership and Customer Focus

Starting at the beginning of 1990, through a major strategic review, Nalco Canada management refocused the TQM process, particularly the group problem-solving activities, on the few critical issues that would make the difference in the upcoming one to three years. While individual employee initiatives were encouraged as per the Crosby system, the new main thrust was to involve employees in those critical areas, identified by management, where significant improvements were needed.

During 1990, there was extensive training on an as-needed basis in the use of the Juran Institute Quality Improvement Tools. We were then able to aim our initiative, which had become broader, at improving and expanding problem solving in partnership with our customers, as well as dealing with internal company issues.

The period from 1990 through 1992 was highly productive with respect to our use of the quality process internally. Major cost savings were made in manufacturing, human resources, purchasing and the logistics function in general. Notable achievements during this period included substantial reductions in employee turnover and in waste generated by our manufacturing facilities.

At customers' plants, it has become the norm that we participate in continuous improvement teams, initiated either by Nalco or our customers. This has often resulted in performance levels never achieved before at these sites. For example, at a refinery where scale deposits in an overloaded cooling system necessitated frequent shut-downs for acid cleaning, the use of quality improvement methods resulted in uninterrupted operation for over a year. Aside from the substantial savings to the customer, we ended up with a close partnership and expanded business with the customer.

By mid-1992, it became apparent that we had arrived at a new watershed in our TQM journey. The issue had again become one of direction. Solutions to major problems and gains made in dollar terms were not continuing at the same frequency or level of improvement. Even worse, some of the old problems were recurring. At the customer level, there was a great deal of problem-solving activity taking place, but no coordinated direction.

Phase III: ISO 9000, Baldrige and Customer Satisfaction

In response to the demands of many of our customers, especially those who, like the pulp and paper industry, export their products to Europe, we decided to register the quality systems at our plants in Burlington and Edmonton under ISO 9002 (covering the manufacture and delivery of products). This was achieved in December 1992. We then expanded the scope of our quality system to include product development and, most importantly, services delivered to customers. We achieved this by obtaining ISO 9001 registration from the Quality Management Institute (QMI) on 19 November 1993.

As we became more familiar with the ISO 9001 standards, we realized that they define the necessary elements of a management system that can be applied to many activities within the company. These elements can be described as a continuing cycle of planning, doing, checking and acting (Deming's PDCA cycle).

The PDCA cycle can be cast in ISO 9000 terms as follows:

- **planning** through management responsibility and the documentation and control of procedures
- **doing** through implementation of these procedures
- **checking** through internal and external auditing
- **acting** through corrective action and management review.

Armed with this perspective on ISO 9000, we began to identify other areas for which the standard was not originally intended but could benefit from the ISO approach. The most notable are in the management of the environment, health and safety. We have married the management elements of ISO 9000 to the guiding principles of the Responsible Care® codes of practice. This has given us a complete system to manage our activities and implement our policies with respect to environmental protection and the health and safety of our employees, customers and the communities in which we operate.

To summarize, if there is a process worth managing, then it is worth applying the ISO approach to it.

This approach has permeated so many of our work processes that we created the new position of ISO Coordinator, responding to the Director of Quality, to manage all our ISO 9001 activities and leverage them in the marketplace.

Quality control and incremental improvements of existing processes are not, however, nearly enough to achieve customer satisfaction. We needed to adopt a comprehensive model of excellence, a target that would challenge us to reexamine the fundamental ways in which we do business. A number of excellent models exist, such as the Canada Awards for Business Excellence Quality Award and the Deming Award in Japan. The Nalco Chemical Company has adopted the criteria of the Malcolm Baldrige National Quality Award as its road map for quality improvement.

The seven categories making up the Baldrige criteria focus on the customer, or more specifically, customer satisfaction. With their balance between approach and deployment on the one hand, and results on the other, these categories provide an excellent means of evaluating the effectiveness of our TQM process.

We have, therefore, instituted an annual cycle of self-assessment using the Baldrige criteria in which all potential opportunities for improvement are identified and teams (led by senior managers) are assigned to achieve breakthrough improvements in the areas identified as high priority. This process is undertaken in every Nalco operation throughout the world and progress is documented.

Corporate quality management evaluates the progress of each unit and makes recommendations to award the Nalco Chairman's Quality Award to the most deserving groups.

Conclusion

The only constants in our TQM journey have been the commitment of management to make it happen and the recognition that the process is evolutionary. Our willingness to embrace elements from Crosby, Juran, Deming, ISO 9000 and Baldrige, and adapt them to our organization has, we believe, been a healthy process. It has resulted in a TQM system that is unique, and highly relevant to Nalco and the business environment in which we operate.

The benefits of the TQM process to Nalco have been both financial and cultural. Most importantly, Nalco has become a more flexible organization, focused on its customers and more responsive to changing market demands. These are attributes which no company can ignore and expect to survive into the next century.

Evolution of Total Quality at Sterling Pulp Chemicals

by Wayne Matthews, Manager, Engineering
Harry Conrad, Quality Manager
Paul Rostek, Vice-President, ERCO Systems Group

The Company

Sterling Pulp Chemicals, Ltd., a wholly owned subsidiary of Sterling Chemicals Inc. of Houston, Texas, is comprised of three distinct business activities: the manufacture of sodium chlorate, the manufacture of sodium chlorite and the ERCO Systems Group. The latter is responsible for the development, engineering and international sales of patented technology to produce chlorine dioxide from sodium chlorate for the bleaching of wood pulp.

The company employs 360 people, including 120 in the ERCO Systems Group. This business unit is based at Sterling Pulp Chemicals' Toronto offices and has been the market leader in chlorine dioxide bleaching systems since the 1950s, with sales of more than 100 chlorine dioxide plants in 17 countries. This paper describes the evolution of total quality within the ERCO Systems Group from 1990 to the present.

Overview of Sterling's Total Quality Process

Sterling Pulp Chemicals' initial quality effort began when the company was ERCO, a division of Tenneco Canada, Inc. and subsidiary of Albright & Wilson Americas Limited. The impetus for change came from Tenneco who visualized the need for a cultural change in the way the company conducted its business. In its early stages, there was a massive quality training program with the intent of getting everyone involved. Similar to the experience of many companies, the quality process reached an early plateau, resulting in some disillusionment and questioning of commitment by the company's employees.

The quality effort was renewed, however, with the sale of ERCO and the sodium chlorate and sodium chlorite plants to Sterling Pulp Chemicals in 1992. Sterling follows the Deming quality principles and believes that the customer is the most important factor in the quality process. The company quickly adopted the Deming quality philosophy, practised by the new owners.

Sterling's quality process involves the following steps: Once the environment for change is created by the company's leadership, every department and individual in the company must identify their customers, both external and internal, and their customers' needs. The needs are prioritized and key measures identified. Measurement systems are then validated and data collection begins. Workers are

trained to monitor the data and reduce variation by identifying and eliminating assignable causes. Everyone in the organization including workers, engineers, supervisors and managers, continuously compares process output to customer needs. When the data reveals that a process is not capable of meeting requirements, appropriate actions are taken to improve it.

In some instances, the appropriate action is to form a team composed of employees at all levels who are knowledgeable about the process in question. These teams are formally chartered and empowered to improve the process. Team boundaries, if any, are identified in the charter. Team members receive training in the use of the basic tools and the team process.

Team recommendations are handled in one of two ways. They may be implemented by the team, if so empowered by the charter, or they may be taken back to the chartering body for implementation. Teams are normally disbanded at this point and the responsible department continues to monitor the process for stability and capability. This process is recycled for continuous improvement or until the customers needs are exceeded. Gains are monitored by the chartering body.

The ERCO Systems Group is ISO 9001 certified. We recognize, however, that ISO certification is only part of the total quality system and not an end in itself.

Key Learnings

In the early days, our numerous quality initiatives were more of a patchwork quilt than an organized approach. Quality was a separate activity, often done as time permitted. We were aware that we had to apply quality principles to our business if we were going to survive, however, we did not know exactly how to go about it.

Everything that we did had some value, even if the implementation may not have been as effective as possible. The key was that we were trying things, learning from the experience and making adjustments as we went. Another key learning was that quality is not a separate activity; it is an integral part of everything we do. We have also learned that it is necessary to change company culture and operation, and how we think and act, so that quality becomes a way of life.

Although we have come a long way, the most important thing we have learned is that quality is a process, not a destination — there is always much more to do.

Our total quality program is based on the following principles:

- management leadership and commitment
- customer focus
- employee involvement
- continuous process improvement.

Below are described some of the key initiatives undertaken in relation to each of these four principles.

Management Leadership and Commitment

It has been said many times, but leadership and commitment from upper management are critical to the success of any quality program. Some of the key elements in our program are:

- When Sterling acquired the business, the quality program was refocused by setting and communicating clear policies to the company's employees.
- Sterling, with the involvement of many work groups, developed a **Vision Statement** and **Quality Policy Statements** for customers and suppliers, and a **Strategic Plan** and **Operating Plan** for employees, that laid out the company goals and expectations. This gave direction to company activities. Everyone knows where we are headed and what their group has to do to ensure success.
- A **Quality Council** composed of upper management was created. They lead the Quality Program for Sterling Pulp Chemicals.
- ERCO Systems Group set up its own **Quality Steering Committee** to oversee the quality implementation in its own department. It developed a Vision Statement and a Quality Plan that ensures that the corporate quality goals are implemented in the ERCO Systems Group. It meets monthly to monitor key measures, identify improvement opportunities and initiate and support Quality Improvement Teams. It also reviews ISO 9001 related issues.
- Each department and natural work group within the ERCO Systems Group became a self-directed group, consisting of its leaders and their employees. Actions mandated by the council and the committee, as well as those initiated by their own improvement plans, are implemented by these groups.

Customer Focus

The ERCO Systems Group has always been a leader in bleaching technology, developing new processes and products to meet industry needs. The company has a highly skilled work force of engineers, scientists and technicians and invests heavily in research and development (R&D). The focus was on being a successful business from a technology base and telling the clients what they needed. While our clients valued our technology, they had many frustrations in trying to make their needs known.

As serious thought was given to quality, we became more aware that being the best in the business meant not only the best technology but also the best service in the eyes of our customers. We had to become more focused on the customer to clearly define their needs and to meet or exceed them. We had to listen closely, communicate more, accommodate special requests and go the extra mile. In short, we had to shift from a technology push to a customer pull orientation, with accompanying

changes in marketing activities and organizational culture. Some of the key initiatives and elements in this area include:

- The management of Sterling and ERCO Systems Group developed a **Mission Statement** that highlighted satisfying the customer's existing and future needs. A significant effort was made to communicate and train the work force. The key is to change the culture so that the customer is king and not a nuisance.
- The development process was improved by implementing an **Innovation Steering Committee** that focused on the future needs of our customers. A number of partnerships with key customers and suppliers in the development process were formed to maximize the benefits to all parties.
- The sales and proposals groups made changes to their **Marketing Strategy** and became more receptive to customer needs. Increased effort is being made to help our customers define their needs more clearly and to ensure that we understand them.
- Sterling's marketing groups for Technology Sales and Chemical Sales were integrated, to enable each division to better support the other, and to provide an overall package that encompassed all the customers' needs more effectively.
- The Engineering Department changed its approach to customer relations. Each project now is handled by a multidisciplinary team that meets frequently with customers in an effort to have them become part of the team.
- A formal **Customer Feedback System** was initiated that asks for input at 10 different points of contact throughout each project, from the proposal stage, through plant start-up and ongoing operation. This feedback is reviewed and corrective actions taken. Improvements are also made to our work processes to ensure continuous improvements on future work.
- We had to realize that, in order to be successful and to meet the needs of our external customers, that we had internal customers whose needs had to be met. Significant time was spent to identify who our internal suppliers and customers were, what their needs were and how best to meet them.

Employee Involvement

No quality program will succeed without the commitment and involvement of employees. We recognize that our business success depends on the quality of all our people. To this end, we are committed to their development, through the provision of training, and to their empowerment in the pursuit of continuous improvement. Some of the key initiatives in this area include:

- A **Profit Sharing Program** was initiated in which a portion of the revenues above that which is required to maintain the business is shared among employees based on a sliding scale which reflects the extent to which their responsibilities can directly affect the company's performance.
- A **Recognition System** is in place that includes notices on bulletin boards and letters of recognition.

- A **Quality College** was set up with a curriculum of courses to increase the awareness and understanding of all employees and to provide them with the necessary quality tools and skills.
- A **Leadership Development Process** is under way that will take all leaders, including upper management, through a program of training, self-assessment and actions to become better leaders. It is critical that work groups are properly led to ensure that employees work to their personal best.
- Work groups became teams that were more self-directing and empowered to identify goals and improvements to complement company goals. Responsibility has been delegated much more than in the past. The **Team Approach** is being emphasized in all we do.
- Each job has been clearly defined as to its responsibilities and expectations. This has been done by the group members themselves.
- The **Performance Management Review** process was modified to have every employee input actions and improvements that they will carry out in the upcoming year. Significant input is received during this exercise.
- **Quality Improvement Teams** have been initiated to address problems, recommend solutions and implement corrective actions.
- An **Employee Suggestion System** has been initiated to provide an avenue for employees to give any input that cannot be given easily through other means.
- **Employee Surveys** are conducted on a regular basis to measure changes in attitude and identify concerns.

Continuous Process Improvement

There is never an end to the improvement process. If we sit on our laurels, we can be sure that our competitors will surpass us in quality, with a resultant loss in our business. Everyone must expend effort to make things better. Some of the key initiatives and elements in this area include:

- Each of our work processes have been **SIPOC**ed (**S**upplier, **I**nput, **P**rocess, **O**utput, **C**ustomer). A full analysis has been done as to who our suppliers and customers are, definition of process inputs and outputs and the process itself. Many of our work processes were flow charted by the work groups to ensure an understanding of the process and to identify improvements.
- The **ISO 9000 program** has been of significant help in organizing our work processes so that our customers consistently receive the quality they expect. Procedures have been put in place to **say what we do** and audits are done to ensure that **we do what we say**. The ERCO Systems Group received ISO 9001 certification in May 1993. This is a milestone on the road to quality. ISO registration is only one aspect in our quality program and our ISO program must mature as our overall quality system continuously improves.
- Numerous measures are in place and others are being developed to ensure that we monitor the key operating parameters of the business. This includes much more than financial results. We will measure all aspects of our operation.

Summary

From the above, one can see that quality encompasses all aspects of the business and is not a separate program. Although, there is much more to do, the ERCO Systems Group has achieved significant improvements using the total quality approach.

Benefits include:

- We have captured between 65 to 75 percent of the available contracts during the past three years.
- We have successfully expanded our business in the Far East and are pursuing a joint venture in China.
- Our lead in technology has increased and will provide long-term viability and profitability.
- Feedback from our customers is generally showing an improvement in their level of satisfaction. The feedback highlights opportunities to improve our products and services still further.
- The benefits seen and experience gained in the ERCO Systems Group will enhance successful integration of quality throughout Sterling Pulp Chemicals.

Success, as evidenced by the results discussed above, has been rewarding. But success has not come easily. The technical aspects of the quality system (Statistical Process Control, basic team tools, design of experiments, etc.) have been relatively easy to implement. Implementation of the human aspects of the quality system (people involvement, empowerment and elimination of barriers) has not been as easy. People who have lived and worked in a society where participative management has been nothing more than a dream find it difficult to change. It is for this reason that the role of the company's leadership in creating the necessary environment is so critical. Changing the culture of an organization requires demonstration by example and not just verbal support for change.

Business Regrowth through Total Quality

by Suzanne McCarron, Manager, Public Relations
The Upjohn Company of Canada

The Company

The Upjohn Company of Canada (Upjohn) is a subsidiary of The Upjohn Company, a worldwide, research-based manufacturer and marketer of human health care products. Upjohn, which employs 400 people in Canada, has annual sales in Canada of approximately $100 million, and about $15 million export sales. Its head office and manufacturing facilities are in Don Mills, Ontario, and there are sales offices in Vancouver and Montreal.

A Highly Competitive Environment Drives Change

Over the past few years, the Canadian pharmaceutical industry has experienced significant competitive pressures. Genericizing pharmaceutical products is a hotly contested area these days in North America, but in 1988, it could have spelled disaster for Upjohn. One of the company's leading products, Halcion, with $25 million in sales, had reached the end of its patent protection. In addition to reducing sales by 50 percent, Upjohn also faced the prospect of two more of its drugs becoming generic the following year. Clearly, it was time for appraisal and the development of a new strategy to direct the company through the 1990s.

Upjohn has responded by investing in *Regrowth:* restructuring, re-engineering and adopting a strategy based on total quality. This article begins by reviewing the competitive environment in which Upjohn operates and describing the strategic changes which the company undertook to remain competitive and grow. Upjohn's total quality process and some examples of the results achieved are described.

Upjohn Canada Responds with a Total Quality Strategy

Upjohn's President initiated the change process by undertaking a company-wide assessment. This process, assisted by a consulting firm, involved questioning and challenging all aspects of the business, e.g., Is this process or department an advantage to Upjohn? Is this an area of expertise? This in-depth examination resulted in the decision that the company should function only in its areas of expertise and increase dependence on outsourcing.

The **corporate mission** was redeveloped to read:

> **The Upjohn Company of Canada, a customer-focused total quality business, profitably develops, manufactures, markets and distributes quality pharmaceutical products to the Canadian and selected global markets.**

Based on this vision, Upjohn redefined its values and goals to ensure that employees strive for excellence on a global scale. The new vision intended that major purchasers, looking for a company with superior customer service, would think of Upjohn first. The subsidiary's goals include making The Upjohn Company of Canada the standard for Upjohn divisions worldwide.

Implementation of TQM at Upjohn Canada

The first step in implementing the new, total quality-based strategy was to organize the team which would be responsible for launching Total Quality Management (TQM) throughout the organization and ensuring its acceptance. The President led the team, and his involvement in every step of this initiative was critical in demonstrating management commitment. In early 1990, he appointed a team of cross-functional managers, the **Quality Improvement Team (QIT)**, and had the group attend an intensive, four-day training program at Philip Crosby's Quality College. Upon completion of the program, they met to create the **Upjohn Quality Policy**, as well as a detailed implementation plan. The policy, which draws on the company's heritage, is:

> **It is the policy of The Upjohn Company of Canada to "Keep the Quality Up." We will deliver on time, every time, error-free products and services that meet our customers' requirements.**

Quality was defined as meeting the customer's requirements. No Quality Manager was appointed as it was important for employees to understand that quality was everyone's mandate.

The QIT identified two major objectives which flowed from the company's quality policy and mission statement:

- to ensure quality is the cornerstone of the business of The Upjohn Company of Canada
- to ensure Upjohn employees at all levels and functions strive to meet their customers' (both internal and external) requirements.

Because of stringent quality-control procedures used in the pharmaceutical industry, product returns are extremely rare. Upjohn has not experienced a product recall for products manufactured in its facilities in 20 years. The principle challenge, therefore, has been to continuously improve customer service while maintaining the company's strong product quality record.

Upjohn management quickly realized that small changes could lead to large savings. Industry estimates suggest that 30 to 40 percent of a pharmaceutical company's revenues are lost as **Prices of Non-Conformance (PONCs)**, or waste. Only tasks that are done correctly contribute revenue.

Using the Crosby system, the QIT developed a 14-step implementation plan and schedule, with each QIT member responsible for a single step. Subteams of employees from across the company were recruited to assist the QIT members with the various steps. Subteam membership changed periodically in order to maximize opportunities for employee participation.

Functional Objectives

All departments were asked to develop their own mission statements based on the corporate statement and quality policy. They were also asked to develop specific, measurable objectives. These objectives were developed with employee involvement and are built-in to employee performance standards. This process ensured that individual, divisional and corporate objectives were linked together and tied to appropriate measurements. Taken together, the company's mission, quality policy and objectives form a hierarchy called **The Quality Pyramid.**

Examples of functional objectives identified for many departments include:

- eliminate major PONCs affecting performance and customer satisfaction
- develop key events to eliminate PONCs by specified dates
- incorporate measures to assess results.

Customer Satisfaction

Also critical in the process of goal/objective setting was the identification of important company services that play a key role in customer satisfaction. These were identified using regular industry customer satisfaction surveys (of physicians and pharmacists). Supplier input was obtained via the Purchasing Department.

This input led to additional customer satisfaction objectives for specific business units such as frequency of sales calls, timely delivery of rush orders, availability of product samples, clarity and convenience of product packaging, and product availability.

Employee Involvement

The involvement of all of Upjohn's employees was critical to the successful implementation of the new quality-oriented strategy. For Upjohn's employees, however, the initial reaction could have been a common one, "Its the flavour of the month; it will pass." Consequently, the senior management team focused on employee empowerment.

Employees were encouraged to identify quality issues using an **Error Cause Removal (ECR) system**, adapted from the Crosby approach. This system has, to date, generated about 207 suggestions, focusing primarily on cross-functional issues. Examples of issues resolved through the ECR include use of bar code scanning on packaging, and communications between Upjohn Canada and one of Upjohn's European operations.

The QIT also developed a unique system for employees to recognize quality successes or bring attention to departmental quality problems. This system, entitled **RxPress**, consists of a hot-line number, mail-in and E-mail options. To date, the system has logged 272 suggestions or problems and 312 successes. Examples of issues resolved through this system include product packaging as well as communications between Upjohn sales representatives and medical staff.

The QIT realized that it is important to measure employee satisfaction, morale and interest. In addition to using the RxPress system for this purpose, employee focus groups and mail-in surveys have been used.

Employee training was undertaken to ensure that employees understood the new strategy and had the problem solving and teamwork skills needed to carry out their responsibilities within the total quality process. All employees received the same training, in 10 two-hour sessions, led by experienced members of Upjohn's Training Department. The training was provided in small groups of cross-functional employees from different levels.

Ongoing technical and quality-related training is a key element of Upjohn's quality strategy. Department managers review training requirements with employees during performance appraisals. If training is required, Upjohn's quality trainers suggest appropriate courses.

Management Leadership and Commitment

Management leadership and commitment was recognized as an essential element of successful total quality. Management demonstrated their commitment by several actions, including posting their personal PONCs.

The President held quarterly employee communications sessions, focusing on quality. All employees had a chance to ask him questions — either in person or in writing (anonymously if desired), prior to the meetings. This enabled him to gauge employee acceptance and understanding. He also held bimonthly management meetings focused on quality and gave each subteam the opportunity to present their activities and progress. Managers were encouraged at these sessions to bring problems or opportunities forth for discussion.

Other senior managers at Upjohn have also been heavily involved in leading the quality initiative. Sales management, for example, held specialized quality training programs for sales representatives

and allocated time at conferences to discuss issues related to the company's new focus. Furthermore, all department managers provided opportunities for employees to discuss the quality focus during regular department meetings.

Management demonstrates its commitment to total quality by responding to employee improvement suggestions and problem identification. Employees communicating to management through the ECR or RxPress systems receive acknowledgment within one week and responses to problems within a month.

Internal Communications

Communicating the total quality initiative has been a priority action. The communications strategy for the quality plan and policy was developed by the awareness subteam of the QIT. They developed several programs, including employee contests to develop communications tools (e.g. the "Illustrate the Four Absolutes of Quality" contest). The RxPress system has also been a highly effective mechanism for employees to communicate their successes.

The employee publication, *Intercom Canada*, was also used to present important information and progress toward goals. The back page of the quarterly publication has been dedicated to featuring quality success stories. One of the more popular communications tools has been Quality Day or Zero Defects Day. Employees from throughout the company are brought to Toronto for a one-day celebration and training session on TQM. Senior managers from Upjohn's parent company in Kalamazoo, Michigan, have also attended.

Measuring Progress in Total Quality

Monitoring organizational change has been an ongoing part of the implementation process. The QIT reviews progress toward organizational and departmental goals at their monthly meetings. The team also planned for a third-party evaluation, approximately two years into the quality initiative, and a follow-up evaluation in 1995.

The results of the first external review indicated a high degree of employee buy-in and understanding. The entire organization understood the quality policy and the vast majority of employees are committed to total quality and believe that the company is committed.

Measurements are in place to monitor and improve the performance of all departments. The QIT's Goal Setting and Measurement subteams provide assistance to individual departments. Progress is reported monthly to the QIT. As mentioned earlier, the Error Cause Removal System, in addition to being a channel for employee input, provides a mechanism for identifying process improvements that require interdepartmental cooperation.

The QIT uses the PULSE system to handle quality improvement processes within each department or division. This system involves developing measurements within each division to identify critical success factors and to report on results. Each department is responsible for developing key measurements, meeting regularly to discuss results and taking actions where improvements are needed. A PULSE report, which tracks overall company improvement goals, is regularly reviewed by senior management.

Ongoing measurement of quality and related factors guides the company's progress. Upjohn relies on several formal feedback mechanisms to measure customer needs and satisfaction, as well as product and service quality. For example, all departments are asked to survey their key internal customers on these issues. Every two years, a survey is conducted of the two major customer groups, physicians and pharmacists, to measure their needs and satisfaction with regard to the company/industry products and services. The survey ranks Upjohn on a number of parameters as compared to other Canadian pharmaceutical companies. Survey information is used to identify improvement opportunities and to track the firm's progress in continuous improvement.

Because of feedback received from users of Upjohn's medical information hot-line, reference articles quoted in Upjohn's written responses to medical questions are now more thoroughly catalogued and updated to avoid customer difficulties in obtaining them. Survey results, on customers' requirements for sales calls, led to the development of a Quality Call Checklist to ensure Upjohn's representatives cover all important aspects of a quality sales call.

Product quality is tracked using a sophisticated system and is reported to the QIT. The system uses the following indicators: customer complaints, conformance to target specifications, reject levels (product not meeting registration specifications) and project recall.

Upjohn believes that it is important to work with suppliers who have similar quality standards. The company measures if supplier products are delivered on time, meet product quality specifications and how often products are rejected. The company views its relationships with suppliers as partnerships and, therefore, provides formal feedback on a monthly basis. On-site inspections of certain supplier operations are conducted annually. A vendor certification program is now being developed and, in 1993, Upjohn Canada issued its first **Quality Supplier of the Year Awards.**

Results: Improvements to Process and Financial Performance

Throughout the above discussion, examples of Upjohn's progress in total quality have been provided. Below, we discuss some additional results including specific process improvements and financial results.

The Upjohn Purchasing Department produces thousands of purchase requisition forms. In 1990, in a sample examination, not a single form was filled out correctly. After quality sessions, by 1992, 99.6 percent of all forms were properly prepared. This initiative alone saved $700 000.

In the customer service order entry system, quality improvement has allowed orders received by 3 p.m. to be shipped by 4:15 p.m. This increases the company's efficiency while ensuring premier service to customers. A secondary and substantial benefit was a PONC saving of $20 000 by the first year, a $60 000 saving in transportation costs by consolidating orders and a $40 000 saving by changing to a one-part form. Shipping costs were reduced from 2 percent to 0.6 percent of sales between 1990 and 1993. The Customer Service Department is now achieving an overall efficiency rate of 99 percent in customer transactions.

TQM was implemented during a period of unprecedented change, characterized by right sizing and re-engineering. Throughout this period, Upjohn has continued to provide significant earnings to its parent, The Upjohn Company. Doing more with less, through TQM, has enabled the company to remain in the top three Upjohn subsidiaries in the world. Upjohn's strategy of regrowth, through total quality, restructuring and re-engineering, has resulted in increased sales and market position for the company's business units.

Reflecting the success of the TQM process is a sales versus expenses comparison. Comparing a pre-genericization year, 1989, with 1993, Upjohn's sales increased 26 percent. Between 1991 and 1993, expenses as a percentage of sales decreased from 38.1 percent to 35.7 percent. Sales per employee increased by 15.5 percent, due primarily to increased productivity resulting from process improvements, including PONC reductions.

Conclusion

Since launching its total quality initiative in 1990, The Upjohn Company of Canada has made constant progress. The major lesson to be learned about TQM at Upjohn is that it is definitely not a flavour of the month. The company's improvement efforts are continuing and are guided by the internal and external assessment activities described earlier in this article.

Part 2

ISO 9000: Planning and Implementation

Part 2

ISO 9000: Planning and implementation

Overview

Since the late 1980s there has been growing industry use of the ISO 9000 series of standards developed by the International Organization for Standardization (ISO). These standards, which first gained widespread acceptance in Europe, are now becoming more influential in North America and Asia, partly as a result of increasing globalization of industry and markets.

The five success stories in this Part focus on ISO 9000. Several other articles mention it as part of the overall company approach to quality. ISO 9000 implementation can be done without the use of outside consultants and it is possible to achieve success during the first audit. Successful ISO 9000 implementation is, however, very time-consuming for the staff involved. Implementation is usually undertaken by a core team and involves participation from all employees. Support from senior management is essential.

The articles emphasize that ISO 9000 is compatible with the total quality approach and provides a framework for continuously improving all aspects of business. It can also be used as a framework to integrate quality, environmental, health and safety and other management systems.

The articles in this Part are summarized below:

ISO 9000: A Quality Perspective from DuPont Canada: ISO 9000 has become a recognized best practice within DuPont Canada Inc. DuPont has over 200 registrations worldwide, with approximately 150 additional registration initiatives under way. This article describes the steps involved in DuPont's registration process and shares key learnings from its experience, including the need for early and continuing management involvement, the importance of communicating to all employees their role in the process, and the use of internal audits, followed by corrective action, to continually improve the quality management system.

The Road to ISO 9000 Registration in Imperial Oil, Chemicals Division: The approach being used by the Performance Products Group of Imperial Oil Ltd.'s Chemicals Division emphasizes developing systems rather than solving individual problems. Key success factors include adequate resourcing, using the standard as a template but not following it blindly, accessing industry-specific implementation knowledge, and post-registration "embedding" of the system to ensure that it continues to function as planned. Results are provided which support the idea that ISO 9000 provides an effective framework for continuous improvement.

Total Quality and the Implementation of ISO 9002 at Saskatoon Chemicals Ltd.: This company began its total quality journey in the aftermath of a strike. Both management and workers wanted a management system which would accommodate the needs of both employees and customers. The company decided to implement ISO 9002, partly in response to customers and partly to provide a framework for continuous improvement. The article discusses the planning and implementing ISO 9002, which resulted in a first-time successful registration audit. The ISO 9002 format is also being used to ensure that materials handling regulations are complied with.

Evolution and Benefits of a Third-party Registered Quality System: In October 1985, KWH Pipe Ltd. was the first polyethylene pipe company to achieve CSA Z299.3 registration for its quality system. This was done originally to comply with an industry code, however, the quality standard requirement was subsequently dropped from the code. KWH decided to adopt a leadership position in its industry by maintaining its quality systems registration. Since that time, the company has successively adopted more comprehensive quality standards, most recently achieving ISO 9002. This article provides an overview of the firm's implementation process.

Getting It Done: Starting the ISO 9000 Implementation Journey: Prior to implementing ISO 9000, Toronto Plastics Limited had an advanced quality system which complied with the requirements of its customers in several different industries. ISO 9000 provided a means to consolidate these requirements into a single system. In this article, the company's process for achieving registration and the benefits which have been achieved are discussed. ISO 9000 has also provided a solid base for the company's approach to total quality. Major steps in the process are discussed, including planning, changes to the existing quality system, training and communication, and reassessment, follow-up and feedback.

ISO 9000: A Quality Perspective from DuPont Canada

by Diane C. Wilson, Continuous Improvement Coordinator
DuPont Canada Inc.

The Company

DuPont Canada Inc. is a diversified industrial company serving customers in every Canadian province, the Yukon and the Territories and in more than 60 countries worldwide. We market the thousands of products and services of the global DuPont organization to our Canadian customers; likewise, we sell our Canadian-manufactured products in Canada and around the world. More than half of our sales of Canadian-manufactured products are to export markets. There are just under 4 000 employees.

Our business, which includes both manufacturing and marketing, falls into three main categories: fibres and intermediates; specialty chemicals and materials; and specialty plastics and films.

DuPont Canada is a publicly traded Canadian corporation with about 75 percent of its common shares being owned by E.I. DuPont de Nemours and Company of Wilmington, Delaware. The remaining shares are held principally by Canadian investors and include about 1 800 employee shareholders.

DuPont and ISO 9000

DuPont first became interested in ISO 9000 registration in the mid-1980s. At that time, it was our belief that the European Community was emphasizing international standardization and that quality systems registration could be used as a non-tariff barrier to entry to Europe. With this in mind, we took defensive measures to protect our European market positions, and we took advantage of the discipline provided by the ISO 9000 standards to document our quality management systems.

We involved employees as broadly as possible in the registration process. For example, much of the all-important documentation required for our quality management systems was prepared by our people on the production floor who typically flow charted and then documented the processes in which they were involved. Likewise, rather than attempt a centrally controlled registration process, we required our individual businesses to take ownership and responsibility for their own quality management systems and resultant registrations. We believe that this principle of "ISO ownership" has helped us

in the ongoing maintenance of those quality management systems, such that all of our subsequent surveillance audits have been essentially trouble-free.

As we gained experience with our ISO registered operations, we were pleased to see a number of significant benefits appear. In many cases, a cost reduction of as much as 16 percent was noted as a consequence of our ISO 9000 registration efforts. The number of customer audits at our various plants has dropped significantly thereby making more time available for our other activities in continuously improving customer satisfaction. Our achievement of ISO 9000 registration has greatly enhanced our competitive advantage in the marketplace; a number of our customers have sought our assistance in guiding them in their own pursuit of ISO 9000.

ISO 9000 has become a recognized best practice within DuPont. Globally, DuPont has in excess of 200 registrations to the ISO 9001 and 9002 standards. With another 150 or so registration efforts under way, we hope to have 86 percent of our worldwide manufacturing capacity registered to ISO 9001 or 9002. As of April 1994, eight of 10 DuPont Canada manufacturing facilities were registered to ISO 9002, the remaining two expect to complete the registration process in 1994.

The Registration Process

Our registration process consists of a number of well-defined steps. Once an individual business commits to pursue registration, the business management team develops a strategic plan and communicates their commitment to the registration process to their organization. The management team identifies the management representative and ensures that sufficient resources are made available to follow the process through to successful registration. As mentioned earlier, our principle is to involve as many people in the organization in the registration process as is feasible.

As a first step, the management representative takes the five-day lead assessor training course, supplied by P.E. Handley Walker/Batalas U.K. In fact, every management representative within DuPont Canada has taken this training. Aided by this intensive training, our management representatives are well-equipped to lead, plan and manage the registration process for their particular operation.

Our next steps are to communicate the details of the strategic plan to the entire organization and to establish and train the steering group and area coordinators. Area coordinators are provided with an ISO 9000 review session followed by a summary of the tasks they will be responsible for over the next 10 to 14 months. In these sessions, the coordinators are also encouraged to contribute their ideas on the plan and all their questions are addressed. Next, coordinators organize their teams and start to address the documentation of the work processes in their area.

We have found it helpful to start the internal, compliance auditing early in the process. This provides early answers to questions such as: Do the necessary procedures exist? Are they being used? Are they

effective? We follow a cycle of audit, upgrade/corrective action, management review, audit, etc. To ensure the effectiveness of our internal auditing process, we provide a two-day, in-house auditing skills course for our internal auditors. We have also found that registrars are more inclined to give us the benefit of the doubt where a noticeably strong internal audit and corrective action process exists.

Once the quality management system becomes further defined, after approximately six to eight months, we conduct an internal preassessment to determine our readiness for registration. The preassessment team is drawn from an internal pool of audit professionals, all of whom have taken the lead assessor training course. This team is selected from people outside the business being audited. This eliminates bias and also results in a sharing of ISO experience with the auditees. An internal preassessment is carried out at least once prior to the registration assessment.

The choice of registrar for each business is determined by individual needs. We have worked with a number of different registrars across the corporation globally, and we draw on this wealth of experience and information to make an informed choice for each business. DuPont Canada presently has six facilities registered by British Standards Institute/Underwriters' Laboratories and one facility, registered with the Quality Management Institute, which is a division of the Canadian Standards Association.

We can identify a number of key learnings from our experience with the ISO registration process. Early commitment and involvement of management is essential. This includes strong management support for the work of the management representative, as well as making their commitment clearly visible to all employees in their organization. We recognize the importance of communicating that the ISO 9000 registration process is part of everyone's job and not just something done by a select few. Involvement of as many employees as possible in the documentation process has helped us to establish "ownership" for our quality systems. Frequent and extensive internal audits, followed by relevant corrective action, help us to focus on continually improving our quality management systems.

ISO 9000 and Total Quality Assessments

As indicated earlier, we are now well on the way to having all of our manufacturing facilities registered to ISO 9001 or ISO 9002. We are now focusing on registration of our service functions, such as Sales & Marketing and Materials, Logistics & Services. Our objective is to standardize our approach to improve our quality management systems right across the company.

In addition to ISO 9000, we carry out total quality assessments of our individual businesses and functional units on a periodic basis, to identify opportunities for continuous improvement. These total quality assessments use the Malcolm Baldrige criteria as their standard. Although we certainly view ISO 9000 as a necessary step on the quality journey, the total quality assessment gives us an appreciation for the potential length of that journey, which is far greater in scope than ISO 9000.

The Road to ISO 9000 Registration in Imperial Oil, Chemicals Division

by Andy Main, Performance Products Quality Leader

The Company

Imperial Oil, Chemicals Division, an operating division of Imperial Oil Limited, produces petrochemicals for domestic and international customers. The division, which employs over 1 000 people in Canada, has worldwide sales of approximately $1 billion.

In the division's Performance Products business group, several businesses are combined that share strong customer, marketing and technical orientations. These businesses produce products such as higher olefins used for plasticizers, solvents and carrier fluids for coatings and adhesives, lubricants, fuel additives and application chemicals for oil production and refining.

Background to ISO 9000

Throughout the late 1980s, it became increasingly apparent that Performance Products customers were interested in the system used to supply products as much as product specifications. Led by the automotive original equipment manufacturers and their supply chains, customers required the division to answer questionnaires and undergo audits examining the systems used to assure product quality.

By 1989, customer awareness and responsiveness in the organization had been significantly enhanced and many resources were being used on quality issues. Analytical equipment was improved and training conducted in the statistical tools. Customer satisfaction, however, had not increased appreciably and problems continued to occur. Suppliers were contacted when issues arose, but overall raw material quality and service failed to improve.

In 1989, the Performance Products business team decided to design and implement improved quality systems using ISO 9000 as a template. Registration to ISO 9000 would be a milestone on the continuous improvement journey. This article describes the approach used and some of the results obtained.

Planning and Preparation

From the outset in 1989, it was realized that three aspects would characterize the effort:

- **The need for a dedicated resource.** People in line functions cannot effectively write quality manuals when it is 20 percent or less of their job. Multiple authors for quality manuals produce a collection of individual procedures, not a cohesive, seamless system. The dedicated resource should be internal so as to retain the expertise. People involved in the first developments have remained in the registered system or progressed to development roles elsewhere in the company.

- **ISO 9000 is a template, but should not be followed blindly.** The new/improved systems were expected to be efficient and meet customer needs. The "plaque on the wall" syndrome can be a trap when the focus becomes, What does it take to pass the standard? as opposed to, What makes sense for the business? and, Does this meet the standard? In most cases, systems designed to meet business and customer needs have met or exceeded ISO requirements. The standard, however, was the starting point in directing attention to specific areas.

- **The need for help from people who knew the standard and had implemented it in similar businesses.** This would help translate the concepts into a vision of what the system would look like when implemented. In 1989, there were very few registered systems in the North American petrochemicals industry, however, several registered systems existed in Exxon Chemical in Europe. Three systems in the United Kingdom and Belgium were reviewed in the summer of 1989. Valuable insight was gained as to what quality systems look like after development and registration.

  The choice of registrar is important as credibility in the marketplace and the ease with which the process takes place are affected by the decision. Important factors in the choice of registrar are integrity, availability, access, industry experience and cost. It is useful to make the choice early in the development. This establishes a relationship which allows the registrar to develop an understanding of the organization and the organization to understand the interpretation of the standard by the registrar. Questions and issues are then resolved as they arise. The registrar must be accredited by an accreditation body such as the Standards Council of Canada. The Quality Management Institute (QMI) has been the registrar in all Chemicals Division registrations.

These were critical steps at the outset of the development. One aspect that was not realized at this time, and a lesson learned, is the need to continually paint the picture of what life will be like with the new quality system in place. This picture needs to be committed to by management and continually communicated to all employees. This builds the case for change, removes apprehension and engenders commitment and involvement (see, for example, Hammer, J. and Champy, J., *Reengineering the Corporation — A Manifesto for Business Revolution*, Harper Business, 1993).

System Development

Through awareness of ISO 9000 and comparable development of safety standards, consideration was given to approaching quality improvement by **developing systems as opposed to solving individual problems**. For example, fixing the calibration system rather than solving the flash point measurement problem.

In the process of developing quality systems (and management systems in general), a number of strategies have proven successful. Three important strategies are the involvement of senior managers, resourcing and filling the gaps.

Involvement of senior managers: Successful ISO 9000 implementation requires culture change. The senior managers have to lead the organization by playing their part in the processes that affect them. Examples are management reviews, contract approvals and training plans. Senior managers are integral parts of these processes and have defined roles and responsibilities in the system. Disciplined adherence to documented systems is a basic tenet of quality systems. Changing the culture to this mode requires the leader's personal adherence to the system. Otherwise, managers cannot expect their subordinates to adhere. Well-publicized development of management systems sends early signals to the organization that change is taking place and that new ways of doing things are expected.

Resourcing: There is a need to have an **expert** who is intimately aware of the standard, its interpretation and how it can be applied to the system in question. This person is trained on the standard and has seen systems where it has been successfully implemented. In Imperial Oil, Chemicals Division, this expertise was available internally. In smaller organizations, the use of consultants has been successful.

The expert leads a team of **coordinators** who hold critical line positions in the system under development (e.g. Operating Supervisor, Quality Assurance Laboratory Supervisor and Purchasing Agent). They meet regularly with the expert and review and plan the work to be done. The coordinators have the ability to arrange for resources to develop the system (e.g. revise operating procedures and contact suppliers). These are the **implementors**.

The relationships among the above personnel are shown in **Figure 1**.

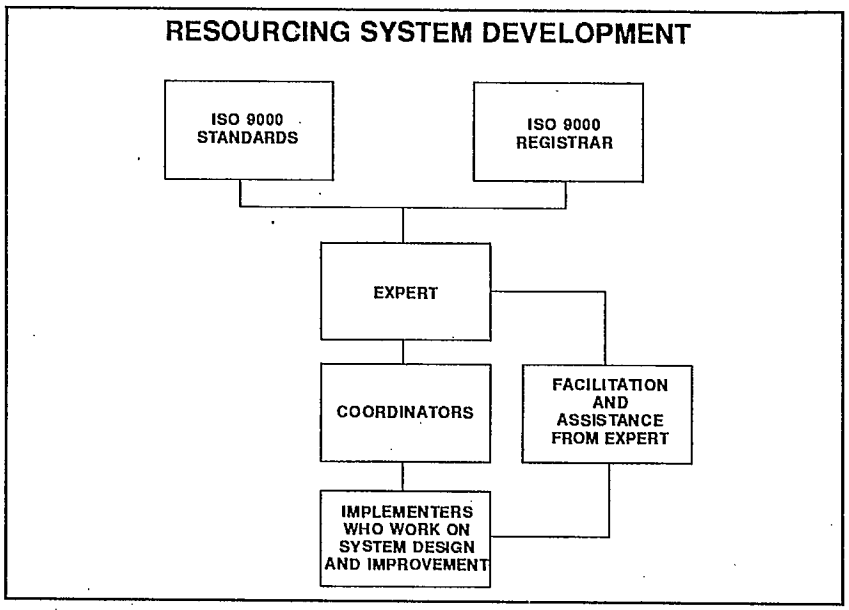

Figure 1 — Imperial Oil, Chemicals Division

The group reviews the development, with the expert providing advice and the coordinators ensuring that the work gets done according to plan. This is the optimum approach to development because it is conducted by the people who work in the system. It leads to the system accounting for practical realities and builds ownership. The expert is able to judge the extent to which the system should be applied. There is a tendency to develop a system (e.g. for supplier assessment) and then to apply it uniformly to every interface the organization has with the outside world. The expert guides the organization in identifying those elements which are critical to performance and in applying the quality system to them.

The group of expert and coordinators has access to senior managers to free up further resources or review priorities. The expert liaises with the registration body on issues and timing of the registration process. One feature that has worked well is the setting of a realistic audit date at the earliest possible opportunity. This deadline galvanizes the organization into action.

Filling the gaps: The system development process should start with definition of the system scope — what is to be included and excluded. This analysis is done hand-in-hand with the selection of the registration standard (i.e. ISO 9001, 9002 or 9003).

Performance Products' strategy has been to develop systems in digestible chunks, based on functional, organizational or physical boundaries. Manufacturing was the initial focus, with the scope including the process plant, loading racks, laboratory, site management and head office functions directly associated with the plant (i.e. customer service, sales and distribution). Other functions, such as technology and head office marketing and planning, have been added later or through separate registration.

If one consistently uses the same registrar, it is possible for individual functions in separate registrations to be audited once, or to later combine registrations. Early scope definition is critical since it is wasteful and difficult to modify the scope later.

The system development process most often used at Imperial Oil, Performance Products is gap analysis: The target is established and compared with the current situation. The gap between these two defines the required improvements. The development group conducts the gap analysis repetitively, starting with a high level analysis to identify the large gaps. Once these are examined in more detail, more specifics are added.

Using the gap analysis, the resource requirements are estimated and a sequence of activities is planned. The group draws up a project execution chart, showing timing and responsibility for each activity. The group meets regularly to steward the progress. Further gap analyses are conducted as more is learned about the standard and the system. As systems are completed and implemented, internal audits are conducted and used to update the gap analysis. Gap analysis is an extremely useful communication tool for management and the people doing the work. It provides a complete picture on progress and future work to be done.

Documentation/document control is a particularly important area. The ISO 9000 standard requires improved documentation. Documentation refers to the policies, procedures and instructions on how to do things — not completed log sheets, shipping schedules, etc. — these are records. It is critical to have a clear picture of the documentation structure early in system development. An example is shown in **Figure 2**. Clear protocol on document control at an early stage is also important.

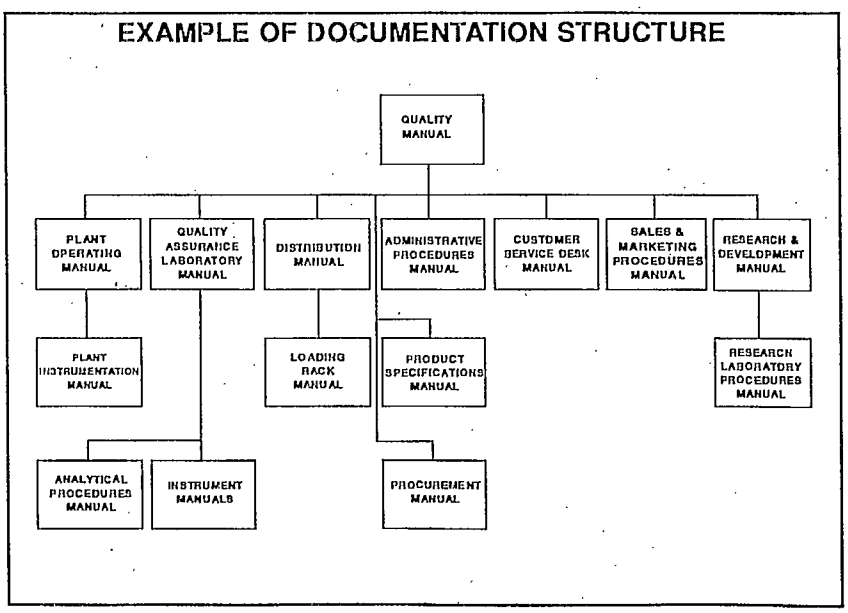

Figure 2 — Imperial Oil, Chemicals Division

It is easy to over-proceduralize the system and end up with volumes of manuals where it is difficult to find the information required, onerous to keep the procedures up-to-date and challenging to ensure adherence by users. It is extremely difficult to step back from this overload situation. Removing or redesigning documentation is not a simple task and one often has to scrap the existing structure and start over.

The definition of documentation structure is a difficult task early in the process, without some expertise or experience, but one where attention pays dividends. A quality manual should be drafted as early as possible following the definition of document structure. A skeleton manual drafted early in the process is an excellent base upon which to build.

Embedding

There is a lot of satisfaction in attaining registered status. It is the culmination of months, maybe years of effort, and one is able to hold the certificate and put the designation onto letterhead, business cards etc. Once the project is completed, people turn their attention to other priorities and the quality system becomes another routine requirement. **In many respects, however, the hard work is only just beginning.** Sustaining the integrity of the system needs continued attention. People can grow complacent with the plaque on the wall.

The fledgling quality system can suffer from various pressures. Many aspects of the system are new and require support to ensure that they become embedded. Change takes place which demands that existing systems are improved or new systems are put in place. The designers move elsewhere and their replacements are not aware of the thinking that went into the system. They also have less ownership. Customer expectations are raised when the supplier has received registration. Registration is no guarantee of excellent performance and customer satisfaction — one has to earn this every day.

Continued post-registration support and embedding should be planned for. Critical support mechanisms include keeping the expert on hand as a consultant, quality councils charged with responsibility for system maintenance, continued management communication on the need to maintain and improve systems, training sessions and internal audits.

Results

Performance Products obtained its first ISO 9002 registration in November 1992 — the first in Imperial Oil. By early 1994, Chemicals Division had attained six registrations, including one in a business office. Five of these registrations were to ISO 9002 and one was to ISO 9003.

When Performance Products embarked on quality system development, the aim was to increase customer satisfaction and contribute to the health and longevity of the business. Since that decision was taken in early 1989, free trade, a deep recession, increasing customer demands, corporate

restructuring, etc. have dramatically changed the business environment. Awareness of ISO 9000 among customers has grown and registration is a now a requirement to operate in some of our markets.

Although we perform periodic customer surveys, there is no quantitative data to state that the ISO work has resulted in increased customer satisfaction. This may be impossible to attain since there are many other factors involved, including the other facets of Total Quality Management (TQM). Certainly, the businesses where ISO systems exist are performing extremely well. Some customers still perform their own audits and, in these cases, scores have increased dramatically. Quality awards from major customers have been received — the business had none prior to the start of the ISO work.

Improved operations — doing a better job with less resources — has contributed to the financial success of the business. Management is convinced that system development, and the consolidation of system improvements, lead to superior execution of the fundamentals of the business — one of Imperial Oil's critical priorities. Gains result from hundreds of small improvements in procedures, equipment, training etc. Individual improvements historically have a half-life based on the tenure of the originator or the memory of those affected by the change. System development provides a structure for those small event improvements to be captured and institutionalized, resulting in a new base upon which to build. The cumulative effects are dramatic improvements in bulk measures, as shown in **Figure 3**.

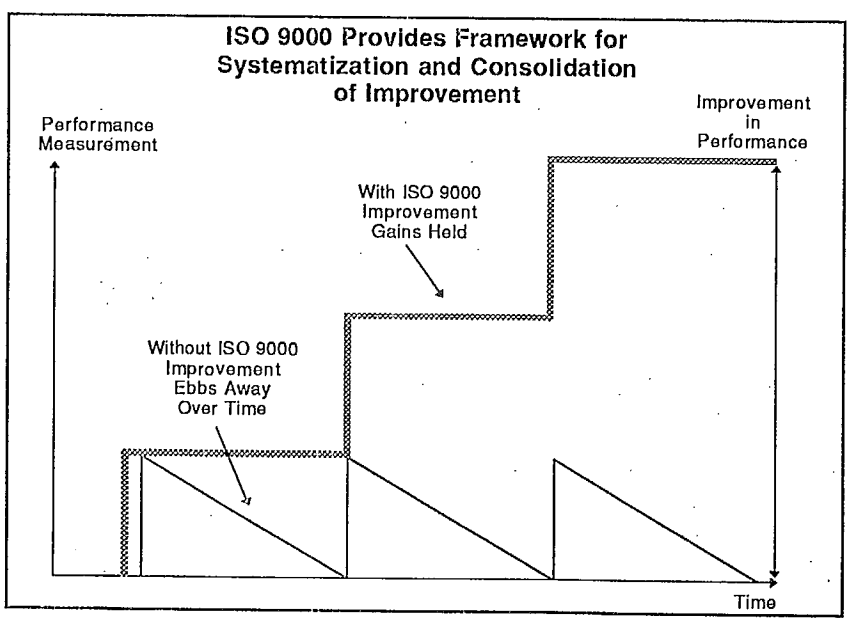

Figure 3 — Imperial Oil, Chemicals Division

In the manufacturing operation, which was the first registration, the systematic capturing of small event improvements has led to a 15 percent increase in capacity over four years. This is shown in **Figure 4** in the data on service factor (i.e. the amount of time that the plant is making salable product). During this period, there have been no significant injections of capital, no new technology and personnel have been reduced. For a capacity-limited plant, this has meant 15 percent additional sales or 30 percent increase in sales per employee. **Figure 5** shows the reduction in swing time between the 17 products produced in the plant.

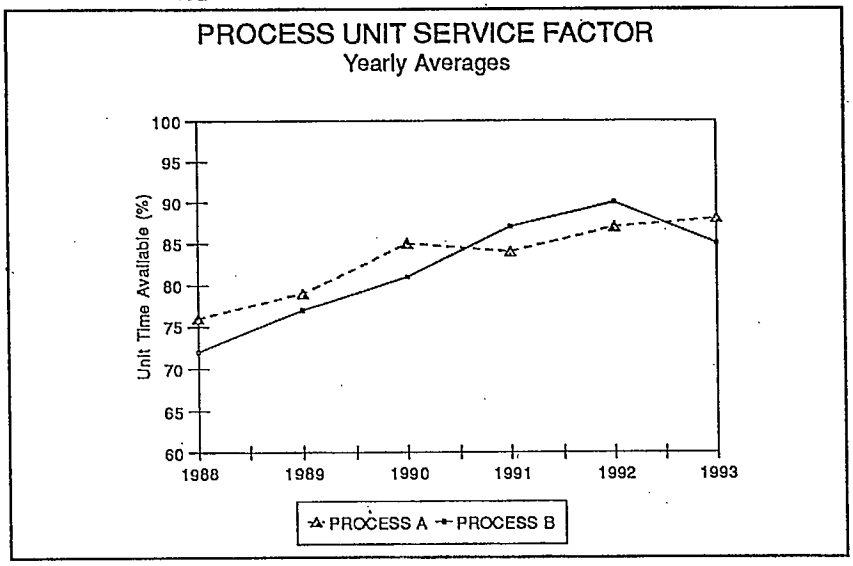

Figure 4 — Imperial Oil, Chemicals Division

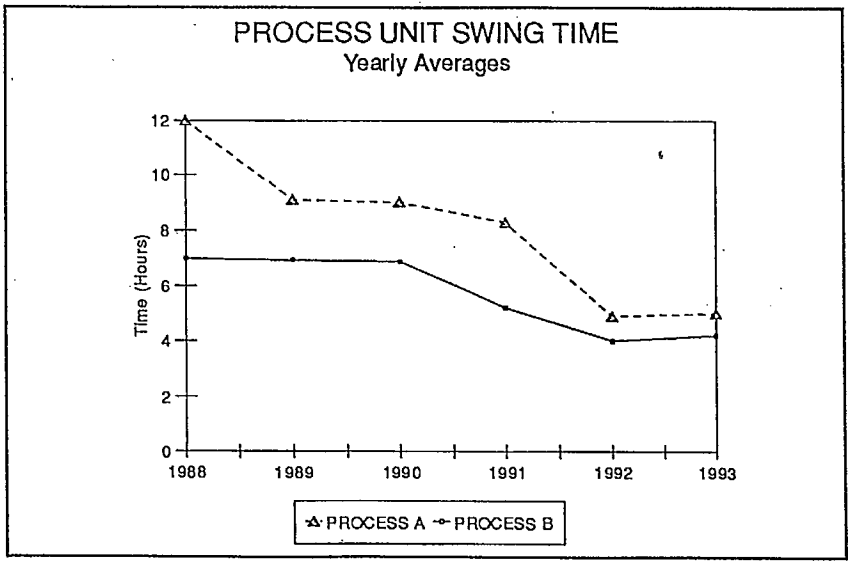

Figure 5 — Imperial Oil, Chemicals Division

Compliance to laboratory test schedules rose from 87 percent to 99.9 percent between May 1991 and November 1992, due partly to system development, but also to the introduction of a laboratory information system. There was an 85 percent improvement in turnaround time on shipment tank samples. There was a 55 percent reduction in customer incidents due to Certificate of Analysis errors.

The importance of embedding was made clear when data from 1993, the year after registration, were studied. Many rapid organizational and personnel changes were made, believing that the systems and culture had been adequately established. Several events occurred which found existing systems lacking, or where actions were inconsistent with documented procedures. This experience has left the organization a lot wiser. Systems are tested by different and changing situations and must be continually improved. The options are to either more soundly embed expertise in the system or to retain existing expertise for a longer period of time.

The overall conclusion drawn from these statistics is that the focus on ISO 9000, and system development work in general, have contributed significantly to the ability of the business to weather an extremely difficult period and grow. It has provided a solid base and freed up resources to pursue new opportunities. Also, by providing people with improved and documented systems, it has improved the quality of working life. Continued adherence to the system approach is required to hold the gains made and to make further improvements.

The Future

Three new registrations are planned for 1994, as well as three upgrades to existing registrations. By the end of 1995, the whole division, including research and development (R&D), manufacturing and marketing departments, will be covered by the appropriate ISO 9000 registrations. In addition to ongoing continuous improvement as customer needs change, another significant development is taking place. A number of areas are integrating quality systems with safety and other management systems.

Imperial Oil and Exxon have adopted a comprehensive safety management system which supplements the previous development of Responsible Care®. The vision is for one operating system, meeting the requirements of ISO 9000, Responsible Care®, Business Controls, etc. Quality and safety objectives are met by one operating system, with one set of procedures, one management of change system, one incident system, etc. This integration is another step toward the superior execution of the fundamentals of the business.

Total Quality and the Implementation of ISO 9002 at Saskatoon Chemicals Ltd.

by Robert W. MacLeod, P.Eng.
Manager, Quality, Education and Technical Services

The Company

From a base of 150 employees, Saskatoon Chemicals Ltd. manufactures and distributes a variety of chemical products used mainly by the pulp bleaching and water treatment industries. The company is a wholly owned subsidiary of Weyerhaeuser Canada Ltd., whose primary products include pulp, paper and wood.

Located in Saskatchewan with gross annual sales of $55 million, our commodities are marketed throughout Western Canada. Our specialty chemical markets are international, including the United States, Australia, New Zealand, as well as Canada.

Overview of Total Quality Initiation

Our progress towards total quality manufacturing began with a significant event in early 1989 — a 10-day strike. This made both groups realize that there had to be a better way to manage the business while accommodating the needs of the employees **and**, simultaneously, satisfying the expectations of our paying customers. The resultant change process brought management and the union together to focus on the success of all aspects of the enterprise through decision making that is based upon facts and that provides results that are beneficial to both groups. There have been no grievances or strikes since the significant event. The momentum for continuous improvement has grown.

From common agreements on the company mission/vision/values to development of strategic objectives, there have been a multitude of successful cross-functional teams used to solve real issues in the workplace. The focus continues to be customer satisfaction — both internal and external.

Key Issues

At the same time that we became focused on continuously improving our business, support for the ISO 9000 standard for quality management systems was gaining momentum in our industry. We identified a need for a rapid approach to ISO 9002 registration due to rising customer expectations for product and service quality. While none of our direct sales is to Europe, many of our customers sell to that market and expect their supplier to meet the standard.

The Quality Process

Planning

The change process was initiated using the principles of Total Quality Management (TQM) through continuous improvement. While the first application was labour relations, the concept spread to other aspects of organizational development. The ISO 9002 registration process provided a model for overall continuous improvement within the company.

Planning included many activities, several of which were concurrent:

a) identifying a senior management sponsor: the Manager, Quality, Education and Technical Services, as the registration process leader
b) selecting a registration body
c) securing the enthusiastic support of the local union
d) developing a team with clearly defined expectations of each member
e) training managers, team members, leaders and all employees
f) developing a quality system strategy
g) identifying a primary responsibility for each element of the standard
h) developing the registration process flow chart and milestones
i) developing a company-wide communications strategy
j) performing internal and external audits
k) recognizing success — quality council members, employees, customers, corporate supporters
l) having a contingency for failure
m) planning for compliance and continuous improvement in customer satisfaction.

Implementation

a) The management team identified ISO 9002 registration as an important objective for customer satisfaction. A senior manager was assigned responsibility for the registration process. This manager, as registration process leader, began by securing the support in principle of the Communications, Energy and Paperworkers Union executive for creating a Quality Council composed of 15 members — both unionized and staff employees working together.

b) The registration process leader selected the external registration body (the Quality Management Institute (QMI) in Mississauga, Ontario), based upon approachability, technical credibility and references, including a positive history with the parent company. QMI provided a basic planning model for the registration process.

c) Securing the enthusiastic support of the local union was essential to the success of the project. The union executive became involved early in the process and applied a principled approach in

determining its support. Time was taken to understand the issues up-front and later to follow the development process. Benefits to the participants as well as to the entire unit membership were described. Finally, the appointment of union participants came through agreement on the selection process. The executive was satisfied with regular and ad hoc communication of progress. Openness marked this relationship — there were no divisive issues. The result was early support by a significant stakeholder.

d) An administrative assistant was selected to provide continuity for documentation. This member was coached by an experienced administrative supervisor, and together they provided appropriate and effective leadership to the council in document control, information system development and communication, both verbal and written. They were acutely aware of actual and potential barriers and sensitized all members of the council in bridging these obstacles.

During initial council meetings, the registration process leader facilitated consensus on initial terms of reference and the quality policy for the company. He then took these results to the management team for affirmation of support. The mandate and terms were then published and the Quality Council was empowered to document the quality system. With some external consultation, the council agreed to a decentralized documentation approach and identified elements of the standard required by each area (e.g. production, maintenance and purchasing).

This team worked intensively over the next 15 months, while ensuring coverage for core functions. Company management could not relieve 10 percent of its work force from normal responsibilities and assign them solely to the creation of the quality system. Thus, while a few council members dedicated their efforts fully to the documentation task, the majority maintained a balance between essential core responsibilities and quality system creation.

e) Training of council members occurred early in the process and included introductory information for all employees as well as more extensive lessons for key members of the council and the management team. Registration process leaders from other business units of the parent company shared their experiences. Open communication within this corporate quality managers' network provided the registration process leader with an improved understanding of the important features of a successful quality system.

f) The documentation architecture was decentralized to reduce the requirement for administrative support and to provide accountability at the effective levels of the organization. The expected benefits were minimal bureaucracy and reduced overhead and cycle time — **responsiveness through empowerment**. A computer networked documentation system facilitated the latter.

g) While members of the management team were ultimately responsible for their elements of the ISO 9002 standard, council members provided definition for their assigned areas. Effective communications was critical as managers dealt with apparently conflicting objectives of cost

control and providing people to prepare quality system documentation. Council members found their new roles brought about through the change process were challenging. These roles involved documenting commonly understood standard procedures. Members consulted with their normal working associates to achieve consensus on documentation — a non-traditional approach.

The registration process leader similarly resolved the competing demands of education and technical services responsibilities with that of quality. He was assisted by the new human resources manager who sponsored employee development. This permitted the registration process leader to focus on both the technical aspects and interpersonal conflict resolution requirements of implementing a new business system, based on ISO 9002.

As the quality system manual was developed, individual managers took responsibility and ownership of their elements. While some required further coaching, the challenges became legitimate queries.

h) Throughout the development of the registration process flow chart and milestones, members and their managers were challenged with resource limitations. Registration by the end of 1993 seemed to be ambitious, nevertheless, charting of progress was considered essential. Regular council meetings provided group pressure to achieve objectives on time. Ad hoc coaching among council members was also effective.

i) Employees learned of progress towards registration through the biweekly newsletter, crew meetings, their area council member and periodic company-wide communications sessions. Initial interest and participation was less than unanimous. Over the course of the registration process, support grew, especially as the council members gained confidence in their knowledge of the standard and employees saw that work instructions became defined and reliable.

The mystery surrounding customer specifications was resolved with their documentation and communication to the operating levels. The view that knowledge is power was realized as power was transferred from selected individuals to those needing the information to make decisions while operating the manufacturing processes.

j) Internal audit teams were formed and reviewed every area of the company, as well as every element of the ISO 9002 standard, at least once before the registration audit. Council members performed the internal audits with assistance from other employees who had volunteered to attend a two-day Introduction to Audit seminar arranged by the Quality Council.

The external auditors found a company and its employees committed to quality through satisfying customers' needs. Every employee interviewed knew the company quality policy, management representative and, most importantly, exactly what part they played in the quality system. This includes knowing how to access the procedures — electronic or paper.

k) The outcome of the three-day audit was successful registration to ISO 9002.

l) At no time did the Quality Council assume that success would be automatic at the first registration audit. Some non-conformances were expected. Members were prepared for overnight corrections to audit observations and the Quality Council was prepared to convene to resolve more serious non-conformances.

m) Once the company passed the registration milestone, the Quality Council prepared a flow chart of quality objectives and continuous improvement activities specific to each area for the next year. The management team recognized the need for succession planning for council members as well as involvement of more employees. The objectives became part of the business planning cycle.

Results

Successful registration to the ISO 9002 standard at the first registration audit, without non-conformances, was a significant achievement for Saskatoon Chemicals Ltd. and its employees.

Tangible initial results include improved operating procedures, significantly reduced product variability, defined customer profiles and cross-functional problem solving to address customers' concerns. Employee interest and participation has improved. Employees expect to be involved in solving quality problems. Recognition by all key stakeholders took many forms and was timely.

For the management team, the quality system has provided an opportunity to focus upon the long-term satisfaction of customers, using appropriate measurements. The system invites ideas for improvement of new and existing processes and ensures participative consideration of every suggestion.

An early post-registration challenge is the collection of all final product handling procedures into the same format as the ISO 9002 registered working instructions to ensure that customers' needs are met as well as compliance with all materials handling regulations. Another is the definition and tracking of quality-related skill sets for each employee. Managers are included in this scope.

As the early benefits of ISO 9000 registration are being realized, concerns about the increased time and resources needed to sustain compliance with the standard have generally changed to support for the system. Process area and sales representatives can demonstrate to our customers that the products and services they receive meet their requirements. There is vastly improved understanding among all employees of the identity and requirements of our paying customers.

Evolution and Benefits of a Third-party Registered Quality System

by Paul Van Warmerdam, Sales and Marketing Manager
KWH Pipe Ltd.

The Company

KWH Pipe Inc., a wholly owned subsidiary of KWH Pipe Ltd. of Vaasa, Finland, is involved in the production and sale of polyethylene pipe and fittings. The parent company operates polyethylene pipe plants in nine countries worldwide, allocating specific geographic sales territories to each company. Sales responsibilities for the Canadian company include both North and South America.

Historically, the company has been a world leader in the development of large diameter, solid wall, pressure polyethylene pipe. Currently, our product offerings extend from 12 mm diameter tubing to 1 600 mm diameter pipe. We introduced 1 600 mm pipe to the marketplace in 1981, and are still the only polyethylene pipe company in the world manufacturing a pressure-rated product of this diameter.

The Need for Quality System Registration

KWH Pipe Inc. was one of the first Canadian companies involved in plastics processing to register its quality system to a third-party standard. In this article, I discuss our experience with quality systems registration, which has led to ISO 9002.

Our products' ability to meet and often exceed customer needs depends strongly on the materials and fabrication technologies involved. Since its introduction to the marketplace in the late 1950s, polyethylene pipe has developed certain market niches where, due to various attributes, it has become the dominant product in use. One of the early uses for polyethylene pipe was for tailings disposal in the mining industry. Due to polyethylene's excellent abrasion resistance properties, our product can outlast steel pipe by a factor of 10 to one under certain flow and slurry conditions.

Polyethylene is also becoming the material of choice in marine environments. The material's light weight and flexibility enable certain innovative construction techniques to be used, minimizing the amount of time a contractor must work on the water, and thereby minimizing overall installation costs.

The butt fusion joining process which results in a virtually leak-free pipe connection is fuelling polyethylene's latest surge in market acceptance. In the municipal water distribution market, a leak-

free joining mechanism is necessary to ensure that all treated water is delivered to the final paying customer, even under shifting ground conditions. Obviously, any water lost through a leaking pipe joint must still be treated, driving up water costs for utilities customers. For wastewater treatment, a leak-free pipe system is necessary to prevent water infiltration, which would increase the total amount of water treated, thereby driving up the total treatment costs.

In the natural gas industry, leak-free performance of distribution networks is of critical importance to safety. Polyethylene's corrosion resistance and the leak-free aspects of the butt fusion connection were instrumental in helping the product attain a position where fully 95 percent of all new natural gas distribution lines installed are made from polyethylene pipe.

The quality verification requirements of this industry were the driving force in the development of a comprehensive Quality Assurance Program at KWH Pipe. In Canada, all polyethylene gas distribution piping installed by gas utilities must be certified to comply with the Canadian Standards Association (CSA) Standard CAN3 B137.4 titled "Polyethylene Piping Systems for Gas Services" (gas pipe standard). In the early 1980s, a clause was incorporated into that standard requiring that all polyethylene pipe suppliers to gas distribution utilities be registered to the CSA's Quality Management Standard CSA Z299.3. KWH Pipe began enhancing its quality system to meet the requirements of the Z299.3 standard.

Implementing and Maintaining a Registered Quality System

KWH Pipe worked diligently throughout late 1984 and early 1985 to produce the necessary quality manual and implement the required procedures. In October 1985, our Huntsville, Ontario, production facility was registered by the Quality Management Institute (QMI) to the Z299.3 standard, making KWH Pipe the first organization in our industry to achieve this distinction. Our Saskatoon, Saskatchewan, plant achieved registration in October 1987.

Shortly after we achieved registration under the Z299.3 standard, this requirement was removed from the gas pipe standard. The basis for this decision was that Z299.3 registration is more of a purchase specification issue than a product certification issue.

With the removal of the Z299.3 registration requirement from the gas pipe standard, the activity in our industry surrounding quality systems registration was markedly reduced. For a number of years, KWH Pipe remained the only North American supplier of polyethylene pipe to be registered under Z299.3. Gas utilities were reluctant to incorporate Z299.3 registration into their purchase specifications since it would restrict their options with regard to suppliers.

During this time, KWH Pipe maintained its registration. This made sense because, once the program is implemented, the overall effort and cost to maintain it are minimal. To differentiate ourselves from our competitors, we made our customers aware of the value of being registered to the Z299.3

standard. All specifications writing efforts on our behalf obviously incorporated the Z299.3 standard as we attempted to drive the industry up to a new quality plateau.

As the ISO 9000 series of quality standards gained recognition in the North American marketplace, our registrations under QMI were expanded in 1989 to include both CSA Z299.3 and ISO 9003.

Our Z299.3 quality system was initially developed with outside consultants and, while effective, was actually more of a Quality Department initiative. At this time, the company was developing a quality philosophy which emphasized the quality of all our processes, not just inspection and testing. The challenge became to integrate the approach developed as part of the Z299.3 system into the company consciousness.

The challenge of integrating the quality system throughout the company was demanding. This challenge became crucial with the introduction of the ISO 9000 series of standards which require total commitment and teamwork throughout the organization. It was necessary to convince various department heads of the value of expanding the program to meet the requirements of ISO 9002. This was challenging since, under ISO 9002, their own responsibilities within the system relating to development, implementation and maintenance would increase significantly. There had also been an informal consensus that what we had was working just fine.

The ISO 9002 implementation program was demanding in that a lot of the required work was labour intensive. Efforts made towards program implementation were in addition to everyone's normal responsibilities, the result being that much personal time was sacrificed by those involved.

Although KWH Pipe's initiative to become registered under a specific quality standard was originally driven by a specific market segment, we quickly recognized the value of these standards as we attempted to differentiate ourselves from our competitors. In October 1993, our Saskatoon production facility was successful in achieving registration under ISO 9002, with registration at our Huntsville production plant being achieved in early 1994.

Although implementation of the ISO 9002 quality standard is a company-wide issue, crossing all aspects of the business, there is no question that there has to be a driving force behind the implementation process. In our situation, our Quality Assurance Supervisors assumed this role. They were instrumental in identifying what had to be accomplished to achieve registration and acted as a resource to Departmental Supervisors who were working to meet the necessary program requirements in their departments. Senior management supported the implementation process through company policy directives and through making the necessary resources available. The brunt of the actual labour involved was at the supervisory level and specifically with the Quality Assurance Supervisors.

Benefits from Quality System Registration

The main benefit that we derived from our original Z299.3 quality system registration was compliance with customer requirements within a specific market, the natural gas industry. The product quality requirements for the water/waste treatment markets are based on the benefit the user receives through the generic use of polyethylene pipe. Z299/ISO 9000 registration has provided assurance to the customer that the polyethylene pipe, as supplied by KWH Pipe, meets or exceeds the relevant industry standards.

A secondary reason for registration was the company's desire to be recognized as an industry leader in quality. This was also the main reason why we upgraded our certifications to ISO 9002. More of our customers are starting to recognize the benefits of purchasing from an ISO 9002 certified supplier. Currently, approximately a dozen of them purchase product solely from KWH Pipe because of these certifications. We expect the influence of the ISO 9000 program to expand in the future.

Among the benefits which the company expects to receive are increased sales, margins and total market share. Obviously, to accomplish this, the benefits of dealing with a registered company must be communicated to our customers. This aspect of the program has just recently been initiated.

Other benefits from ISO 9002 are related to production efficiency. The program forces you to analyze your quality deficiencies and implement programs to minimize/eliminate recurrence. This has resulted in an improvement in our first-through yield. While progress has been made in this area, it is difficult to quantify the total amount saved.

Looking Ahead

In the early years, KWH Pipe's position in the marketplace was that of a supplier of the largest solid wall, pressure-rated polyethylene pipe in the marketplace. In today's changing marketplace, we are actively working to switch this positioning from bigger to better as we lead our segment of the pipe industry in the concept of continuous improvement through the development and implementation of a more effective quality management system.

Getting It Done: Starting the ISO 9000 Implementation Journey

by Dave McQueen, Executive Vice President
Toronto Plastics Limited

The Company

Toronto Plastics Limited is a Canadian-owned, custom-injection moulding company with annual sales of $15 million and 125 employees. The company's customers are original equipment manufacturers of automotive vehicles and systems, business machines, electronics and telecommunications equipment.

In the late 1980s, the company was losing money and at risk of losing major customers. We are now profitable, with annual sales growth currently exceeding 15 percent. A crucial part of this turnaround has been the installation of a world-class quality system. Toronto Plastics was the first Canadian injection moulding company, and the second one in the western hemisphere, to achieve ISO 9002 registration. We began our efforts to achieve ISO 9002 registration in early 1991 and reached our goal on 1 May 1992.

Why Undertake ISO 9000 Registration?

In this article, I describe the factors which motivated Toronto Plastics to achieve ISO 9002 registration, the changes which we had to make to our existing quality system, and the level of effort required to make them.

For most manufacturers today, quality systems are not new. For almost a decade, we have consumed a steady diet of Crosby, Juran and Deming, sprinkled with Statistical Process Control (SPC), Design of Experiments (DOEs), etc. Why then, would a company pursue registration to one of the ISO 9000 standards?

We compete in several markets, each with its own quality system. Automotive customers use Targets for Excellence (GM), Pentastar (Chrysler) or Q101 (Ford). Military customers use AQAP and electronics and business machine customers have their own standards. Smaller customers in these industries have their own variations of the major systems, conduct their own audits, and tend to view other systems with uncertainty.

ISO 9002 offered an opportunity to establish ourselves to a standard that they all would recognize. The primary goal of the ISO 9000 standards is universal acceptance. It represents the consensus of an international body, representing 72 member countries and countless national and industry standards.

This provides a high degree of portability since ISO 9000 registration is not specific to any single customer, country or industry sector. The international recognition attained by the ISO standard was important to us since we export to Europe.

Hand in hand with portability is third-party auditing. The auditor has no vested interest in the product, only the quality system. ISO 9000 can also be used as a second-party standard, in a manner similar to how many companies have used their internal quality systems to audit suppliers. The third-party audit feature of ISO 9000, however, adds credibility and saves everyone time and money.

Prior to implementing ISO 9000, we had an internal quality system based on elements of our customers' systems. As new requirements were added in response to customers, our internal quality system became a mosaic of different and often confusing systems. ISO 9000 has allowed us to unify several customer quality requirements into a single, integrated system.

Another advantage of ISO 9000, and the feature that facilitates the consolidation of disjointed quality standards, is that the ISO 9000 standards focus on process, not product. Customer systems, however, almost always focus on product. Product is extremely important, however, concentrating exclusively on product requirements can result in neglecting the overall company process or system.

Finally, ISO 9002 provided a common goal for all employees at Toronto Plastics and encouraged us to look carefully at all our processes. This has provided a solid base for the company's efforts in total quality.

In the next two sections, I briefly compare ISO 9000 with other quality systems and review the steps that Toronto Plastics went through to achieve ISO 9002 registration.

Comparison of ISO 9000 and Other Quality System Standards

Standards vary with respect to their specificity. Many in-house standards are very specific about how objectives are to be accomplished. Some even dictate the exact forms to be used in reporting. The ISO 9000 series allow much greater latitude in how things are to be achieved, but not on what must be achieved. One should keep in mind that every industry has unique characteristics which determine how the ISO standards should be applied.

An example is the often-repeated claim that ISO 9000 does not require the use of SPC. While this is true, ISO 9002 requires "monitoring and control of suitable processes and product characteristics during production and installation." For manufacturing processes, an effective statistical control system is necessary to satisfy this standard. By contrast, some proprietary standards define particular details regarding the use of SPC. For Toronto Plastics, it was necessary to establish an effective SPC program on all processes and, in certain cases, to provide specific documentation to customers.

A common feature of third-party standards, including ISO 9000, is reliance on audit trails. The linkages between documents, procedures and systems are crucial. A third-party auditor is usually in an ideal position to determine the strength of the audit trails and, without intimate knowledge of the company or its products, must rely on the written documentation as a guide.

In third-party audits, there cannot be a partial degree of success. Unlike most customer systems where partial marks are given for having systems under development, ISO 9001, 9002 or 9003 are standards which you either do or do not meet.

Implementing the ISO 9002 Standard

There are five steps to a successful implementation. The first and most critical is honest self-assessment. If you do not know what is wrong, you cannot fix it. This must be followed by a well-conceived implementation plan. You must then make the changes. You need support and contribution from everyone in the organization so you must consider skills availability, training and communication. While you are making changes, you must keep reassessing the results. The organization will need feedback and follow-up. The last step is to do it all again. Although it may seem overly simplified, the **Deming Cycle** accurately describes the process to follow: plan, do, check, act, and do it again.

Self-assessment: This began with a review of all recent customer surveys, customer quality manuals, internal audits and our registrar's checklist. This information was combined to assess the company's current status and identify required tasks. An effective procedure involves using the audit form that your selected registrar will be using and spending adequate time to examine your organization and assess your deficiencies.

I performed this task in our company over a period of approximately three days and I had my eyes opened in the process. I found numerous cases where employees were doing things well, with a reasonably good approximation of the desired result, but they were not doing things the way we had said they should. In such cases, something has to change — either you change the system or start complying with it.

It is essential to be critical and to avoid the temptation to give yourself the benefit of the doubt. In the United States, 70 percent of companies fail the first registration audit. Many of these companies likely have good quality systems but have left far too many gaps and inconsistencies to pass an ISO audit.

Planning: ISO 9000 can be implemented using standard project management methods — establishing what needs to be done, planning the work, monitoring progress closely and adjusting quickly to correct problems. We developed a critical path plan with completion dates, responsibilities and measures of success. In its final form, the plan exceeded more than 250 tasks. Managers scheduled

tasks using GANTT charts and the entire project was coordinated through a critical path chart. Periodic audits monitored the success of new and modified procedures.

Making changes to the existing quality system. This typically involves rewriting some procedures and manuals. They will not have to become more complex — they may become simpler — but they will have to be very clear. They must indicate who does what, when and how. There must also be a clear connection between procedures and documents. We kept asking ourselves: If we give this document to someone who has never worked here, will they know what to do? These issues often appear in customer audits but are crucial for ISO 9000. If you have had customer audits in the past, check the areas where you scored relatively low. They may indicate weak areas that were adequate for your customer but will not be for ISO 9000.

Compliance is a major issue. We found that many of our employees were doing things approximately, but not exactly, right. Because these results were not far off the mark, our customers had not given us a poor rating. This could have resulted in a critical failure during our ISO 9002 audit. In some cases, we revised the procedures to match what we were doing. In others, we trained people and audited internally to make certain they understood.

Once the deficiencies are identified, prompt corrective action is essential, not only to keep on schedule, but to maintain momentum and morale. There is nothing more deflating than to be heading into the end zone, expecting the quarterback to throw the long bomb, only to find that the centre fumbled the snap. To stay on track, we repeatedly had to rearrange activities, reassign resources, crash programs and modify schedules. By keeping our ultimate objectives in focus, we were able to adjust reasonably well to these forced changes.

Training and communication: Training was critical as it provided the means through which the objectives of the ISO program were communicated. By having our own people act as trainers, communications channels within the company were strengthened. Commitment from top management was crucial to the program's success. The President and CEO communicated this commitment clearly to employees, "Our customers deserve perfect quality all the time. We're going to deliver it."

Reassessment, follow-up and feedback belong together. It is always easier to make small adjustments to your course than large ones. It is also usually better for people to know that they have travelled 50 kilometres towards the goal than to simply know that they have not yet reached it. As we constantly measured results, solutions to problems usually became evident. Usually, the time required to make adjustments was small. We rarely had to throw our work into the trash and start over.

Our ISO 9002 implementation took nine months from the decision to start. There was a delay in scheduling the audit and a further delay in actually receiving registration so we were registered a year after the decision to begin. Depending on a firm's current quality system and practices, ISO 9000 implementation may require up to three years of aggressive work.

The costs of achieving ISO 9000 registration are difficult to quantify. Registration fees, paid to the auditing agency, depend on the size and nature of the company. In our case, the cost was $7 500. Implementation costs depend also on company size and type, and on the quality system currently in place. In our case, the resources deployed to achieve ISO registration were approximately $200 000. Much of this cost, however, was not incremental since it involved quality-related activities which would have otherwise been part of our quality process.

Only one person in our organization, our quality engineer, worked full-time on the ISO registration. The remaining workload was spread over all personnel, some working 25 percent to 50 percent on the project, during some time periods. Everyone in the company had some task to complete. We did not use outside assistance.

If your quality system relies heavily on the Quality Department to make it work, you could have a problem. In those situations, compliance is hard to achieve and you may find, as we did, that time is well spent on disseminating their responsibilities.

There are several choices of accredited (through the Standards Council of Canada) registrars now, however, when we began, the Quality Management Institute (QMI) was the sole Canadian organization in this field. QMI has a solid reputation and much experience, as well as a considerable international reputation.

Conclusion

ISO 9000 registration has lived up to our expectations. The job of implementing any quality system is a significant task, but it is not insurmountable, and is worth the effort.

Part 3

Organizational Culture and Employee Involvement

Part 3

Organizational Culture and Employee Involvement

Overview

The articles in this Part focus on issues related to developing a quality-oriented organizational culture and ensuring a high level of employee involvement.

In order to become effective in quality, employees need problem solving and teamwork skills. While much can be learned through experience, there is a need for training, particularly at the beginning of a quality initiative. Several types of training are discussed in the articles, including training using external and internal resources, just-in-time training for teams and an innovative approach to multicompany-shared training.

Effective two-way communications is essential to achieving employee involvement in the quality initiative. The articles in this publication describe a range of formal and informal mechanisms for communication. Two articles in this Part deal with formal mechanisms — an employee suggestion system, and a communications program used to launch the quality initiative.

The organizational culture in total quality companies is characterized by every employee being dedicated to satisfying the customer. This is emphasized in the articles in this and other Parts.

The articles in this Part are summarized below:

A Well-Designed Employee Suggestion System Produces Significant Results: Employee input is an essential element of an effective quality process. The Warehouse Operations Department of Dow Chemical Canada's Western Canada Operations has implemented a suggestion system which combines the best features of the Japanese approach and considerations based on North American cultural and business realities. The company found that a high rate of participation is more important than individual big payoff suggestions. The system produces about 140 suggestions per month and with a 74 percent implementation rate. Financial results have been significant — approximately $30 000 per month in accumulated savings.

The Quality Academy: An Innovative Solution to Small Companies' Training Needs: The Quality Academy comprises Human Resources Consulting Services (HRCS), Nemato Composites Inc., K.P. Bronze Limited, Terra Nova Steel & Iron Inc. and Quality Plates and Profiles Ltd. Several small manufacturing companies supplying to the chemical industry found that employee training costs and time were significant obstacles to quality improvement. The article discusses the limitations of

available solutions, including company-specific training and public seminars. Working with a supplier of quality-related training and consulting services, they developed a new approach, The Quality Academy, which combines the advantages of customization, scheduling flexibility and shared costs.

Communicating with Novacor Employees about Total Quality: When the Novacor Chemicals Division of NOVA was created in 1991, a central challenge was to unite its various businesses into a cohesive group by developing and fulfilling a company vision and commitment to quality. This article discusses the communications program of Novacor Chemicals Ltd., developed to insure that employees would understand the new vision and become involved in making it a reality. The program's main elements are empowered employees, customer focus and process improvement. Activities included an interactive workshop, accompanying video and development of personal action plans by workshop participants. Employee feedback has been positive.

A Customer-Oriented Culture for Long-term Customer Satisfaction: Total Quality Management can take many forms, from formalized programs with buzz words and the latest quality fads to the informal day-to-day, customer-oriented approach. It is the latter which most accurately reflected the Uniplast Industries Inc. approach to total quality. The article describes, in several examples, how the corporate culture at Uniplast emphasizes management leadership, employee involvement and focus on the customer. In these examples, we see the CEO, a production supervisor and product development staff closely involved with the company's customers.

A Well-designed Employee Suggestion System Produces Significant Results

by Bill Doak, Associate Quality Consultant
Jim Zimaro, Warehouse Operations Supervisor
Dow Chemical Canada

The Company

Dow Chemical Canada, Western Canada Operations, located at Fort Saskatchewan, Alberta, started out more than 40 years ago as a producer of glycols, amines and herbicides. In the late 1960s, we expanded to the production of chlorine and caustic, and in the 1970s we underwent a major expansion to include a second world-scale chlor/alkali plant. The expansion also included production facilities for ethylene glycol, ethylene oxide, vinyl chloride, ethylene dichloride, polyethylene, styrofoam and a major power and utilities plant. This brought the operations from approximately 50 employees to 900. The division is currently undergoing another expansion including an ethylene plant and a doubling of the present polyethylene plant. Since a large portion of the products produced are shipped to the Pacific Rim, Dow has a large storage facility in Vancouver where ocean-going ships are loaded.

Overview of Total Quality Implementation

In the early 1980s, Dow began to look for new ways to manage its business so as to ensure its survival. Some of the "gurus" who were listened to included Dr. Deming, Bill Conway, Joseph Juran and Philip Crosby. In 1985, Dow's Western Canada Operations began its quality initiative in earnest when its management met Dr. Deming during a visit to Dow's Sarnia operations. That year, one of us (Bill Doak) was appointed to be the quality specialist for the site. Early in 1986, Tennessee Associates were hired to train the division management and selected specialists in statistical process control.

Since that time, the Canadian operations has been recognized in Dow as a leader in the application of quality technology, including practices such as managing improvement (Hoshin planning), opportunity flow charts (problem-solving process), improving daily work, customer surveys, seven management tools, meeting leadership, facilitation and suggestion systems.

Designing the Employee Suggestion System

Employee input is an essential element of an effective quality process. This paper describes how the Warehouse Operations Department of Dow Chemical Canada's Western Canada Operations developed one particularly effective mechanism for employee input — an employee suggestion system.

It is well-known that suggestion systems in North America have not usually been as effective as their counterparts in Japan. Japanese organizations consider the employee suggestion system as important to corporate success as the company's strategic plan (see, for example, *Kaizen, The Key to Japan's Competitive Success* by Massaki Imai). Japanese suggestion systems concentrate on social reinforcement rather than the tangible (often financial) recognition used in many North American systems. Japan's managers also see the small, but continuous, improvements resulting from suggestions as the key to success, as opposed to the big bang dollar savings that impress North American management. Japanese managers are also held accountable for their responsiveness to suggestions and are expected to develop feedback and reward systems for them.

In 1986, the average savings resulting per suggestion in Japan was $141 compared to $5 500 in the United States. The average award per suggestion in Japan was $3.76 compared to $416 in the United States. Despite the larger savings and award per suggestion in the United States, the savings per 100 employees in Japan was much higher: $267 000 compared to $19 759 in the United States. Clearly, high employee participation and a large number of suggestions play a dominant role in overall performance.

In 1988, one of the authors (Jim Zimaro) led a process improvement team which designed a new employee suggestion system for the Warehouse Operations Department. This department warehouses and distributes spare parts to on-site plants. Its 31 employees are spread throughout the operations, at maintenance facilities located at each of the plants. Key objectives of the suggestion system included involving all employees within the department in the continuous improvement process and enhancing communications within the department.

The team included four supervising technicians (Walter Ewasiuk, Dave Fricke, Roy Lura and Dave Yarmuch). Bill Doak was the team's advisor on continuous improvement.

The system design incorporates the positive aspects of Japan's system while taking into account the fact that North American lifestyle and culture are considerably different than those in Japan. For example, Canadians are not a homogeneous people and most of us do not pay total allegiance to a company.

Our system includes four main elements, including an employee process, a supervisory process, a feedback and reinforcement process, and a group measurement process. Each of these elements is discussed below.

The Employee Process

This process is, by and large, contained on the suggestion form itself, shown in **Figure 1**. First, the form requires an **Opportunity Statement** which is basically the suggestion, itself. It also requests supporting data (i.e. why something appears to be a problem or an opportunity for improvement). The person making the suggestion must then detail his or her plans for implementing the solution to the problem and the specific steps to be taken for accomplishing set goals.

The form also allows space for follow-up comments and notations on the results of changes made. The follow-up section provides space to answer questions such as, "Was the problem affecting any other processes or systems?" and "Is the solution taking the process in the right direction?" The form also includes a line for a follow-up date to encourage accountability. Points are earned for completing each step of the suggestion process. Our actual form contains the point system for submitting a suggestion and other related behaviours.

Originally, the form requested an estimate of savings for each suggestion. This question was deleted since savings are often difficult to estimate. For example, a third of our inputs deal with safety, an area which does not lend itself easily to financial analysis. If you save someone from hurting their back, how are you going to quantify it?

The form was designed to reinforce any steps toward participation. If someone chooses only to make a suggestion without data collection or follow-up, for example, he or she can still earn one point.

The suggestion form is important as the first hands-on antecedent to participation. To be effective, it should be as simple as possible. We therefore avoided excessive boxes and squares and routing directions to various levels and departments. A valuable or high-quality idea will reach its own approval level, therefore, there is no need to specify this on the form. We also have found that when suggestion quantity is emphasized, quality soon follows. Give timely recognition and reward and don't worry about the quality of the suggestions. As people mature with the system, the quality of the suggestions improve.

The Supervisory Process

The most important part of the suggestion system is the supervisory process. Supervisors have to buy into the system since they are instrumental in making it work. They should, therefore, be involved in its initial development. Our system relies on the supervising technicians, known as supertechs at Dow, to provide training and coaching in the suggestion process. They must enlist visible support from management when special recognition is needed and they must allow their people the time to work on improvements.

One way that supervisors in this department provide coaching is by sharing suggestions with their own employees. They do not participate directly in the program and are encouraged to discuss their ideas with others, possibly helping them to brainstorm solutions. This forces the supervisor to interact more with his or her employees.

Another key role of supervisors includes removing obstacles to problem solving, especially with other departments. A supervisor has more clout and can sometimes go to the other departments and help smooth out the rough spots. The supervisors can also expedite necessary job orders and, last, but not least, they must expect and allow for mistakes in the problem-solving process.

Feedback and Reinforcement

Positioned in front of the warehouse and updated monthly, a large chart shows the accumulated suggestions made and implemented. This year, a bar tracking last year's performance on a monthly basis will be added to the chart, enabling employees to compare their current participation with that of the previous year. The high implementation rate, approximately 74 percent, is reinforcing in itself to the performers, along with the consequent benefit of a smoother operation.

After the supertechs tally the points for suggestions made, the department supervisor reads each submission and often writes a positive comment on the suggestion form.

In addition to the social reinforcement provided by the supertechs, the departmental supervisor provides a cash reward (50 cents per point) to each employee. This probably averages out to $30 to $50 per person. Along with the cash award, the departmental supervisor encloses a note welcoming any comments on ways to improve the suggestion system.

To keep the suggestion system alive and current, we set aside time for discussing it in our weekly communications meetings. We have also presented the suggestion plan to several other Dow departments. The supertechs and other employees attend these presentations so they can answer questions about the system.

About midway through the first year of the program, we noticed that the cumulative suggestions were levelling out at about 77 per month. Although we were pleased with the participation rate, we felt that it might be higher if we improved the reinforcement plan. We talked it over with the supertechs and studied the areas that were doing well in terms of submitting suggestions. We found that one of the supertechs set aside about two hours per week to let his employees brainstorm, develop ideas, and put those ideas into action. Consequently, that area submitted a steady flow of valuable suggestions every month. The other supertechs immediately began to use the same method.

Because the warehousing personnel are spread around the site, there was a need to enhance communications among them. A suggestion by a warehouse tech showed the way to accomplish this. The

supertechs set up tours of each others' areas, enabling the warehouse employees to learn about each other's systems and exchange ideas.

Once a month, all 31 employees come together from their various locations for a safety meeting. The supertechs ask them to bring one of their most successful safety suggestions to share with the group (volunteers only, of course).

Giving all employees easy access to their completed suggestion forms was another change made to the system. When the suggestion system was first presented to the employees, some made comments such as, "What if someone steals my suggestion?" or "What if someone thinks my suggestion is crazy?" As a result, the suggestion forms were initially confidential, kept under lock and key, or at least under file and drawer. We eventually found that to be a false fear. We now put the suggestions in a binder in each work area so everyone can review them. People are proud of their suggestions. They want people to see them.

Increased visibility also came in the Monday morning "tailgate meetings." These meetings, a Dow ritual for 19 years, last about 10 minutes and serve to get everyone's mind back on work after the weekend. Each warehousing group meets separately. The supertechs grasped the opportunity to share more ideas by presenting one suggestion from each of the other groups at these meetings.

Group Measurement

Based on the quantity and implementation rate of suggestions, the system, started late in 1988, is a success. Approximately 25 of the Warehouse Operations department's 31 employees regularly participate in the suggestion system. During the first nine months of the program, suggestions rolled in at an average of 77 per month. After several adjustments to the reinforcement system (increasing its profile, providing more opportunities for recognition and participation, and increasing the level of social reinforcement), the suggestion rate almost doubled, to an average of 141 per month. The implementation rate of all suggestions is approximately 74 percent. Prior to the introduction of the suggestion system, monthly safety meetings involved discussion of about three to four safety-related suggestions. They now discuss 30 to 40.

As for money saved, we discovered that the Japanese have the right idea when they applaud the steady, small and continuous operations changes more than the this-will-save-you-a-million-bucks suggestions. For the Warehouse Operations department, the emphasis on continuous improvement, rather than money saved, has nevertheless resulted in a sizable savings — approximately $30 000 per month in accumulated savings — and that is very conservative. That figure accumulates every month because (with suggestion implementation) systems are being changed permanently.

Lessons Learned

At one point we tried to change the tangible part of the system, but without success. Rather than give cash for points earned, employees were given the option of choosing the dollar equivalent in tickets to various social and sporting events or restaurant vouchers. We posted prices beside the events or tickets. Ultimately, every person said they wanted cash.

We are not considering modifying the tangibles part of the system. Cash disappears so quickly that its reinforcement staying power is passing at best. We have no qualms about using cash as a reinforcer, however in hindsight, it would have been better to use something else as the initial reward. The initial use of cash limits flexibility for making subsequent changes to the reward/reinforcement part of the system. Although the cash awards are valued by employees, the most important thing is recognition — a pat on the back, a verbal comment or a note. We now include written positive comments in the cash award envelopes. Our employees are doing great and we want to let them know that management is aware of it.

Several benefits can be achieved with a well-designed, well-operated suggestion system. The system fosters the use of continuous improvement in employees' everyday jobs, leading to improvements in systems and procedures. It motivates average performers and develops a closer working relationship between supervisors and employees. It also generates hard data for positive reinforcement, particularly at job review time. Finally, the recognition and reward is low cost.

Example of Filled-Out Employee Form for Submitting Improvements	
Opportunity Statement:	Describe the opportunity you have decided to work on. e.g. Aerosol paint cans will not spray properly.
Supporting Data:	May be formal or informal, showing the extent of the problem.
Implementation:	Describe the actions taken to address the opportunity and explain the degree of improvement noted. e.g. We obtained paint that met the specifications, for the same price, from a different vendor and tested under similar conditions. The result being jobs completed on schedule and cost effective.
Follow-Up:	At some later date, note the trend of the actions implemented. Explain if this has positively or negatively affected any other procedures. e.g. Checked two weeks later and the customer was still pleased with the results.
Estimated Savings:	The difference between the cost of the project and the benefit to Dow. e.g. 20 cans/day @ \$2.50 = \$50 x 20 days/month = \$1 000/month 1 person-hour/day x \$25/hour x 20 days/month = \$500/month Cost of Project = \$0.00 Estimated Savings = \$1 500/month

Figure 1 — Dow Chemical Canada

The Quality Academy: An Innovative Solution to Small Companies' Training Needs

by Michael Stanleigh, President, Human Resources Consulting Services
Duncan Lyon, General Manager, Nemato Composites Inc.
Cathy Vrancic, Comptroller, K.P. Bronze Limited
Mario Zitella, General Manager, Terra Nova Steel & Iron Inc.
Brad MacDonald, Sales Manager, Quality Plates and Profiles Ltd.

The Companies

Human Resources Consulting Services (HRCS) provides Total Quality Management (TQM) and ISO 9000 related training and consulting services to a broad range of companies. HRCS has offices in Toronto, Ontario, and Houston, Texas. It recently developed an approach to shared training, in collaboration with four small companies, described below, who are suppliers to the chemical and process industries.

Nemato Composites Inc. produces fibreglass products and provides engineered solutions to corrosion problems. Its primary markets are the pulp and paper, mining, chemical, refinery and waste water treatment industries in Canada and the United States. The company employs 46 people, including 11 salaried staff and 35 unionized plant employees.

K.P. Bronze Limited manufactures quality bearing bronze tubes and solids. They currently employ 42 people, including 11 salaried administrative staff, 29 non-union plant staff and two U.S. sales staff. Exports currently account for approximately 70 percent of annual sales. The company is actively pursuing export markets in Cuba, the Philippines and the Asia-Pacific region.

Terra Nova Steel & Iron Inc. is a Canadian distributor of continuous cast iron bar products imported from Brazil. The company has six employees. Its customers include manufacturers of cylinders, gears, pistons, pulleys, hydraulic manifolds, seal rings and moulds.

Quality Plates and Profiles Ltd. is a specialty steel service centre supplying pressure vessel quality and quench and tempered hot-rolled steel plate. The company employs 13 people, including seven salaried administrative staff and six non-union warehouse staff. The company's primary markets include chemical and oil refineries, oil and gas pipelines, mining, heavy equipment parts, components for steam and nuclear generating stations and water filtration systems.

Critical Challenges to Quality Initiatives: Training Costs and Time

Most of the successes in total quality achieved to date by Canadian companies have been achieved by larger organizations — companies with at least 250 employees. The vast majority of Canadian companies, responsible for creating 75 percent of new jobs, are small to medium in size. If these jobs are to exist within a TQM environment, our smaller companies will need to make major advances in adopting TQM.

For smaller companies, particularly those with fewer than 60 employees, training costs are serious obstacles along the TQM journey. This is reflected in the much larger ratio of training costs to sales for small companies than for larger ones.

Training requirements have been further increased by the emergence of the ISO 9000 quality standards as a competitive factor and, in some cases, is a prerequisite for doing business. Both large and small manufacturers are being asked to meet the ISO 9000 standards. The problem for smaller manufacturers is that they cannot always afford the associated costs, much of which are related to training.

A second major challenge faced by small companies involves providing training to all their employees within a short period of time, without shutting down their entire operations. Most team workshops offered by training organizations are two to three days in length and require that 15 to 20 employees attend at a time. This number could be increased or decreased slightly, but the impact on the company remains relatively unchanged.

Options for using company-specific workshops to provide training to all employees include holding the workshops over a weekend and paying the employees extra for their time, holding the workshops over a combination of weekdays and weekends to avoid having to pay too much overtime, and closing the operation down completely and providing all training on weekdays.

Given these options, many small manufacturers have not used this type of training. Some have sent clusters of employees to public seminars offered by large training organizations, community colleges, etc. This gives their employees exposure to TQM principles, some guidelines for implementation and a general knowledge of teamwork and problem solving.

These seminars usually cater to all types of manufacturing, retail and service organizations, covering a wide size range. To accommodate this diverse clientele, the course content must be very general. It has consequently been of limited usefulness to smaller firms that need to learn how to implement TQM within their own unique environment.

Small manufacturers require solutions that reduce the costs of training while maintaining a high level of benefits, provide an opportunity for all employees to attend training workshops without having to

completely shut down their operations, are relevant to the environment and challenges faced by the small manufacturer, and integrate quality-related training with design and implementation of the overall quality process.

Shared Training Provides a Solution

Sterling Pulp Chemicals had used the services of Human Resource Consulting Services (HRCS) to implement Total Quality Management (TQM) for about a year when their supplier/customer program was launched. This led to the notification of some of their suppliers that they needed to improve their quality if they were to continue as suppliers to Sterling.

One of these suppliers, Nemato Composites Inc., had received this notification. Its work force included 46 employees from diverse cultural backgrounds, speaking several languages and possessing varying degrees of literacy in English.

When Nemato management first approached HRCS concerning TQM implementation assistance, they were sceptical as to the potential outcome. They believed that training their work force would be close to impossible due to the high degree of illiteracy and factions among the plant employees and between the plant and office. They were also facing a financial crisis due to declining sales, with no corresponding reduction in costs. Nemato engaged our firm to provide the training and consulting services needed to help them address these issues.

The first stage of implementation involved working with senior management to design the process, starting with a three-day High Performance Teams Workshop which covered topics such as dealing with conflict, effective communications and the roles of team members. Considerable time would also be spent discussing TQM and why management had chosen it as the basis for its survival strategy. Finally, the workshop would provide employees with a team-based, problem-solving process which they could use to solve problems facing their company.

The workshop was held twice. Half the employees, including senior management, attended the first workshop and the remaining half attended the second one. The workshop was held Thursday, Friday (normally a half-day for employees) and Saturday. Employees were told about the company's situation and asked to attend the workshop on their own time. All their expenses (food, etc.) were paid for.

The workshop boasted a 100 percent attendance and immediately changed the way people interacted with each other. Back in the workplace, teams were immediately formed to deal with some of the issues facing the company. After seven months, Nemato has measurably increased its level of quality and, through its teams, is finding ways to survive. For example, two teams are now working on innovative methods to reduce waste. Each has set a team goal of $300 000 savings. But this was only the beginning.

Several months after the formation of quality teams within Nemato Composites Inc., K.P. Bronze Limited approached HRCS to assist them with TQM implementation. Their work force of 36 non-unionized employees was also comprised of different linguistic groups, with varying degrees of English literacy. The major issue facing the company involved working toward ISO 9000 in order to meet new customer requirements. They also felt that to become more effective they needed to adopt a team-oriented approach. The High Performance Teams workshop completed for Nemato Composites Inc. was used with K.P. Bronze. They decided on the same format and days of the week.

Immediately after the training program, management at K.P. Bronze observed an extremely high increase in the motivation and morale among employees. Four months after the training, they were rapidly moving into compliance with the ISO 9001 requirements.

It was not long before Nemato Composites Inc. and K.P. Bronze required more training. Management needed to understand more about TQM, particularly how the roles of all employees would change. Both companies needed more technical and measurement-oriented courses. They wanted to learn more about Cost of Quality systems, supplier/customer programs and applying TQM to the innovation process within their companies.

The number of employees that each company could send to each of these subsequent workshops were not enough to justify the costs, nor did they want to attend any of the public offerings available. Our first suggestion to each of them was to invite some of their suppliers and/or customers to attend these workshops. This proved difficult. These organizations were either large companies well into TQM, or smaller firms who did not realize the potential benefits of TQM, or did not consider it a priority. Thus, this solution did not prove effective.

Almost simultaneously, two other small companies approached HRCS: Terra Nova Steel & Iron Inc., with six employees, and Quality Plates and Profiles Ltd., with 12 employees. These firms wanted to adopt TQM because, based on what they had heard and read, they believed it would help them to innovate and continuously improve. They did not, however, have enough employees to independently hold even the High Performance Teams Workshop. (Quality Plates and Profiles could have done this but only if they were able to completely shut-down their operation for three days.)

We suggested that the general managers of the four companies meet to explore the idea of sharing our services and, consequently, the costs. The first meeting was held in October 1992, and out of it was born what they titled the Quality Academy. Prior to this meeting, the four firms did not have contact with each other. The meeting provided an additional benefit in the form of a networking opportunity.

Through the Quality Academy, HRCS was able to offer workshops on High Performance Teams, The Cost of Quality, Managing in a Total Quality Environment, Quality Function Deployment and Supplier/Customer Program Development. Each manufacturer signs up attending employees for the

mutually agreed upon dates. Prior to holding workshops, the firms are consulted to ensure that the course content will meet their needs.

HRCS also supplies quality-related consulting services to these firms on an individual basis. While each firm receives implementation assistance tailored to its unique needs, they benefit by sharing information on progress with each other.

Results to Date

The shared training approach has been an effective solution to the training problems of the four firms making up the Quality Academy, enabling them to share training costs and maximize scheduling flexibility. They see themselves as a close group — a very different perspective than that derived from attending a public seminar. To further spread out their training costs, they are willing to accept other small companies into their Quality Academy. They will know when the optimal number of member companies has been reached.

These companies are beginning to see their competitive edge built on the cornerstones of quality and innovation. They are using innovation to adopt new processes and enter new markets, and quality to continuously improve. Each company has maintained a strong, ongoing commitment to training. They have set up teams to deal with many issues and are seeing measurable results. One of the manufacturers is close to meeting the ISO 9000 guidelines. Another will survive — something they believe would not have happened had they not committed to TQM and been a part of the Quality Academy.

Solution Summary

This article has described a model that has been used successfully to provide quality-related training and consulting assistance to several small manufacturers. HRCS is now undertaking to apply the model with additional groups of companies, including several small manufacturers in Vancouver. Key features of the model include:

- facilitating a collaborative approach for sharing training and consulting resources among clients
- working with client senior management to develop a TQM implementation approach that reflects the company's culture and environment
- providing an initial team development workshop which introduces TQM principles to employees, and gives them teamwork, measurement and problem-solving tools for continuous improvement
- engaging all levels of management and supervisory staff in a Managing in a Total Quality Environment program to help them to deal with the change that will have begun in their companies
- assisting in the development of a Cost of Quality system, enabling companies to measure progress and identify opportunities for continuous improvement

- providing clients with facilitator services for the change process; ensuring that teams are functioning well and that management is adapting well
- assisting the progression to subsequent stages of TQM which could include their own supplier certification program and ISO 9000 registration.

Communicating with Novacor Employees about Total Quality

by Bob Freeborn, Director of Total Quality Management
Gail Holbrook, Senior Continuous Improvement Advisor
Herman Hulshof, Manager of Employee Communications
Novacor Chemicals Ltd.

The Company

Novacor Chemicals Ltd. is a wholly owned subsidiary of NOVA Corporation, with headquarters in Calgary, Alberta, and 3 000 employees. The company is a major North American producer of petrochemicals such as ethylene, propylene and styrene, and plastics such as polyethylene, polystyrene and polypropylene. Its nine manufacturing sites are located in Joffre, Alberta; Sarnia, Ontario; Montreal, Quebec; Marysville, Michigan; Springfield, Massachusetts; and Decatur, Alabama.

The corporation's vision is to be "The best natural gas services and petrochemicals company — integrated, worldwide." In order to achieve this, Novacor needs to undergo change and Total Quality Management (TQM) will help achieve that.

The Challenge

Novacor Chemicals Ltd. today is a combination of eight different companies that were acquired over the past 15 years. Each company brought to Novacor its own history, culture and way of doing things.

In early 1992, TQM initiatives across the company could be best described as jigsaw puzzle pieces waiting to be put together into a coherent picture. Quality initiatives in four of the businesses were quite sophisticated and appropriately linked to a vision or a mission. They had drawn their expertise from such masters as Deming, Juran and Crosby since the mid- to late 1980s. In the other businesses, there was little awareness of TQM concepts.

In late 1991, NOVA restructured and set up the Novacor Chemicals Division. The businesses within the Chemicals Division were not a cohesive group and were not working together toward a common goal. The challenge was to unite them.

The newly appointed quality manager and the Novacor executive group spent two days in spring 1992 to develop a mission, renew the management philosophy and pull together a commitment to quality **(Exhibit 1)**. The commitment was focused on satisfying our customers' expectations through a

COMMITMENT TO QUALITY

We at Novacor are committed to supplying products and services which satisfy the quality expectations of our customers. We will foster a culture that practises continuous improvement to achieve our objectives of successful and satisfied customers, motivated employees, profitable growth, competitive advantage and business leadership.

John E Feick

JOHN E. FEICK
On behalf of the Management Committee

Novacor

Exhibit 1 — Novacor Chemicals Ltd.

continuous improvement culture, embraced by all employees. For that to happen, a high degree of quality awareness and understanding among all employees would be required. This article focuses on the communications initiative undertaken to generate this awareness and understanding.

The Communications Initiative

An initial employee communications program was unveiled in summer 1992 to share with everyone Novacor's new mission and our commitment to quality. The management philosophy and our Responsible Care[R] commitment were also reinforced. A video was produced in which five members of the management team answered employees' questions about these initiatives. Copies of the new documents were framed and prominently placed in the offices and manufacturing sites.

Meanwhile, the quality manager had formed a Quality Council to exchange information and learn about implementing the mission, quality commitment, quality concepts and practices within the new Novacor. The council, comprised of employees from across North America who were involved in quality assurance, training, ISO 9000, etc., was a sounding board as the new and improved quality jigsaw pieces were put together.

Throughout 1992, the quality manager worked closely with the executive team to educate them about the organizational and behavioral changes required throughout the company to achieve quality thinking and practices. Considerable time was spent pulling together the quality concepts that would drive our new approach to satisfying customers' quality expectations. There was close interaction with all the businesses to ensure full understanding and acceptance of these concepts. In September 1992, all concepts gathered from executives and employees at the different sites were presented to the management team in a cohesive manner to ensure that we covered everything.

It was now time to educate the employees and communicate with them so they fully understood what quality in "the new Novacor" was about, and the role that each person must play.

We wanted to ensure that the new quality concepts were seen as fundamental to how we would operate, and that they would impact all employees, regardless of their knowledge level. While management would lead the initial presentations, it was important that whatever we developed, anyone within our company could present it.

The quality concepts were extensively discussed and revised with the executive team and presented to the Quality Council for feedback. A communications plan, featuring an interactive workshop in which employees would learn and share, was then developed. We knew a traditional top-down approach would not succeed.

A consultant was hired to develop material for an interactive, face-to-face workshop. We tested the half-day workshop on two focus groups, primarily finance and research staff. We were sent back to

the drawing board after the employees told us they were bored and the material lacked impact. They wanted to see how the many initiatives under way at the time all tied together. Novacor was in a state of flux, and employees were asking, "How do Fair and Equal Treatment, Teamwork, ISO 9000, re-engineering, and Responsible Care® all fit together . . . or, even, do they?"

The various components were broken down into three key areas — empowered employees, customer focus and process improvement. Key elements in each area are shown in **Exhibit 2**. All were tied together using an arch as the framework (**Exhibit 3**). As the president described it, "The arch is a bridge that supports the road to continuous improvement."

To complement the workshop content, a video was produced in which the arch is built, using blocks representing the components of Novacor's TQM process. The video's script and setting are informal and represent a major shift from our more traditional conservative approach to communications. Only key statements for each component are made, so that the audience will retain the message. Our president appears in the video, inserting the final block of the arch. The video was tested with focus groups of employees at several locations prior to use.

In addition to the video, internal staff wrote the detailed workshop material. Under the heading of Superior Results through Customer Satisfaction, content included The Changing World, What Is Quality, Novacor's Quality Model (empowered employees, customer focus, process improvement) and Continuous Improvement. Workshop leaders are employees from any level of the company. During the workshop, employees are challenged to ask questions, share issues or concerns and discuss solutions.

Most importantly, participants must develop their own Personal Action Plans, including goals and tasks in the three areas of empowerment, customer focus and process improvement. Each employee's Personal Action Plan is discussed with his or her team leader and co-workers. Progress towards meeting these plans will form part of the employees' ongoing professional development process.

The workshops are being implemented in Novacor's different businesses, using a phased approach, during the first two quarters of 1994. To generate interest in the workshop, each employee receives a personal letter from the president and a brochure capturing the workshop highlights. Other publicity includes posters announcing the workshop and a display of the actual arch in the lobby of our headquarters.

The Results

Employee feedback, collected at the end of each workshop, has been mostly positive. Initial results indicate that the workshops provide employees with a better understanding of the importance of quality, and the changes needed to achieve superior quality. They have generated discussion among management and employees about quality, empowerment, customer focus and process improvement.

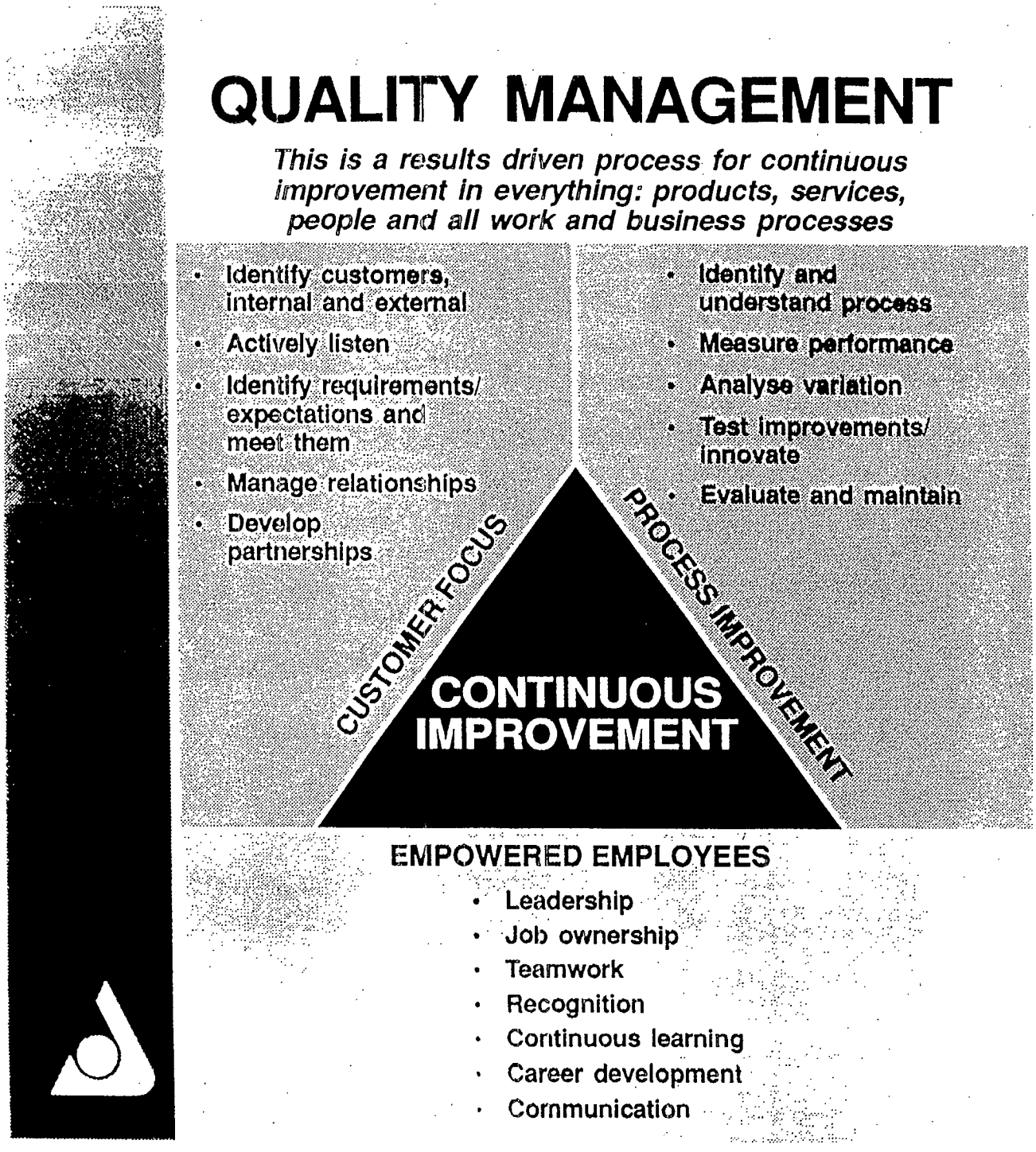

Exhibit 2 — Novacor Chemicals Ltd.

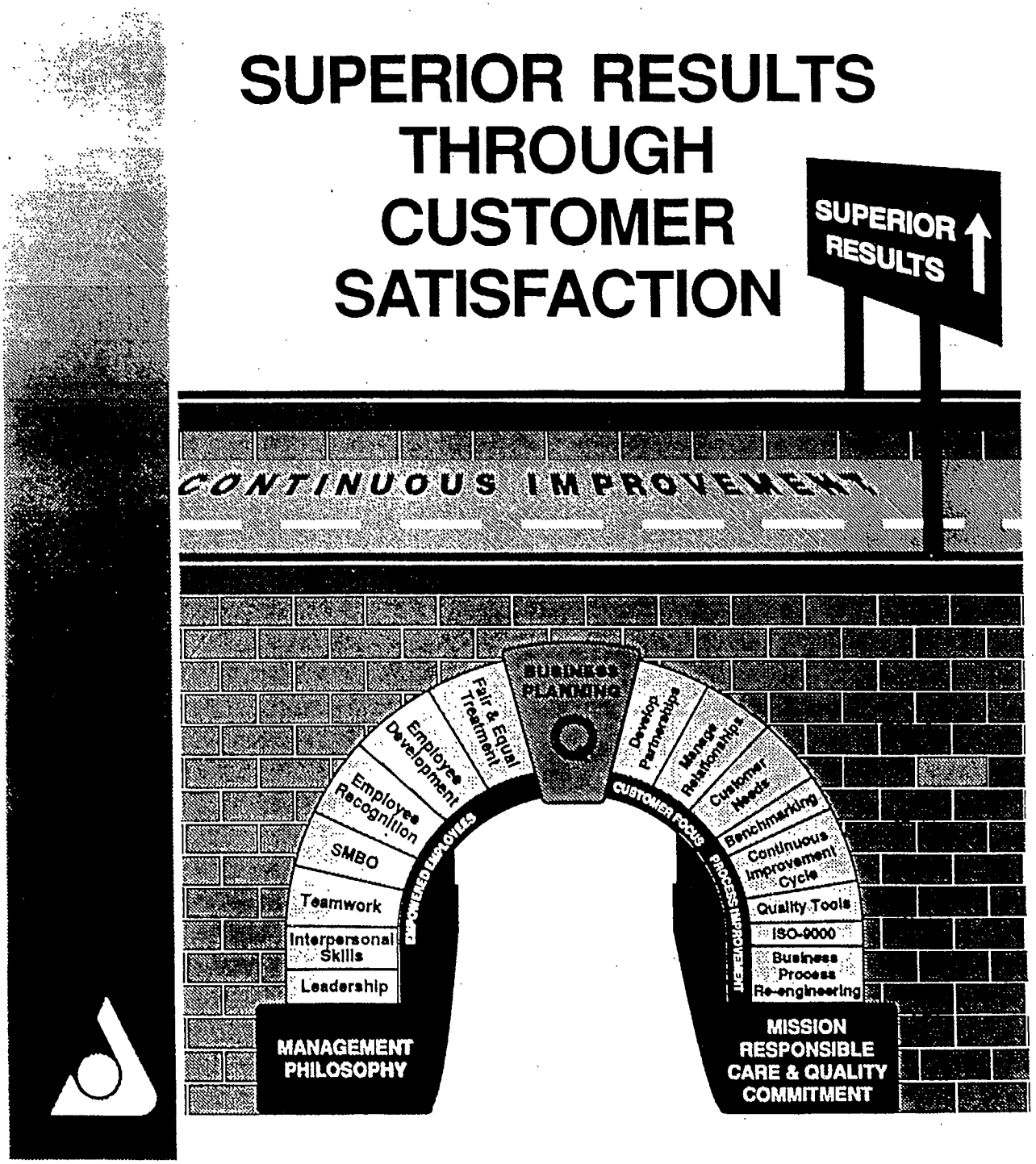

Exhibit 3 – Novacor Chemicals Ltd.

Understandably, implementation of the workshop has not been given the same priority in all businesses. Based on the results to date, however, the jigsaw pieces are now being put together as part of the complete picture for the new Novacor.

Future Plans

Novacor conducts an employee climate survey every two years. The next survey, scheduled for the end of 1994, will include examination of the medium-term impacts of the workshops, e.g., the extent to which the new approach has helped break down barriers between management and employees, resulting in better two-way communication; Are employees thinking in a new way about the work that lies ahead?; how to do it in a team environment; how to work more closely with internal and external customers; and how to be more efficient and improve our work processes.

As Novacor works to become more customer-focused, ongoing education and communications will continue as new pieces are added to the jigsaw puzzle. Also in the near future, we want to measure our quality performance and to develop a continuous strategic planning process.

We have already had many successes with TQM. Within our new culture of employee recognition, we plan in 1994 to say thank you to those employees who have contributed to successfully completed continuous improvement projects.

Now that NOVA has a new vision, Novacor is planning and implementing changes to allow the company to be "the best" as described in the vision. TQM will help us get there.

A Customer-oriented Culture for Long-term Customer Satisfaction

by P. David Douse, Vice President
Uniplast Industries Inc.

The Company

Uniplast Industries Inc. is an international producer of a broad and innovative range of plastic films. The company began in 1984 with two polyethylene blown film extruders and has since expanded to operate more than 30 mono, cast and co-extrusion lines throughout North America.

The products produced at Uniplast include laminating film for food packaging, shrink film for bundling items such as soft drink and pet food, converting films for bags, skin packaging film for protection and display of hardware, multilayer films for sophisticated food packaging and cast embossed films for diapers and sanitary napkins. There are four manufacturing facilities with annual sales of over $60 million that ship products throughout North America and as far away as the Caribbean, South America and the Far East.

Corporate Culture and Total Quality Management

The exciting growth at Uniplast Industries Inc. has been a result of strong and dedicated leadership that has focused on achieving long-term customer satisfaction. From the very beginning, the corporate culture was such that everybody understood that the customer was and is, and will forever be, the reason the company is in business. All employees share the responsibility for quality and productivity through awareness and commitment to customer needs. Today's customer wants more than conformance to requirements. Quality at Uniplast is where products and services exceed the customers' expectations.

Total Quality Management (TQM) can take many forms, from formalized programs with buzz words and the latest quality fads to the informal day-to-day, customer-oriented approach. The latter most accurately reflects TQM in our company. Perhaps the advantage of being small in the early days made communications and training easier, achievements more visible and change a way of life. Always, the customer needs were given the highest priority.

In subsequent years, this foundation for TQM was built on, through continued leadership, coaching and employee motivation and recognition by management, and by ongoing goal-setting and measurement of results. Product development was recognized more as a core business activity rather than just

a support function. The overall result is a high quality and innovative product line, and a continually growing and loyal customer base.

Uniplast encourages all its employees to strive for superior quality in everything they do — dealing with our customers, with our suppliers and with each other. The following are some typical examples of how Uniplast's TQM philosophy has been reflected by the actions of Uniplast employees when they react to customer challenges and requests.

Solving a customer's film tracking problems:

A customer called us to relate film tracking problems they were experiencing on their bag machine and which they thought were due to a film defect. Our production supervisor surveyed our production reports and retained samples from the order and found everything to be well within specification. He talked to the customer's machine operator and, because of his past experience with bag machines, suspected a machine problem rather than a material problem.

The problem was solved by our production supervisor driving four hours that night to the customer's plant to fix the problem with the bag machine. We not only kept the business, but we actually improved the customer's process and solidified the supplier/customer relationship for long-term mutual gain and respect.

Avoiding unavoidable production delays:

An extruder is essentially a screw in a heated barrel that melts, homogenizes and transports plastic pellets before the molten mass is forced through a die to form the final film product. The screw is a solid steel, auger-like precision designed component that is manufactured to plus or minus two thousands of an inch tolerance. A few months ago, during the busiest part of the year, the screw on our biggest line started to fail on a Friday afternoon. This particular screw measures 11.43 centimetres (4.5 inches) in diameter by 2.74 metres (9 feet) long and weighs in excess of 226.8 kilograms (500 pounds). There were no screws available at any manufacturers and we could not afford a minute of downtime because of pending orders.

Our CEO met with Manufacturing and Maintenance to define our needs, personally made many phone calls and found a similar screw at a competitor's plant that was not required right away. Our screw supplier retrieved the screw, machined it to our specifications through Friday night and Saturday morning, shipped it back and we were running by early Saturday afternoon.

The cost of Friday and Saturday's events was minute compared to the over $1 million worth of business that our customer would have lost if we had been down much longer. Management leadership, employee involvement and a focus on the customer enabled us to get back into production and prevent a catastrophe for our customer.

Customer-focused product development:

Product development has always concentrated on improving present products as new technology emerges and searching out new and more innovative applications. The customers are at the centre of the development picture because it is them that ultimately have to use our product and benefit from the advantages of superior quality, cost effectiveness and custom design.

As products become more sophisticated, processing parameters and quality control specifications become increasingly more critical and narrow. The whole product mix has benefited because the attention to detail required for the high-end products is translated to normal quality practices for all products. The result is a broad range of materials, even the so-called commodity films, that we believe are a premium over the competition. Reliability, achieved through continuous improvement of manufacturing practices and quality control, gives the customer complete confidence in our film product.

Summary

The above examples are representative of our total quality philosophy. There are many other initiatives at Uniplast that further advance this philosophy in our company. Absolute on-time deliveries at any cost, small cash awards to employees as often as necessary for special successes and ideas, strategic planning, customer complaint analysis and prevention, as well as continually charting and reviewing productivity and quality improvement.

While these initiatives are part of the TQM equation, it still remains a fact that unless the whole Uniplast team is focused on exceeding customers' needs and expectations, Uniplast cannot expect to earn long-term success in the plastics industry.

Part 4

Process Improvement Using the Total Quality Approach

Part 4

Process Improvement Using the Total Quality Approach

Overview

The articles in this Part focus specifically on a variety of process improvement projects dealing with manufacturing, office related and environmental processes.

Several success factors are identified in the descriptions of these projects, including clear identification of the problem or improvement opportunity (including objectives, scope and customers), use of multifunctional teams (including people working in the process, their suppliers and customers, and persons with specialized knowledge), adequate training of team members, management support, sufficient resources, project planning, suitable performance measures, an iterative problem-solving approach, along the lines of the Deming cycle of plan, do, check, act, and finally, a clear process for solution implementation and monitoring.

The tangible results reported include reductions in costs, cycle time and environmental impacts as well as increased product, process and service reliability. Less tangible, but of great importance, were the reinforcing effects that successful projects had in moving toward a total quality culture.

The articles in this Part are summarized below:

Using TQM to Improve Environmental Quality and Reduce Costs: Ashland Chemical Canada Ltd. applies its total quality principles to all its processes, including manufacturing and environmental, health and safety operations. This article describes how Ashland used the total quality approach to plan and implement a waste reduction system that improved both environmental and financial performance. The waste incinerator described in this article removes solvents and other materials from the waste stream and generates a significant fraction of the plant's fuel requirements. The total quality approach ensured adequate stakeholder involvement and measurement to support continuous improvements.

Continuous Improvement Process Teams at Canada Colors and Chemicals Limited: The quality process at **Canada Colors and Chemicals Limited** has been strongly influenced by the Deming approach. Key elements include a strong customer focus, coupled with elimination of waste throughout the organization. Over 27 Continuous Improvement Teams, involving 133 employees, have been improving the company's business processes. This article describes two examples — reduction/elimination of credit notes, and ensuring the accuracy of customer codes on packages. Other developments include achievement of ISO 9002 certification.

Statistics within a Total Quality Management Environment: As markets continue to globalize, **Canada Cup Inc.**'s challenge has been to remain competitive. The use of Statistical Process Control (SPC) within a total quality environment has been critical to achieving this, through continuous improvements in manufacturing processes. Examples are given, showing how teams have used SPC to understand the voice of manufacturing processes. These include injection moulding cycle time reduction, increased process stability and reduction of weight and scrap. These and similar projects have resulted in major productivity increases for the company.

Starting Out Right — Effective Beginnings to Process Improvement Projects: One of the most difficult phases of a process improvement project is the start-up. This article describes the approach taken by **Glaxo Canada Inc.** to initiate projects to maximize their success potential. Team members need to define the goals of the project and acquire the problem solving and teamwork tools necessary for achieving them. Efforts are made to build on these skills throughout the project, and this is where an expert facilitator can play a significant role. A successful improvement project, involving turnaround time reduction for clinical trials data management, is also described.

Statistical Design of Experiments Contributes to Quality at Monsanto Canada's LaSalle Plant: One of the most powerful process improvement methods used by Monsanto Canada is the statistical Design of Experiments (DOE). DOE can be applied to both manufacturing and non-manufacturing processes and, when successful, can produce improvements of 50 to 200 percent. Because these improvements require changes to policies and procedures, DOE is a tool for management. Senior management must understand the process to ensure effective use of DOE and implementation of results. This article provides an overview of DOE at Monsanto and discusses two examples of its application.

Use of Multidepartmental Teams to Solve Problems: During production of one of **Uniroyal Chemical Ltd.**'s crop protection formulations, a sudden increase in variability of percent active ingredient occurred. This resulted in significant rework and retesting and, subsequently, increased costs and delays in customer deliveries. This article describes how a multidepartmental task force analyzed and subsequently solved the problem. A number of methods contributed to the solution, including brainstorming, cause and effect diagrams, laboratory testing and statistical techniques. Several small problems were identified and eliminated, resulting in increased capability to produce a consistent product.

Using TQM to Improve Environmental Quality and Reduce Costs

by Roland Blondin, Operations Manager
Ashland Chemical Canada Ltd.

The Company

Ashland Chemical Canada Ltd. is a specialty chemical company that produces chemicals for Canadian industry and global export. Ashland has established a reputation for providing products and services of high value to its customers.

In 1973, Ashland relocated to its current site in Mississauga, Ontario. This plant serves customers in the foundry, paint and coatings and fabricated plastics industries. Ashland has focused on specialty polymer technology to meet the particular needs of industry partners. The company also provides numerous other products and services to complement their product lines.

In 1981, the Industrial Chemicals and Solvents Division also relocated to the Mississauga site, later opening a second distribution centre in Boucherville, Quebec, in 1983. This was followed by expansion into the specialty chemicals market for the pharmaceutical, cosmetics and food industries in 1988. That same year marked the entry by the General Polymers division into the Canadian market as a distributor of thermoplastics resins.

Overview of Our Total Quality Process

Quality and consistency of product performance are the outstanding features of Ashland Chemical Canada Ltd.'s reliable products. This has earned the company numerous product quality accreditations since the early 1980s. Continuous improvement and ISO 9002 certification for our manufacturing facilities ensures worldwide recognition of the company's quality standards.

Quality Plus, Ashland's Total Quality Management (TQM) principles are based on its commitment to develop, produce and deliver on time, competitive products and services that are totally acceptable to our customers. This philosophy controls all aspects of our operation including leadership, management systems, manufacturing, accounting and control systems, and customer activities. It includes continuous improvement through employee involvement and teamwork to monitor and improve our processes. The goal is to establish the quality required to meet our customers' needs at acceptable costs while continually improving productivity.

While our initial TQM focus was on product and customer satisfaction, it was evident that we could not operate only one part of our company on quality principles. The TQM approach was therefore expanded to other areas of our operation, including maintenance, attendance, safety and waste reduction.

TQM and Environmental Quality

Our environmental, health and safety commitments, through the chemical industry's Responsible Care® initiative, for example, are a fundamental part of our TQM process. Our employees and residential neighbours are our customers in this area. The same essential elements of TQM, namely, focus on customer satisfaction, management leadership, employee involvement and satisfaction, and continuous improvement are just as necessary in environmental quality as they are in product quality. Our incinerator is one example of how continuous improvement has been used successfully throughout the facility.

When we moved to Mississauga in 1974, our operation was located in a rural setting. In the next 10 years, this area changed into a largely residential neighbourhood to the north and west of our operation. Odours which were tolerated in unpopulated areas in the early 1970s were no longer acceptable by the mid-1980s.

In 1986, the Ministry of the Environment approached us about the need to install an incinerator to capture emissions from our manufacturing operation. During this period, we were also experiencing a rapid increase in the cost of liquid waste disposal. A local incinerator had ceased operation, causing us to ship our liquid wastes to Sarnia, Ontario, for incineration. Consequently, both disposal and transportation costs were increasing dramatically.

Project Initiation and the Design Phase

To successfully implement this project, we had to satisfy many different stakeholder needs. Ministry officials had their own priorities, which were focused on odour reduction in the area. Residents were not only concerned about odours, but also had negative impressions of incinerators arising from poorly run apartment incinerators. They were also concerned about transportation of hazardous wastes through the community. Management was concerned about the high initial cost and significant operating costs which would be required. Employees were concerned that the changes in operations would limit operating flexibility and about potential safety problems arising from attaching an incinerator to our vent lines.

In late 1986, we began discussions with the Ministry of the Environment on installation of a liquid/vapour incinerator at our site. The proposed incinerator would capture process vapours, thus addressing the neighbourhood concern regarding odours. In addition, we sought to address a further problem — our liquid wastes. By incinerating these wastes on site, we could reduce the hazard of

liquid waste transportation. Cost reduction in waste disposal would help justify the project. We also planned to burn spent solvent as fuel, and recapture the energy required for incinerator operation through a heat recuperator (waste heat recovery system). This energy could be used in our manufacturing process.

The primary focus was always on the technical requirements to ensure safe operation and complete combustion. Employees were involved in the design stage to ensure confidence in the protection devices required during normal and abnormal conditions.

Key public officials and environmental activists were involved early in the process to gain their acceptance and support for a system that would ultimately reduce the environmental and safety concerns of our neighbours. By working together with the Ministry of the Environment, city officials and residents, we were able to receive approval in 1987 for construction of the incinerator. Operations began in the spring of 1988, with proof of operating efficiency achieved later that year.

Incinerator Start-up and Improvement Actions

Typical of most start-ups, where complex interactions of different systems are involved, we had our share of initial problems. Most of them related to the protection system's sensitivity to changes in volatile solvent and oxygen contents of the feed supplies to the incinerator during process operations and the responsiveness of the protection devices controlling incinerator operation.

Initially, start-up involved fine-tuning the system and training plant employees in procedural changes required to minimize upsetting the air and vapour feeds to the incinerator. Some issues were obvious and easily resolved. Others required considerable systematic problem solving to establish root causes. Employees used their previously acquired brainstorming and problem resolution training to address these issues. We began graphing downtime to get a clearer picture of both frequency and duration of failures. Extensive downtime was the initial concern as problems were not always quickly solved. Identifying basic causes, rather than the more obvious effects, was initially time-consuming. As we became more proficient in identifying root causes quickly, the duration of failures decreased rapidly.

With procedural issues becoming less of a problem, we then focused on the frequency of control equipment failures. These were much harder to resolve and ultimately required computer-based monitoring of the exact operating conditions in various parts of the system at the time of failure. Again, through root cause analysis, brainstorming and teamwork among plant and maintenance personnel, each individual failure was traced to its root cause. Because of the extreme sensitivity of the failure detection system, minor variations in its response characteristics would signal a potential problem and cause emergency shut-down. Identifying the exact cause of these failures established the need for more sophisticated control and detection systems.

Run charts and Pareto charts were key tools used in monitoring and analyzing failures, allowing us to focus on issues by priority. Maintenance employees were assigned the responsibility to resolve issues related to equipment failure, with engineering staff acting as advisors. Equipment modification, computer analysis and control system changes all resulted from employee problem resolution efforts. Employees collected data, plotted and submitted monthly graphs summarizing operating status, improvement and analysis of problems.

Management's role was one of support, having provided the initial training in basic quality concepts, graphing and problem resolution techniques and the team approach to problem solving. To ensure changes met basic guidelines, management was kept aware of progress and proposed changes through the normal channels. Details on how to resolve issues, what changes to make and selection of appropriate equipment were the responsibilities of the maintenance project group.

Results

As with most projects we undertake, the results of continuous improvement came slowly at first but accumulated with time. By combining a series of problems and objectives into a single project, we managed to achieve significant improvements.

Volatile organic compound emissions from our site have decreased 85 percent as a result of the incinerator operation. Operating reliability in 1993 has increased to 99.8 percent of incinerator operating time. **Figure 1** shows the year-to-year trend in incinerator reliability.

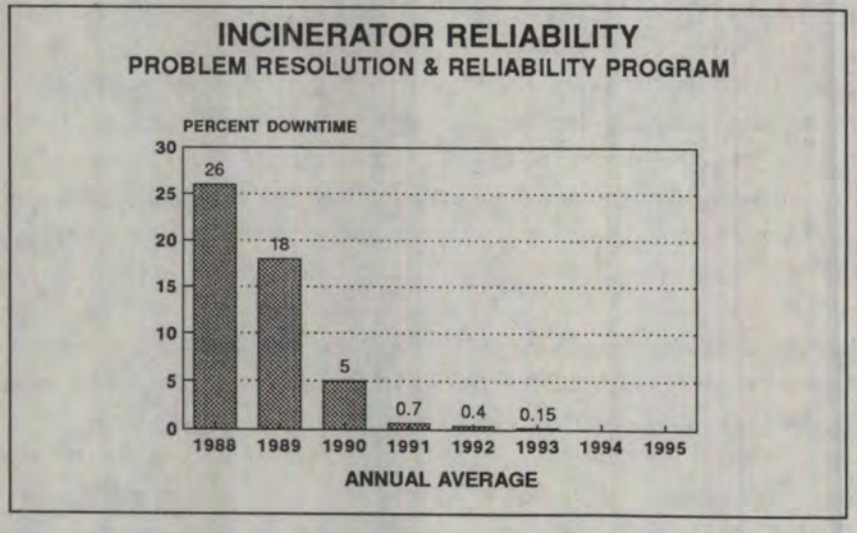

Figure 1 — Ashland Chemical Canada Ltd.

Most of the energy used by the incinerator is derived from the volatile organic compounds and spent solvents being incinerated. Previously, these waste materials required incineration at a site several

hundred kilometres away. We are now able to incinerate these waste streams at virtually no additional fuel cost. Furthermore, savings from avoided transportation and off-site incineration more than offset the cost of natural gas required to incinerate the vapours drawn into the incinerator from various points in our process. These savings offset over 65 percent of the total fuel requirements for the entire facility. The relative size of the savings resulting from these factors and their relationship to total fuel costs are shown in **Figure 2**.

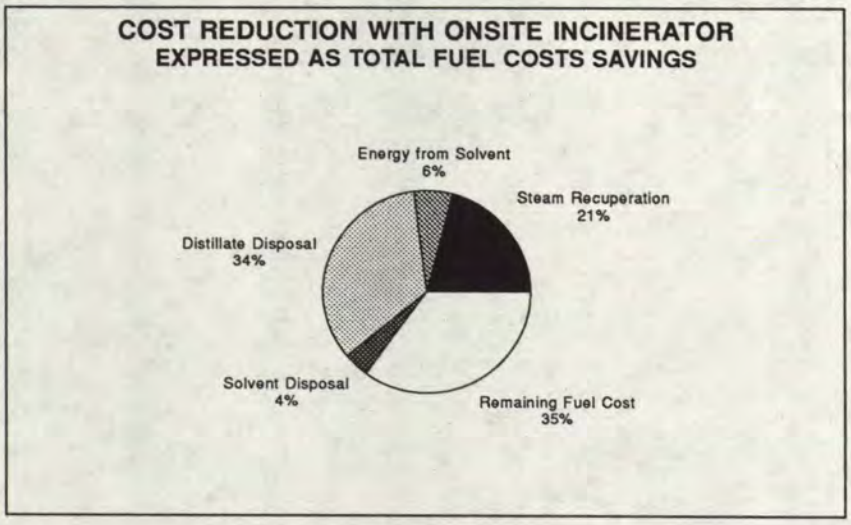

Figure 2 — Ashland Chemical Canada Ltd.

Further Improvements

In 1992, we began applying the same monitoring and graphing techniques that we apply to our manufacturing processes to fuel consumption on all users in our operation. **Figure 3** shows the relative fuel consumption requirements of major use categories. Through the monthly monitoring of fuel consumption and implementation of a burner calibration program, we have seen the same type of improvements noticed elsewhere in our operation every time we begin measuring any parameter. Gas consumption for equivalent energy requirements was reduced by 27 percent from the previous year on our incinerator and other users. We are now searching for low energy users to justify further energy retrieval from our stacks.

Steam generation consumes over 20 percent of the plant's overall fuel requirements. By installing a heat recuperator in the incinerator stack, we capture energy to generate steam for our process needs, thus reducing the requirements for additional energy elsewhere in our operation. We are thus able to keep our main steam generator as a stand-by unit, generating steam mainly from our waste heat source.

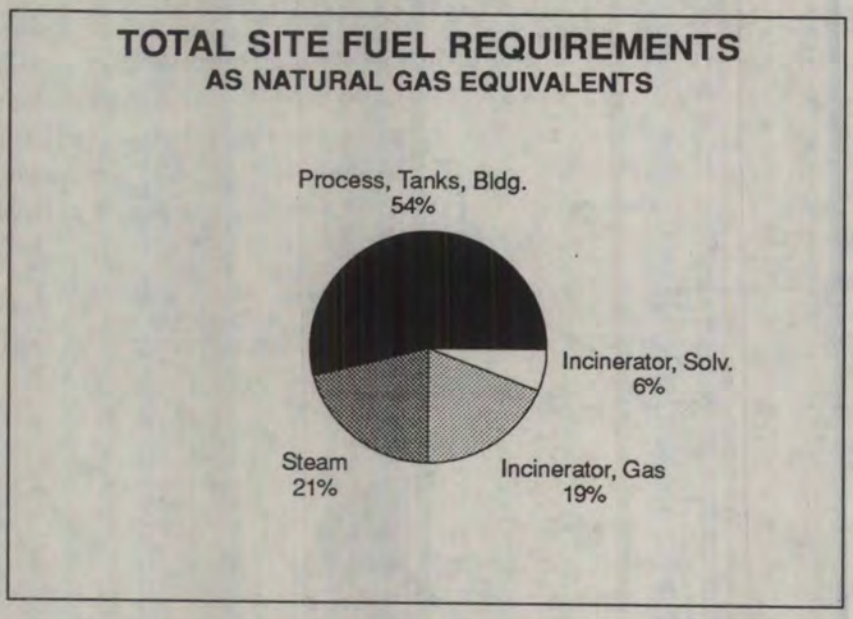

Figure 3 — Ashland Chemical Canada Ltd.

Conclusion

The problem resolution process is the essence of continuous improvement. By searching for and focusing on the basic cause of a problem, we enable change to take place. Monitoring progress by graphing performance characteristics also plays a key role. A simple, easily understood graph, representing what one is trying to improve, provides everyone with an instant picture of the progress being achieved. This is the verification step in the continuous improvement cycle.

An additional benefit, which we have seen repeatedly, is that the act of monitoring brings about improved performance, without any changes being made to the process. Once everyone knows there is a problem, that management have defined what is expected and that progress is being monitored, everyone is more conscious of the need and improvement occurs automatically. This often comes as a surprise to those beginning to use continuous improvement techniques but is actually a commonplace occurrence.

A systematic approach to problem solving and progress monitoring are essential to continuous improvement. Teamwork brings ownership to problems, speeding up the resulting solutions. Involving the operating personnel and giving them the authority and responsibilities to solve their own problems, provides ownership and pride in resolution of the issues. When all the groups relevant to a problem or solution work as a team, the solution is usually simpler, less costly and more effective.

Continuous Improvement Process Teams at Canada Colors and Chemicals Limited

by Vern Wilson, Vice President, Chemical Distribution Division

The Company

Canada Colors and Chemicals Limited was founded in 1920. Its primary business is the distribution of chemicals and plastics to many different industries throughout Canada including plastics, paints and coatings, chemicals, food and beverages, soaps and detergents, and specialty chemical compounding. With annual sales of $160 million, Canada Colors and Chemicals is one of the three largest full-service distributors in Canada and the tenth largest in North America.

The company provides a fully integrated logistics and selling service with distribution facilities in Toronto, Montreal and Vancouver and sales offices in Calgary, Edmonton, Winnipeg, Windsor and Dartmouth, supported by independent warehouse services. Our plastics compounding plant, located at Colborne, east of Toronto, produces colour and additive concentrates and polyvinyl chloride (PVC) compounds. Our Elmira, Ontario, plant manufactures sulphuric acid and oleum. The company employs a total of 280 people, including a sales and marketing complement of 50 technically trained professionals.

The Beginning of our Quality Journey

In 1988, our corporate management committee agreed to investigate quality as a process. Over the next few months, various approaches were examined, including those provided by Deming, Conway, Juran and Crosby.

Bill Conway, through Canadian affiliate John Petrie, provided an approach that was consistent with our corporate culture and management philosophy. In the early 1980s, Conway was the first CEO (Nashua Corporation) to use Deming as a consultant. Conway's approach provides a strong customer focus coupled with elimination of waste in all parts of the organization.

A Quality Council, consisting of senior management and led by the president and CEO, was formed in 1989. Over the next four years, the council undertook or supported many activities within the company's Total Quality Management (TQM) process, including:

- leadership training of managers and supervisors
- customer satisfaction survey
- employee survey
- development of a mission statement
- just-in-time training of all employees in process improvement tools
- formation and operation of Continuous Improvement Process (CIP) teams.

This article focuses on the role of CIP teams at Canada Colors and Chemicals. Our process for mobilizing teams and two examples of CIP team projects are described below.

Continuous Improvement Process Teams

Over the years, the criteria for CIP teams have evolved. In general, the team should have four to eight members, including a leader and a facilitator. Its mandate must be related to improvement of customer service or elimination of waste, and must be measurable. Initially, teams had to be approved by the Quality Council. Although no team was ever turned down, this has been changed in response to employee feedback. Individual members of the Quality Council can now approve CIP teams.

The sponsor of a team, a member of the Quality Council, must be involved with the development of the team mandate and be committed to it so that he or she can ensure that the needed resources are available. The mandate can change as the team undertakes the project. We have found that as data are collected and analyzed, the team will sometimes change its definition of the problem.

As the team progresses, the sponsor can help with people and organizational issues. Finally, he or she can provide advice on gaining acceptance of the team's recommendations and on implementing them.

Two examples of how CIP teams have enabled us to increase our level of service quality are discussed below.

Example One: Reduction/Elimination of Credit Notes

The first CIP team at Canada Colors and Chemicals was formed to reduce and ultimately eliminate credit notes. These are credits issued to customers against the original invoice and are usually a result of an incorrect price being charged for the product. Causes can include failure to communicate price increases, clerical errors, lack of availability of current pricing and price support situations by suppliers. The team was facilitated by our consultant and the team sponsor participated as an observer. The team members were drawn from the functions which could cause credit notes, including sales, credit, customer service (order entry), marketing and management information services (MIS).

The team started by identifying all causes for credit notes. The frequency of each cause was then identified and analyzed with Pareto charts to focus on the one or two issues which created the most credit notes. During the course of the team's work, it determined that the cost to the company for each credit note was approximately $150. We were generating 80 credit notes per month, resulting in an annual cost to the company of $144 000.

As the team studied the matter, some quick fixes were developed, such as price verification with the customer at the time the order is taken. Ultimately, other solutions were recommended. These included asking suppliers for longer lead times on price changes, more timely maintenance of quotations by the sales department, and improved communications of price changes from sales to customer service.

During the early stages of implementing the CIP process within the company, just-in-time training, provided during team meetings, played a very important role. Training covered the team process and the tools for analysis and solution of the problem. It was felt from the outset that this was the most effective way to train the employees. Over time, as more employees learned the CIP process, new CIP teams often included members who already received training. Employees now receive much of their training outside the team meetings in order to speed-up the overall CIP process and avoid unnecessary repetition of training.

With the implementation of the team's recommendations, the number of credit notes was reduced to about 30 per month, resulting in savings of $90 000 per year in unproductive employee time and other expenses. Since the completion of the team's work in 1990, the number of credits has continued to be monitored. Interestingly, they have never gone below 22 per month and, at times, have risen. Analysis of this situation has resulted in either new causes or breakdowns in existing processes being identified, and corrective actions being taken.

Example Two: Ensuring the Accuracy of Customer Codes on Packages

This team was formed to ensure that product was shipped with the correct customer codes applied to the package. Many of our chemical industry customers use their own code numbers to identify chemicals and ask us to apply them to the package before shipment. If we apply the wrong code number to the package, the customers can experience significant loss of their product. The cost to our company can be significant, even if the customer recognizes an error has been made before using the product. We must still reship the correct product, pick up the previous shipment and issue a credit note.

If an incorrectly labelled product is used by customers, we can incur liability for some of their expenses. The cost of quality in this case is difficult to quantify, but could be many thousands of dollars in cases where additional liability is incurred.

A CIP team was formed which included representatives from customer service (order entry), warehouse and MIS. The team produced two flow charts illustrating the processing of an order from the time it is received to the time when the goods are delivered to the customer. These two flow charts described the existing process and an ideal process respectively. During a brainstorming session, the team identified as many reasons as possible as to why incorrect code numbers could be placed on packages shipped to a customer. Those reasons which could be controlled by the company were subsequently addressed.

Corrective action was taken in a number of ways. A quick fix was identified; products requiring customer codes would be highlighted on the customer quotation. Additional corrective action included working with our customers to review all customer codes in our computer system for accuracy. We also took preventative action by linking all customer code numbers within our computer system to specific product codes used by Canada Colors and Chemicals, thereby allowing the customers to order using their own codes.

As a result of this project, the incidence of incorrect customer codes on packages was reduced to near zero. Recommendations were also made to help warehouse employees avoid applying incorrect data.

The TQM Process Continues

As of the end of 1993, approximately 50 percent of our employees had participated in CIP teams. There have also been many other team activities that have addressed opportunities on a less formal basis.

The CIP team process, itself, also undergoes continuous improvement. We have improved the criteria for CIP teams, the role of team sponsors, the project approval process and overall team effectiveness. These changes have been based on input from everyone involved, both through team recommendations and employee surveys.

The quality process continues at Canada Colors and Chemicals. In 1993, four of the seven locations obtained ISO 9002 certification. The remaining three will follow in 1994.

Also in 1993, compliance with the Canadian Chemical Producers' Association's Responsible Care® initiative was achieved. This initiative, which is based on a commitment to manage chemicals in a responsible manner throughout their life cycle, is a logical one to be managed using the continuous improvement philosophy.

It has been said elsewhere — "Quality is a journey, not a destination." It will be a part of Canada Colors and Chemicals culture for years to come.

Statistics within a Total Quality Management Environment

by Bob Clark, Executive Director of Quality/Service
Angelo Devera, Statistical Resource Specialist
Canada Cup Inc.

The Company

Canada Cup Inc., a James River Corporation Company, is a leading marketer and manufacturer of consumer products, food and consumer packaging. James River brand names include Northern[R] tissue, Brawny[R] paper towels, Dixie[R] plates and cups, Fiesta[R] cutlery, etc. There are five Canadian manufacturing facilities located throughout the country, supplying domestic as well as export markets as far away as Hong Kong.

The Statistics Initiative

Canada Cup Inc.'s first formal exposure to statistics was through Dow Chemical Canada's Alliance for Excellence program, a customer focus initiative which was part of Dow's Continuous Improvement effort. In early 1990, Dow dedicated 50 percent of a technical consultant's time to launch and sustain statistics at our injection moulding plastics facility. As part of this initiative, employees received training in Statistical Process Control (SPC), team dynamics and project planning and execution.

This effort became the genesis of Canada Cup's Service/Quality (TQM) launch in early 1991. Statistics took a back seat as we focused on planning and deployment. Leadership skills development, employee awareness, process management, process improvement, problem solving and facilitation were the focus for the next 18 months. The infrastructure for the expansion of statistics was then created. A statistical resource person was appointed and coordinators were chosen at each of our facilities. These people became resources in the use of statistical tools to support continuous improvement efforts.

Our statistical efforts have been geared toward cost reduction and continuous improvement of our manufacturing processes. We have implemented basic statistical tools to understand the voice of the processes in various technologies. Projects were identified in each plant, dealing with issues such as cycle time reduction, process stability and reduction of scrap and weight. Statistical training was introduced using the Kaizen just-in-time concept.

Below we summarize three representative SPC projects undertaken to achieve process improvements.

Injection Moulding Cycle Time Reduction and Attribute Chart Expansion

This project took place at our Toronto plant, which is an injection moulding facility. A team was organized and its members were trained on the use of basic statistical tools to help measure key process inputs and outputs. The goals of the project were to:

- stabilize machine cycle times
- lower cycle time safely
- eliminate overadjustment
- implement variables control charts
- implement attribute charts.

The following results were achieved:

- reduced machine cycle time of 5.7 percent
- increased throughput resulting in an increase in product output of $133 000 per year
- use of attribute charts to help predict machine maintenance
- increased floor communication
- development of a manual to define subjective defects.

Figure 1 illustrates the injection moulding cycle time for one year prior to the introduction of SPC and for several weeks after its introduction. Average cycle time was reduced from approximately 3.5 seconds to under 3.3 seconds and the variation of cycle time decreased markedly, indicating a higher process capability.

Pre-foam Process: Increased Process Stability and Reduction of Weight and Scrap

This project was undertaken at our Edmonton plant, which manufacturers EPS (foam) products. The project goals were to:

- better understand causes of variation in the EPS prefoaming process
- reduce and eliminate process variation
- reduce nominal product weight
- implement SPC on the production floor.

The following results were achieved:

- annual savings of $15 600 from scrap reduction
- reduced process variability (three sigma control limits narrowed by 35 percent) since the introduction of control charts and the removal of special causes
- annual savings of $36 500 realized due to product weight reduction.

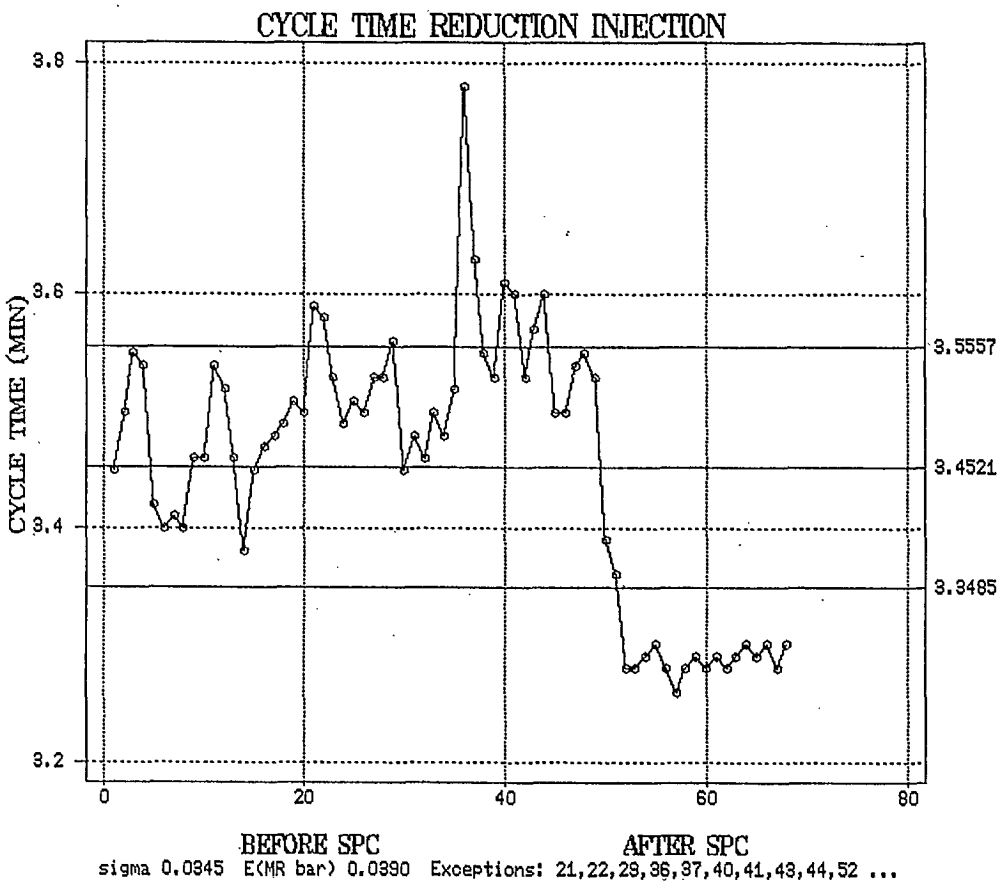

Figure 1 — Canada Cup Inc.

Figure 2 charts statistics on cup weight on a month-to-month basis over an 11-month period. The mean, minimum and Lower Control Limit (LCL) for cup weight decreased over the course of the project. Process capability was such that cup weight did not go below the LCL.

A similar project was carried out at our Brampton plant, which also manufacturers EPS (foam) products. The original goals described for the Brampton facility were similar to those at our Edmonton location, however, the consistency of the raw material supplies was in question. Using SPC data, the project team worked with the supplier to find a mutual resolution.

The following results were achieved:

- $16 000 material claim was qualified by statistical data and measurement
- SPC training and control charting were implemented to investigate key process inputs/outputs
- sampling plans were standardized for weight variation studies
- Phase I of the weight reduction program produced $23 000 annual savings
- a new raw material supplier was sourced due to batch-to-batch variation.

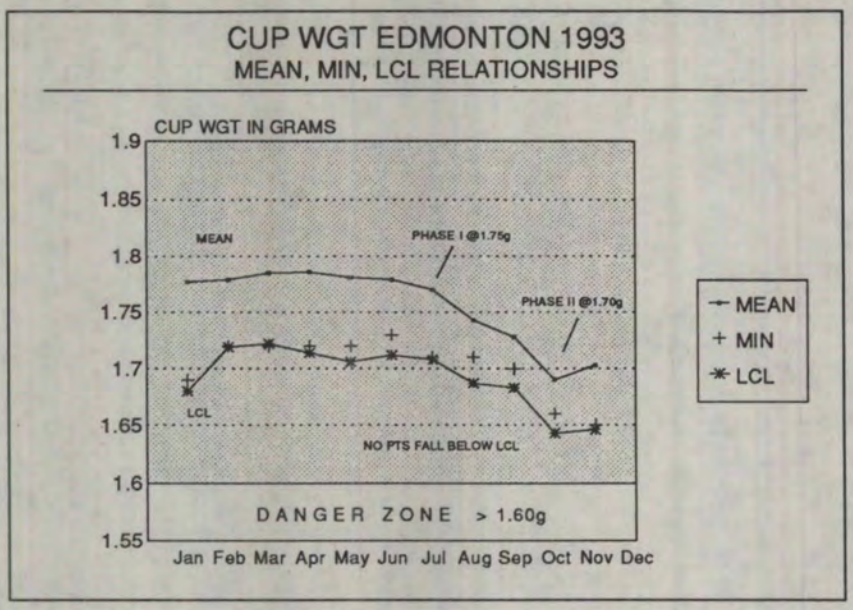

Figure 2 — Canada Cup Inc.

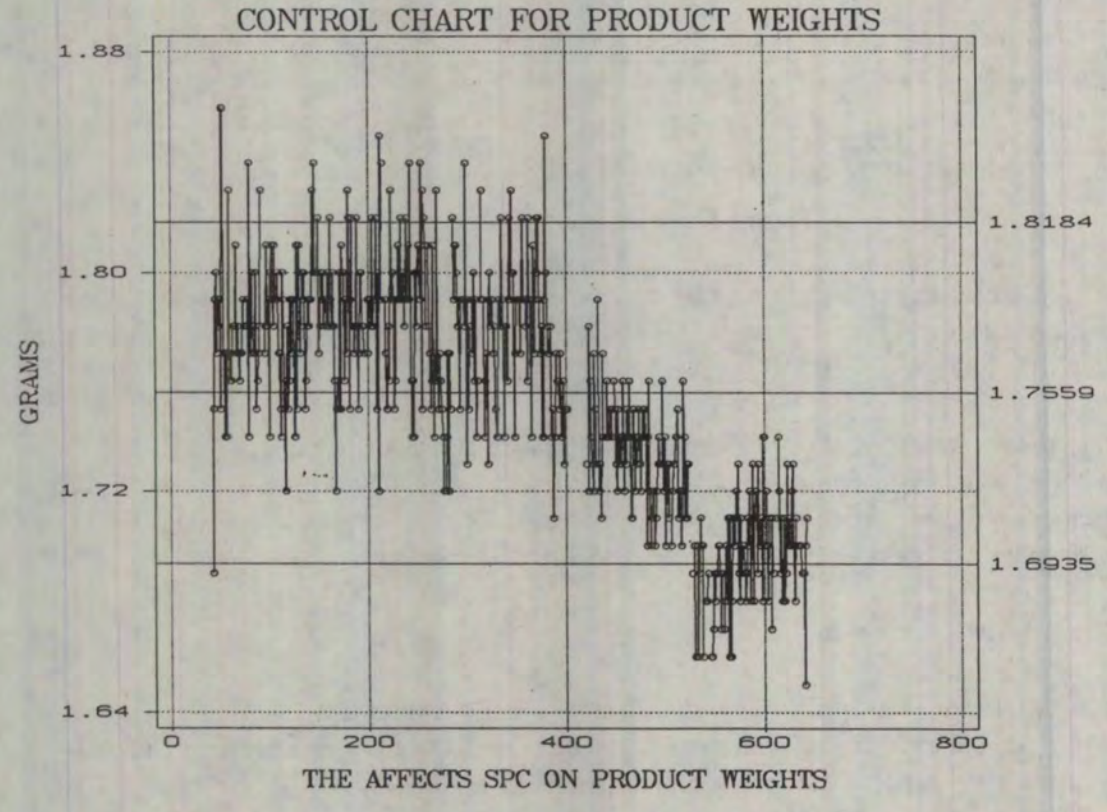

Figure 3 — Canada Cup Inc.

Figure 3 charts cup weight over an 11-month period. The chart shows a reduction in both the mean and variation of cup weight resulting from changes implemented as a result of the project.

Summary of Continuous Improvement Results

Three major objectives of our continuous improvement efforts are increased productivity, scrap reduction and weight reduction. **Figure 4** provides a summary of the results achieved in 1993 compared with our targets for the year. While there is still room for further improvements, these results represent significant operational and bottom-line benefits. These benefits were achieved by providing teams of employees with the proper tools and resources and creating an environment where all departments communicate and work together — key elements of a total quality strategy.

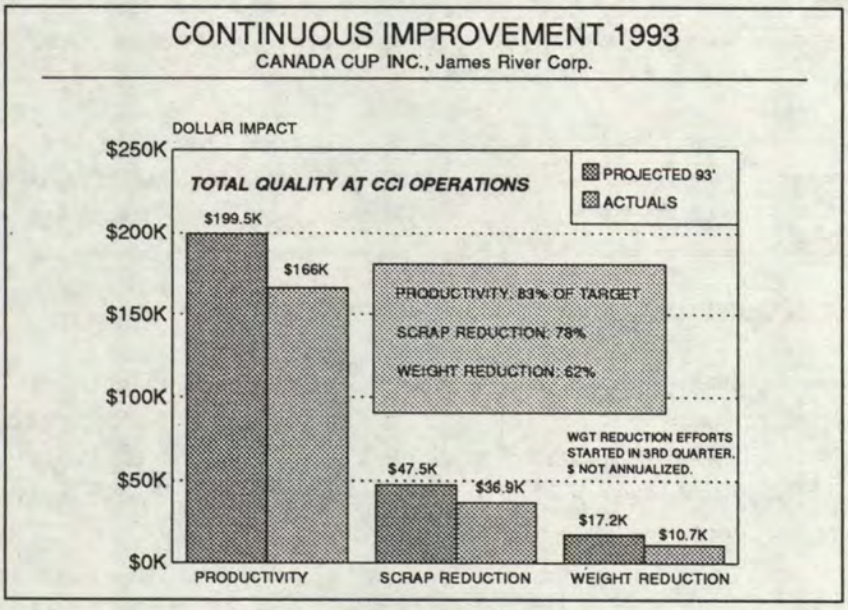

Figure 4 — Canada Cup Inc.

Starting Out Right: Effective Beginnings to Process Improvement Projects

by Mark Towers, Continuous Improvement Facilitator
Glaxo Canada Inc.

The Company

Glaxo Canada Inc., part of Glaxo Holdings PLC, is one of Canada's largest research-based pharmaceutical companies. The company, which has served Canadian doctors and their patients for 90 years, provides safe and effective drugs of high quality, such as Imitrex®, Zantra®, Ventolin® and Beclovent®. Glaxo Canada invests approximately $30 million annually into the discovery and development of new medicines.

Glaxo Canada's headquarters and manufacturing facilities are in Mississauga, Ontario. Distribution centres are in Moncton, Montreal, Toronto, Winnipeg, Calgary and Vancouver. The company employs over 1 000 employees in research, development, manufacturing, sales and marketing.

Overview of Process Improvement Projects at Glaxo

The basic unit of Continuous Improvement (CI) at Glaxo Canada Inc. is the Process Improvement Project. The beginning stages of these projects are both difficult and critical to success. This article provides an overview of Glaxo Canada's approach to Process Improvement Projects and a close look inside the team meeting room during the beginning stages of projects. A successful project, dealing with clinical records information management is then discussed.

Process Improvements Projects (PIPs) at Glaxo Canada involve the following five stages:

- **Set-up:** Initial project discussions through the first team meeting.
- **Current State Analysis and Target Setting:** Process performance data is analyzed. Performance targets are developed by the team and agreed to by management.
- **Recommendation:** Process improvement recommendations are developed by the team and approved by management.
- **Implementation:** Approved recommendations are implemented.
- **Monitoring:** Ongoing results are tracked and used in executive reporting.

Several difficulties are encountered in the beginning stages of PIPs for a number of reasons. Throughout their working lives, people are conditioned to think of what they do as individual or departmental tasks. They do not easily change their thinking to see work as a series of processes,

crossing departmental boundaries and having suppliers and customers. "Fire fighting" is often enshrined as the dominant operating methodology. There is also the usual stumbling around in the dark — a natural phenomenon at the beginning of any undertaking.

Setting up Effective Process Improvement Projects

Team sentiment at the start of a new project: "We can't really improve this process because the problems exist outside our control, with the outside agency and another division within the company. We'll work through the process improvement model, but we don't have a lot of faith in getting results."

Team sentiment at the end of the project: "We've been able to reduce the process turnaround time by approximately eight months and bring in millions of dollars to the corporation. By using data which we've always known of, but never systematically captured and analyzed, we've helped the other division improve what they deliver to us. The improved process is so good that it will likely be adopted throughout Glaxo worldwide."

The above example is one of our more dramatic illustrations of how the difficulties associated with beginning PIPs can be overcome. Below, is discussed the first stage of the journey that each of our teams makes. Almost no team follows it exactly and yet every team follows it generally. The size, nature and urgency of the issue all have an impact on how the team begins it's journey. Over the past two years, we have evolved what follows through the learnings of the teams and those of us responsible for designing and implementing CI.

Clarifying the Issue/Problem/Opportunity

PIPs are initiated at Glaxo in a number of ways: a departmental manager may have it as part of his or her performance management objectives for the year; a director may initiate it with his or her direct reports; a division may identify improvements that need to occur within the year; an individual (from hourly workers to executives) may identify an opportunity or problem. As one colleague stated: "Energy forms around an issue and at some point crystallizes . . . resources get committed to doing something about it." While there are a number of ways to begin projects, a sound beginning is critical to ultimate success.

To help people determine when to use the PIP methodology, we use the criteria shown below. Someone from the CI group then works with the project initiator to identify the mandate and scope of the project.

Criteria for Process Improvement Projects

- Clear linkage between PIP mandate and corporate or divisional business objectives as well as customer (external/internal) needs.
- PIP team participates in CI basic training.
- PIP team follows CI Process Improvement Model.
- Team uses a CI-trained facilitator.
- Team regularly tracks improvements after project completion.
- Team members have PIP as part of their performance management plan.
- People have agreed to play key roles: senior sponsor, management sponsor and project leader.
- Team commits to regular meetings until implementation stage is completed (approximately 40 hours of meetings).

The last criterion has been modified recently. We used to require the team to meet every week for two hours. Experience has shown that teams are more efficient if they meet for longer blocks of time. It takes about half an hour for team meetings to get into high gear. Our teams now usually meet for three to four hours each week, and all day at least three times during the project. Another advantage of more intensive, shorter projects is that they avoid loss of team enthusiasm, which can occur if projects last longer than five to six months.

The Management Mandate

The mandate is presented by the sponsoring manager at the first meeting and is also written down to ensure continued understanding by the team. Documentation includes a statement of the mandate, linkage to the divisional business objective, the customer, potential impacts, project scope, the performance characteristic(s) to be improved, and process boundaries. While management is working on the mandate, we ask them to select a project leader.

Project Team Selection

The sponsoring manager selects a project leader and they, in turn, select team members. The project leader usually reports directly to the sponsoring manager. We have found that, even for a project within a department, there is value in bringing in outside opinions on how to improve a process. We next find a facilitator, who works with the team throughout the project. That person is usually a line facilitator, someone who has contracted with the CI group to facilitate two teams the first year, one the second and one the third. Prior to facilitating a PIP team, this person has attended CI basic training, been a member of a PIP, attended facilitator training and facilitated a team through CI basic training. We assign an experienced facilitator coach to work with the line facilitator for the first couple of PIPs that person facilitates.

CI Basic Training

Once the team is selected, members participate in a three-day learning event. This involves a business process simulation with four cycles, during which we introduce teamwork and process improvement tools. The learning event, which involves 65 percent simulation and 35 percent concept presentation, has been described as intense and enjoyable. Two take-aways are given to members: *The Memory Jogger: A pocket guide of tools for Continuous Improvement* and a folio with the Continuous Improvement logo and the elements of CI: Customer, Process, Data, Team and Results, printed on the inside flap. These items are usually brought to team meetings by team members and are highly visible throughout the company.

First Meeting

For the first meeting, a roughly standardized agenda is prepared by the project leader and facilitator. The team members prepare future agendas. Team members learn meeting effectiveness skills while participating in a PIP, through just-in-time training and practice at every meeting. Participants have stated that this is one of the most important skills they learn during the PIP. The team meeting rooms have wall hangings on these techniques and large, 1.2192 m × 0.9144 m (4 feet × 3 feet) sheets used to plan the next meeting's agenda. We also use an electronic flip chart, allowing team members to have copies of the minutes and the next meeting agenda before they leave the meeting.

As a bridge between CI basic training and the first team meeting, we ask participants to identify specific learnings from the training which they want to ensure the team will use. These are recorded in round robin fashion on the flip chart. We have found it helpful to ask team members to take several minutes at the beginning of the first meeting to identify their personal objectives of participation in the PIP and the strengths they bring to it. This is a very revealing and satisfying way to help team members gain clarity on personal and professional benefits gained and offered.

The main task of the first meeting is the presentation to the team, and their subsequent discussion, of the management mandate. Understanding, agreement and commitment proceed from this discussion.

To be successful, the PIP must focus on one specific process **and** on improving one performance characteristic of that process at a time. This is difficult, as people want to improve everything simultaneously. They also want to set aggressive targets before baseline data are gathered. We have created a special mid-course management presentation at the end of stage two to enable management and the team to set targets.

The disciplined problem-solving approach embodied in the PIP structure does not allow people to follow their natural tendency to jump to their favourite solutions. While initially frustrating for team members, it ultimately leads to better solutions.

Beyond the First Meeting

At the beginning of each team meeting, we take approximately 10 minutes to review a 0.9144 m × 0.6096 m (3 feet × 2 feet) team board. On one side of the board are the relevant divisional yearly business objective, the issue statement and the process performance measures. Reviewing these items focuses the team on the meeting purpose. On the other side are the team's norms, four to six of which are usually created in the first couple of meetings. A team member reads them out loud and we may focus on one which we are doing fairly well, or one that we are not doing well, and identify ways to improve. Teams do not initially seem to value this discussion but the value gradually becomes apparent to them.

Teams choose from a broad range of problem-solving methods to develop and reach consensus on possible solutions. These include brainstorming, process mapping, cause and effect, and force field diagrams, interviewing persons outside the team and running pilot improvement tests.

Once a team has prioritized its agreed upon solutions, each is developed as a recommendation and included in a CI executive summary. Decisions are required on each of the recommendations and someone is assigned responsibility to ensure that this happens. The CI executive summary forms the basis of the implementation plan.

Once two thirds of the recommendations have been implemented, the final senior management presentation is scheduled. During this presentation, the team presents its progress and results. After the final presentation, the project leader and sponsoring manager meet monthly to review progress on the remaining recommendations to be implemented.

Improvements which have been implemented prior to the final management presentation are monitored by team members until that time. After the presentation, a Quarterly Progress Report, delivered to the Executive Committee, tracks ongoing monitoring of improvements. Process performance measures can be tracked regularly wherever the process is run.

An Example Process Improvement Project

This project included two team members from each of three different groups in the Medical Division: Biostats and Data Management, Clinical Research Scientists Group, and Clinical Therapeutic area. I acted as the team facilitator.

Glaxo always strives to successfully launch all new products and line extensions as early as possible. Each year, many clinical trials involving thousands of patients from across the country are conducted by physicians and coordinated by Glaxo's clinical research staff. Reporting the results of clinical studies is critical to gaining approval for new pharmaceutical products.

When a patient enters a clinical trial, the physician will record details of the patient's medical history on a Clinical Record Form (CRF). Information on the patient's progress and response to the new drug are subsequently recorded on the CRF. Once the study is complete, the CRF is returned to Glaxo, where the data are carefully analyzed. If there are any discrepancies or questions about the data, a Data Clarification Form (DCF) is sent to the Glaxo clinical research scientist for resolution of the data query with the investigator.

Reducing the turnaround time of managing, entering and validating the CRF data is critical to reducing the approval time for new medicines. A team from the Clinical Therapeutics Area, Clinical Research Scientist Group and Data Management was formed to do the job. **The team's issue statement became: To reduce the high turnaround time of the CRF process.**

The group identified the culprit responsible for high turnaround times to be wait time. They found that, of a total processing time ranging from 54 to 101 days, 40 to 84 days (80 percent on average) were wait time. The team decided to target those steps in which wait time was a high percentage of total time, i.e., data entry (94 percent), validation (91 percent) and DCFs (74 percent).

After a detailed study, using statistical data and other reference material, the team found that the following areas contributed substantially to the wait time:

- **Data Entry:** Unnecessary and duplicate data entry and manual logging of process steps; lack of notification of expected arrival time of CRFs.
- **Validation:** CRF coding errors, unnecessary validation, poor agreement on validation specifics and manual logging of process steps.
- **DCFs:** Lack of clarity, no policy for sign-off authority, difficulty in contacting investigators and lack of notification to Glaxo staff of expected arrival time of DCFs.

The team evaluated potential solutions based on practicality and the availability of human resources and technology. Pilot projects conducted by the team have generated impressive solutions. Five days were saved by automating the logging process. A further eight days were saved by giving data monitors the authority to resolve non-clinical data queries, thereby reducing the number of DCFs requiring solution.

The team looks forward to the savings that will be realized when additional suggestions are implemented, for example: approximately three days will be saved by a new report that improves prior notification of the expected arrival of CRFs; a new computer program that will allow easier customization of data queries; and a proposal to alter the DCF routing and resolution procedures that will save approximately three to four weeks. The end result will be a 32 to 37 day (31 percent) reduction in turnaround time.

Conclusion

At the beginning of Glaxo's CI initiative, the CI group recognized the need to produce financial results. We recommended to the Executive Committee (EC) that we should return to the company, at least the cost of our existence, by the end of three years. At the November 1993 EC meeting, we reported a total of $2.4 million annualized gains through CI — greatly exceeding the cost of the CI initiative. Partly as a result of this, they requested and received an expansion of the CI initiative within the company.

Statistical Design of Experiments Contributes to Quality at Monsanto Canada's LaSalle Plant

by Joe Gaetan, Manager, Human Reources, Total Quality and Continuous Improvement
Pierre Fournier, Sales Representative
Remi Fortin, Production Supervisor

The Company

Monsanto Canada and its subsidiaries employ 1 200 people in Canada and have annual sales of approximately $500 million. The company manufactures a wide range of specialty chemicals and resins for several markets, including plastics processing, food and agriculture.

Monsanto's LaSalle plant employs 250 people and manufactures a broad range of specialty coating, plastic and agricultural products for the Canadian and export markets. Over the past three to four years, the plant has evolved from manufacturing for the Canadian market to producing niche products for the North American and global marketplace. In 1992, it was the first chemical production plant in North America to receive ISO 9001 accreditation.

Overview of Design of Experiments

Monsanto's approach to continuous improvement involves the use of many statistical, problem solving and teamwork tools. In this article, we provide an overview of our use of statistical Design of Experiments (DOE) and two examples of its application.

The traditional approach to experimentation is to hold all conditions constant except for the one variable (or factor) being studied. The effect of this factor on the output variable of interest (key measurement) is then recorded. If more than one factor is involved, separate experiments are performed on each of them, while all other factors are held constant.

The one-factor-at-a-time approach has major drawbacks such as producing results that ignore interactions among factors. These interactions, which are widespread in industrial processes, result in the combined effects of two or more factors being different than the sum of their separate effects. For example, an electronic circuit may test perfectly at 125°C and independently survive 95 percent relative humidity (RH). If tested at 125°C and 95 percent RH, however, the circuit may fail due to the combined effect of temperature and humidity. The one-factor-at-a-time approach is also inefficient since more data is ultimately collected than is necessary to characterize the response of the key measurement to the relevant factors.

Statistical DOE allows one to deal with large numbers of variables, and sources of variation, using a manageable number of experiments. It involves varying more than one variable within each experiment, in a manner that allows separation of their effects during the analysis stage.

At Monsanto, the use of DOE and other statistical methods is integrated with the human element. This is reflected in the fact that human resources and total quality functions are combined. Training of management and local work force employees is essential for successful use of DOE. Approximately 50 key people from all levels of the organization have attended DOE training sessions taught by Qualpro. The training has been applied throughout the organization, in both the manufacturing and non-manufacturing areas.

Experimental Approach

Relationship between DOE and SPC

Before applying DOE to a process, it should be tracked using Statistical Process Control (SPC), and special causes of variation should be identified and eliminated. The responsibility for identifying and eliminating special causes lies with the work force, those persons who normally operate the process. The elimination of special causes may result in a process which is in control but unsatisfactory because there is too much variation in the key measurement due to common causes, or the average value of the key measurement differs significantly from its optimum value.

Note: Special causes of variation are intermittent, not inherent to the process and result in a process that is not in statistical control. Common causes of variation are always present, inherent to the process and responsible for variation that is randomly distributed.

Converting an unsatisfactory process to one which is satisfactory requires management action, such as changes to policies and procedures affecting the process. DOE is an effective tool to support management actions, resulting in reduced common cause variation and/or improvement to process variable set points. The elimination of additional special causes may then be necessary and may involve a journey upstream, starting with an in-depth examination of two to three issues. Finally, one achieves a process which is both stable and satisfactory. This can be a launch point for a new DOE to achieve improved costs, performance, etc.

The above steps, involving both SPC and DOE, are shown in **Figure 1**. During the improvement project (and before and after it) control charts are used to determine whether the process is in statistical control and the magnitude of variation.

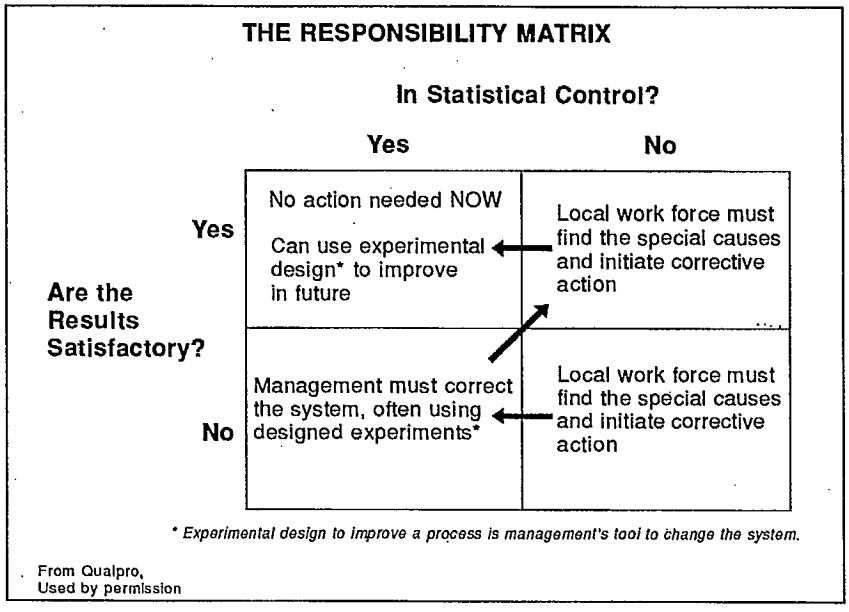

Figure 1 — Monsanto Canada

Selecting the Key Measurement

The first step in planning the DOE involves identifying the key measurement requiring improvement. This may be the output from any number of key processes in manufacturing, marketing, sales or administration, e.g., process variables such as Melt Flow Index, or annual sales of product X.

Selection of the key measurement is critical to a successful DOE. Decisions must be made on whether to measure the final output of a process or to divide it into segments and apply DOE separately to each of them. For example, the scope of a DOE project could involve improving the sales of product X, or the advertising component of a sales campaign for the product. The key measurement would be chosen accordingly.

Brainstorming Phase

Once the key measurement is chosen, a cross-functional team is assembled to brainstorm from 60 to 70 ideas that may result in improvement. Brainstorming is a critical aspect of the DOE. It maximizes the potential for identifying high potential ideas, even obscure ones. It also brings practical knowledge of the process to bear on the problem and facilitates questioning the status quo.

The next phase of the process is to distil the resulting 60 to 70 ideas into a manageable size for the experiment. The number of variables, experimental ranges and data collection procedures will vary with the nature of the process. Experiments typically begin by examining from four to 50 variables with the objective of identifying the one or two that will improve the process. Small experiments

(three to four factors) can be managed using a factorial design approach while larger experiments (eight to 40 factors) require the use of a Plackett-Burman design.

Running the DOE

The next step involves running the experiment. An experiment consists of several runs, each with a set of predefined levels for each factor. The combination of levels set for a given process run is called the **treatment combination.** The data collected during a given run, consisting of multiple values of the key measurement, comprise an **experimental cell. Figure 2** shows the relationship among the elements of a DOE. In this case, four runs (corresponding to four treatment combinations) of two variables, A and B, are conducted. For each run, three measurements (y_1, y_2, y_3) of the key measurement are made and the average, y, is calculated.

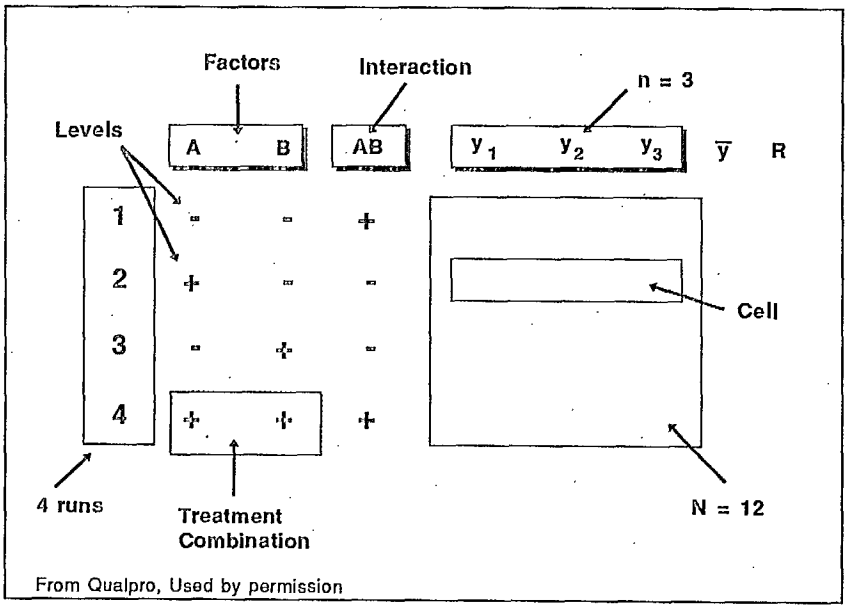

Figure 2 — Monsanto Canada

Results Analysis and Implementation

The final steps involve analyzing the results and planning changes to the process. The DOE results include parameters describing the dependence of the key measurement on each of the factors and the interaction among the factors. These indicate which process variables have the greatest impact and how variables interact to yield a synergistic effect. Before being accepted, however, results should be questioned, to ensure their validity, using practical process knowledge.

It is crucial that the appropriate levels of management understand the basic concepts behind the DOE. DOE is capable of breakthrough results, with improvement of 50 to 200 percent being possible. Breakthroughs, however, are generally not achieved without risk, therefore, educating decision makers in this tool is critical.

Two examples of how DOE has been applied at Monsanto's LaSalle plant are provided below.

DOE Leads to Product Improvement

In order to improve consistency and resolve quality issues associated with manufacturing an alloy grade of acrylonitrile-butadiene-styrene (ABS) resin. A DOE was conducted on the compounding process used to produce the alloy intended for use in microfloppy disks. The goal of the experiment was to determine which process variables had a significant influence over the melt flow index and the presence of unmelted rubber particles in the resin.

The DOE was conducted using eight runs and seven independent process variables on the compounding process. Steps were taken to minimize variation in factors outside the scope of the DOE, such as other process variables and feedstock quality.

The DOE revealed that none of the variables under study had a significant influence on melt flow index. The conclusion from this part of the experiment was to orient efforts toward improving the feedstock. Three process variables showed a noticeable impact on the unmelted rubber particles, one of which was a total surprise. (Factors that are initially considered unimportant are often revealed to have relevance as a result of a DOE.) Changes to these variables were subsequently incorporated into the permanent process operating conditions. The customer now receives a product with more consistent melt flow characteristics, resulting in improved moulding operations.

The Power of DOE in the Decision-making Process

In 1990, the LaSalle plant was competing for product mandates for the North American and global marketplace. The plant had previously manufactured several thermoplastics and new equipment had recently been added to expand the compounding facility. One product being considered was a thermoplastic alloy (Triax) that had not been produced at the site, due to uncertainties concerning the capability of the processing equipment. The new alloys were being manufactured by a U.S. toll compounder, using equipment which had previously performed better than equipment of the type located at the LaSalle plant.

In order to demonstrate capability to produce the Triax alloys and to optimize process conditions, the Chemicals Group, Plastics Division, utilized a four-factor DOE. The DOE was conducted by a team which included operators, facilitators and technical specialists, and incorporated several problem-solving tools.

The DOE team was to able demonstrate that the plant's compounding equipment could produce Triax with properties, equal or superior to those produced by the toll manufacturer. The project revealed variables which had been dismissed earlier, and allowed fine tuning of the process. Although the toll manufacturer had superior equipment, our overall process was better. The LaSalle plant was subsequently awarded the worldwide mandate for production of Triax alloys. Although several other efforts contributed to obtaining this mandate, the DOE was a key factor.

Summary

DOE is a powerful statistical tool when employed with other total quality methods and initiatives. It can be applied to both manufacturing and non-manufacturing processes and, when successful, can produce improvements from 50 to 200 percent. Because the improvements resulting from DOE require changes to policy and procedures, DOE is a tool for management. Senior management must understand the process to ensure effective use of DOE and implementation of results.

Use of Multidepartmental Teams to Solve Problems

by Ed Treciokas, Quality Assurance Manager
Uniroyal Chemical Ltd.

The Company

Uniroyal Chemical Ltd. is an international leader in the production of crop protection chemicals, rubber chemicals, other specialty chemicals and polymers, including polyurethanes. The company employs approximately 300 people in Canada and has its head office and manufacturing facility in Elmira, Ontario, sales offices across the country and research laboratory in Guelph, Ontario. Uniroyal Chemical, which has been in operation in Canada for over 50 years, is part of an international company, Uniroyal Chemical Co. Inc. of Middlebury, Connecticut.

Since the company's formation, its production of high quality chemicals has expanded greatly to serve customers around the world. The objective of Uniroyal Chemical products is to enhance the quality, reliability and serviceability of goods produced by its customers. For example, crop protection products combat plant diseases and pests to increase crop yields and farm productivity. All Uniroyal Chemical programs are backed by extensive technical support programs to ensure that customers' needs are met.

Uniroyal Chemical's Commitment to Quality

A strong commitment to quality has contributed to the company's success in Canada and internationally. Uniroyal Chemical began its quality programs in the early 1980s and its success was demonstrated in 1989 when the company received the silver medal in the Canada Awards for Business Excellence quality category. This commitment to quality encompasses all aspects of the company including its products, research, the environment, customer service, employee health and workplace safety. This article discusses an important aspect of Uniroyal Chemical's quality process; the use of multidepartmental teams for problem solving.

Problem Solving Using Multidepartmental Teams

During production of one of Uniroyal Chemical's crop protection formulations, a sudden increase in the variability of percent active ingredient was experienced, resulting a large proportion of production requiring rework and/or retesting. This resulted in increased costs and delays in getting the material to customers. Initial attempts to isolate the cause of the problem failed. The variation problem continued and could not be tolerated. A multidepartmental task force, sponsored by the General Manager and involving production, quality assurance, R&D and the math group, was established to

tackle the problem. This task force was co-chaired by the Quality Assurance Manager and the Manager, R&D — polymers, physics and engineering. Each member of the task force brought a particular expertise into the group.

To gain a better understanding of the problem and identify opportunities for improving future production, a number of brainstorming sessions were held to try to isolate all potential causes of variability of percent active. This resulted in the fish bone diagram shown in **Figure 1**. These potential issues were prioritized to determine what course of action to take and the various groups were given assignments to determine their contribution to the total variation.

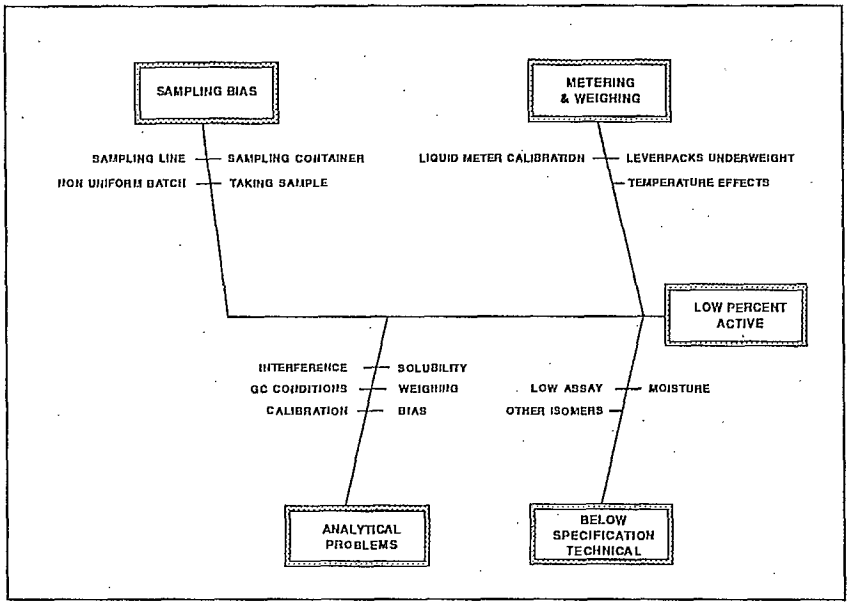

Figure 1 — Uniroyal Chemical Ltd.

One of the first observations was that in order to ensure that we could see minor changes in results, improvements to the analytical method had to be made. The analytical groups (QA and R&D) came up with a way to reduce the method's variability by 50 percent, dropping the percent relative standard deviation from 0.2 to 0.1, through better sample solubilization and use of improved instrumentation. This ensured that the task force could accurately quantify the percent active in the formulation and assay the pure technical material being used.

The R&D formulation group made up lab quantities of the formulation to ensure that there were no problems with the raw materials and as a check on the analysis. These lab samples (tracers) proved to be very useful to the lab, to verify the method and to track its long-term variability. This group also ensured that stable rheological properties were maintained in material that was reworked and/or had higher solids loadings.

The production people ensured that all scales and metering equipment were calibrated and functioning properly. They also performed time studies of mixing which ensured that samples were representative of the batch. These studies found that the final batch was homogeneous earlier than had previously been thought, thus decreasing the total formulating time. Production supervision talked with plant operators to ensure that each person knew the importance of recording accurate information about batches and taking good samples for the laboratory to test. This would allow greater ease of finding the cause of any future problems.

Our math group determined what statistical techniques could be used to determine source and size of error and set up a number of experimental designs to examine analysis, plant variability and sampling.

Raw materials, particularly the suspect active ingredient, were also examined by the analytical groups. They found that the purity of the raw material received varied more than what the supplier was claiming. The group believed that this could account for some but not all of the observed variation. It did, however, lead to tightening of specifications, as well as performance checks on the raw material before receiving it into the plant.

At the end of the project, the task force concluded that the increased variation in the plant had resulted from the combined effects of a number of small problems. Once all these problems were addressed, and more care was taken to ensure consistent raw materials, proper samples and accurate analysis, the production unit was able to maintain a more consistent product, and the standard deviation decreased from approximately 0.5 to 0.2.

Summary

Uniroyal Chemical's quality programs have evolved over time so that people in different functions can come together for short periods of time to solve production problems. By combining the abilities of specialized individuals, with those of people involved on a day-to-day basis, problems can be solved more effectively and efficiently. Uniroyal Chemical continuously tries to improve its products both in form and consistency through group efforts. The end results are better products for our customers.