INDUSTRY-UNIVERSITY CO-OPERATION: A CASE STUDY

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IIQP Research Report
RR-94-02

January 1994

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ABSTRACT

Co-operation between a University and an Industry can yield substantial pay-offs for both parties. There are numerous examples where Industry-University co-operation has resulted in significant discoveries or improvements in products and processes. What is less documented, is how Industry and Universities should work together in order to be mutually beneficial. This paper describes the experiences and the lessons learned as a result of a working partnership between General Motors of Canada and the University of Waterloo.

KEY WORDS: partnership, consulting, education, methodology.

1. INTRODUCTION

Many people, particularly government officials talk about the need for co-operation among various sectors in our economy. One area that is often cited is co-operation between industry and academia.

Forming a relationship between an educational institution and industry is not unlike a marriage. The courtship is often rosy and a wonderful honeymoon period follows. Like marriages, people bring different expectations to the table, and sometimes these do not surface until the partnership is well under way. When this happens in an industry-academia partnership, both parties may have second thoughts and may even proceed to dissolve the relationship.

We have been asked to assist other institutions in the "courtship" phase of the partnership and we have witnessed the devastating and expensive demise of unsatisfactory partnerships.

The relationship between General Motors of Canada and the University of Waterloo has been growing since 1985. Both parties have benefited greatly from the partnership. During this time we have learned a great deal about structuring a partnership between industry and academia.

One of the main reasons for sharing our experience is that we believe there is enormous potential not only for businesses to benefit from this type of arrangement, but also the educational institutions. It is our belief that the structure of our partnership can be used as a model for other successful partnerships across different industries.

2. BACKGROUND

The partnership between General Motors of Canada and the University of Waterloo grew out of discussions that began in 1984. A reason for initiating the dialogue was the fact that graduate engineering students had little or no knowledge of the application of statistical tools to one of GM's primary concerns, quality improvement.

In 1985, soon after discussions began with GM, the Institute for Improvement in Quality and Productivity (IIQP) was formed. General Motors of Canada and a small group of other prominent Canadian businesses provided initial funding to the Institute.

In 1987, the partnership between GM and the IIQP was strengthened with the formation of the Quality Resource Centre at General Motors of Canada. The Resource Centre is an umbrella organization that has three main facets; consulting, research, education and training. It was this structure that allowed the relationship to flourish.

The University of Waterloo saw the partnership as an opportunity to obtain a better understanding of what tools and techniques were needed in industry. Moreover, the opportunity of having General Motors of Canada plants as a research laboratory, excited many of the professors.

3. QUALITY RESOURCE CENTRE--A MODEL FOR PARTNERSHIPS

Some unique and important features of the Quality Resource Centre are:

- its long term and on-going nature which have led to a high degree of trust among the parties
- the inclusion of three separate activities: teaching, consulting and research
- the shared goals which impact both GM and the University

Establishment of the Resource Centre helped to raise the profile of the whole partnership. Being highly visible is not only important in attracting customers, but also for securing future funding.

Commitment of full time resources by GM helped to get the Professors familiar with plants, processes, and products, in a very short time period. Moreover, this helped to ensure that professors were supported and provided a mechanism to open doors and to cultivate customers.

The Resource Centre provides an important source of continuity, since professors are not able to be on site at all times. This is an important factor in the completion of projects. Moreover, our customers have a single point of contact. Much of the co-ordination and scheduling work that needs to be done can channelled through the Centre.

The shared goals made both the professors involved and the General Motors' employees feel part of the same organization.

4. IMPLEMENTING THE CONCEPT

Implementing the concept of a Quality Resource Centre is, in our mind, one of the key factors in the success of the partnership.

It is very important, when considering the implementation of a partnership, that the concept is championed not only at the company but also at the university. Strong champions are vital in the nurturing of the partnership, particularly during its first few months.

Details of the implementation phase were sorted out by a task force in a series of six meetings. These meetings also allowed GM and the University professors to get to know one another better. The main recommendation of the Task force was the formation of the Quality Resource Centre, staffed jointly by full time GM employees and part time professors.

There were two recommendations that were judged to be of considerable importance to the success of the relationship. These were that a long term relationship should be established with initial funding for three years. This funding was provided centrally so that individual customers of the Resource Centre were not charged directly. The recommendations of the Task force were accepted by both GM management and the University administration. These recommendations formed the blue print for the working relationship.

5. GOALS AND OBJECTIVES

Although the goals and objectives of the Resource Centre have evolved over the last 5 years, the ones listed below are representative of the kinds of things the Resource Centre has attempted to accomplish.

1. Incorporate Continuous Improvement (CI) concepts, tools, and examples into the Engineering and Mathematics curriculum at the University of Waterloo. Then use the revised curricula as a model for other Engineering schools throughout Canada.
2. Involve graduate students and faculty members in research problems generated from GM in order to create experts in continuous improvement methods.
3. Expose faculty members to a large number of problems and examples in manufacturing and assembly environments to refresh and enhance their teaching.
4. Provide an avenue for the development of new and relevant methodologies in the

area of Continuous Improvement and Statistical Methods to help General Motors achieve competitive advantages through early application of the research.

5. Increase the ability of GM employees to apply successfully, statistical concepts and tools in order to achieve cost and quality improvements.

6. Work cooperatively to improve specific processes within GM operations.

No specific measurement systems were established to measure progress towards the achievement of the goals and objectives. This was a deliberate decision because it was felt that easily measured quantities such as number of projects, dollars saved, students trained, etc. do not reflect such progress and, in fact may misdirect the management of the whole enterprise. The most important figures are not knowable in this case.

Some managers were a little uneasy with this concept initially. However, their fears were quickly allayed after we held our first symposium where project teams presented the results of applying what they had learned from courses and consulting visits.

6. ACHIEVEMENT OF GOALS AND OBJECTIVES:

1. Cost Savings at GM

The University has been involved in projects in all of GM of Canada facilities (13 plants) and with many GM suppliers. The investment in the partnership has more than paid for itself and generated significant quality and productivity improvements. Each year, there has been at least one project, where the payback has been several times the investment in the partnership. The most important savings often cannot even be estimated. There are many instances where people in plants have applied statistical tools that have been taught by the University to achieve significant gains in reducing complexity.

2. Cultural Impact at GM

Long term gains require a change in the corporate culture. This is much more difficult to measure considering the time span for such a change is several years. What signs do we have that our venture has been successful and that GM's culture is changing? We have cultivated a number of "statistical thinking" champions in the plants who in turn, motivate others to apply

statistical concepts to their jobs. The language that management uses has changed. Although there are still managers that require additional exposure and practice to statistical concepts before they can be considered to be proficient, we have at least broken through the awareness stage. Most importantly, we find that managers have gained an enlightened view of the application of statistical methods to manufacturing problems that were previously thought to be difficult or impossible to solve.

Managers have also started to learn the right questions to ask when reviewing data. This, in itself, has had a positive impact on the way things get done in General Motors of Canada.

3. Immediate Application of Research at GM

The relationship has also allowed GM employees to apply recent research to manufacturing problems. This has happened several times particularly in the area of experimental design. The results of this have been more efficient designs and some innovative approaches to difficult problems.

4. Change in Engineering Curriculum at UW

There has been a substantial change to the content of Statistics courses at Waterloo, taught by Faculty involved in the partnership. The first course taught to Mechanical and Systems Design Engineering students now revolves around the concept of continuous improvement of processes. For example, these students are exposed to Experimental Design, a very powerful tool which enables the efficient and effective assessment of deliberate changes to a process. Students, after taking these courses, have conducted experiments at GM during a cooperative work term which have resulted in substantial annual savings. During management review meetings, the students have indicated that the techniques used were learned in their statistics course.

5. Change in Mathematics Curriculum at UW

Within the Mathematics Faculty, a new course on Statistical Methods for Quality Improvement has been developed and offered many times. Substantial changes have been made to an advanced course in Experimental Design to reflect the applications seen at GM. Graduate courses and seminars have been offered to raise awareness and interest in research problems and

advanced methods for Quality Improvement. On-going changes are being made in other statistics courses to emphasize the nature of problem solving.

6. Knowledge Transfer to Other Universities

There has been some attempt to transfer the developments at Waterloo to other Universities, although progress has been slower here than expected. In June 1991, a one day seminar on Teaching Statistics to Engineers was delivered to teachers of statistics at the Statistical Society of Canada meeting in Toronto. Suggestions on course outlines, and notes for several sections of the proposed course were explained. The seminar was delivered by Waterloo faculty and GM employees. It is clear a more concerted effort is required to ensure that all Engineering students are exposed to Continuous Improvement concepts and methods as part of their education.

7. Graduate Student Involvement

There is an ever increasing involvement of graduate students within the Department of Statistics and Actuarial Science with research problems generated from GM. The appointment of Professor C.F. (Jeff) Wu to the GM/NSERC (Natural Science and Engineering Research Council) Chair in Industrial Quality has been an important catalyst to this effort. This is expected to continue with the renewal of the Chair to be held by Professor Jerry Lawless. At the moment, there are 7 or 8 students working on research problems in the area of industrial application of statistical methods. Several of the current problems have come directly from GM. One example involves methods for modelling cylindrical data arising from an experiment on balancing of brake rotors. Another is the search for better ways to study measurement systems to increase their robustness to uncontrollable noise factors.

8. Research

There has been considerable research activity on the part of the involved Faculty. This has been documented as part of the IIQP Research Report Series which has a wide international distribution. A typical example is the work of Professors Lawless and Kalbfleisch on dealing with lag in the reporting of warranty claims. Interestingly, this work arose because of queries

from GM and has a direct analogy to a similar problem arising in AIDS research. There have been three important research conferences at the University during the partnership. In each case, there was participation from GM.

Research and development has been an important component of the relationship for both partners. Specific examples of new ideas applied directly at GM include a method for increasing the robustness of measurement systems, some techniques to aid in the evaluation of a key business strategy, and the work on warranty problems described above.

9. Enhancement of Course Content

Faculty members have made hundreds of visits to GM locations throughout Canada. A wide variety of examples including casting, machining, injection moulding, all types of assembly, etc. have been collected. These examples appear in lectures and assignments not only in courses on Continuous Improvement but also in many other statistics courses.

The fact that the examples are real and often involve thousands of dollars in savings excites both students and professors. In some instances, the stories develop in real time since the Faculty are involved with on-campus teaching and consulting at GM simultaneously.

Studies have been formally documented in the Case Book prepared for the Annual Symposium sponsored by the Quality Resource Centre. Many of the case studies have been discussed in the classroom. The casebooks have been made available to teachers at other Universities for class room use.

10. Broadening the Perspective of the Faculty

One large change in the Faculty has been the realization of the strong interaction required among the statistical tools, the people using them and the management systems in place in order to get a successful application. This realization has resulted in a greater emphasis on the people and systems issues when the statistical methods are presented to undergraduate students.

Faculty members have had incredible opportunities for professional development because of their hands on experience at GM. In several cases, the whole approach to their chosen subject, has changed both in the classroom and in research. The statisticians have been treated with respect and as an asset at GM. The complete experience has generated a new enthusiasm which affects all aspects of their job.

There have been a wide range of research opportunities, some of which have been described earlier. The chance to see the methods developed applied immediately is very appealing for most of the faculty involved.

7. BENEFITS TO STUDENTS

Students in undergraduate programs in Engineering, and Mathematics Faculty have benefited from the University's relationship with General Motors and other corporations.

Many changes have been made to the curriculum from the course notes, case studies, and examples that have been brought into the classroom as a result of the partnership. Statistics is a subject with an unenviable reputation. It is a required course in many programs and frequently, has been very unpopular with students who could see little value in the concepts and methods. The emphasis on process improvement, instead of statistical tools, is seen very differently. This is especially true among Engineering students who have often been exposed to some of the tools in the workplace before taking the course. The professors' experiences allow the demonstration of the practical consequences of theory and concepts. Increased interest in the course results in greater learning and retention.

Moreover, many of the undergraduate disciplines taught at the University of Waterloo are based on the co-operative educational system. Students alternate four month work terms with four months of study throughout their undergraduate academic careers. Consequently, students are continually challenged to apply what they have learned.

Graduate students have benefitted from the funding provided but, more importantly, from the problems generated for their research. There are many students who find research on problems closely tied to direct application highly appealing. In many cases, the research involves generalizations and extensions from the original situation. However, having reality to look back at is a strong motivator for many students. Students educated in this area are highly valued by Industry and Universities so that there are long term employment benefits, as well.

8. BENEFITS TO SOCIETY

The role of Continuous Improvement in maintaining and enhancing competitiveness has become very clear with the emergence of systems for Total Quality Management. There is an enormous advantage in exposing University students to these ideas as part of their curriculum

instead of leaving the task to organizations who subsequently employ them. The developments in the UW programs that have been spurred by the partnership will benefit everyone.

The partnership has also contributed substantially to the overall development of the IIQP. The Institute works with many other organizations as well as GM and benefits from the partnership have accrued to these other organizations. The IIQP also devotes considerable resources to the promotion of the importance of Continuous Improvement which increases societal awareness of this important issue.

9. BUILDING STRONG RELATIONSHIPS

We were asked to assist one University that was interested in forming a similar partnership with a manufacturing firm in the local area. We were invited to present our experiences as part of a seminar. The audience was composed of prospective industry partners and future consulting academicians.

Our advice to this University was to not take their eyes off the customer. This is easier said than done when there are professors with specific interests who prefer to consult in a narrow field. The real challenge is to organize talent and experience in a manner that will meet customers' requirements.

Customers have varying degrees of sophistication and in-house capabilities. Partnerships work best when these capabilities are incorporated into the relationship and not left as separate entities. When handled in this manner, the in-house capabilities are enhanced and the benefits of synergy are realized. The manufacturing floor or head office can be turned into a very rich and rewarding laboratory, if the relationship is well managed.

10. CELEBRATION OF SUCCESS--A CRITICAL MOTIVATOR

Each year since its inception, the Quality Resource Centre has sponsored a symposium where personnel from the plants present the results of their projects. This is essentially a showcase for the application of the methods that employees have learned through their involvement with the Resource Centre as a result of consulting or training.

The Symposium serves a number of purposes. It provides recognition to employees that have completed quality improvement projects. As well, it is a yearly reminder to management of the existence of the Resource Centre and its benefits.

Our Symposiums started rather small with approximately 50 attendees. At our 1993 symposium, the attendance was 250.

We would encourage other University-Industry partnerships to consider holding a symposium to showcase some of the work that has been done and to provide recognition to employees and faculty that have been involved in the project.

11. CONCLUSION

A partnership between industry and academia can be very rewarding for both parties. Communication and understanding of the needs of the company are critical to success. If this type of venture fails, it is extremely difficult, if not impossible to resurrect it, in any form. It is important that the company involved in such a partnership devote the required resources to managing and sustaining the relationship. A long term relationship and ease of access for customers are important factors. In our experience, the rewards from the relationship, are well worth the risk involved in undertaking such a venture.

12. ACKNOWLEDGEMENT

The authors wish to acknowledge the vision and dedication of Dr. J.D. Kalbfleisch and Dr. J.C. Young of the University of Waterloo and Mr. J.E. Urbanic of General Motors of Canada in creating and supporting the partnership.