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MANAGEMENT DEVELOPMENT CENTER

REPORT TO UNIDO
ON
PILOT SEMINAR ON STATISTICAL PROCESS CONTROL

XP/BRA/90/066
Contract No. 90/096

August 13-17, 1990
São Paulo, Brazil

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CONTENTS

ABSTRACT

During the week of August 13-August 17, 1990, the Management Development Center in collaboration with the Carlos Vanzolini Foundation presented a seminar on the uses of statistical process control techniques in the management of manufacturing firms. The participants included 24 top level executives from Brazilian manufacturing firms, three high-level government officials, and the Dean of the School of Engineering of the University of São Paulo. Curriculum materials and lectures were presented in both Portuguese and English. The objective of the seminar was to inform and convince the participants of the importance of management's knowledge and leadership in the use of statistical process control techniques in establishing continuous improvement systems for productivity and quality. The materials and their presentation succeeded in engaging the attention and thoughtful consideration of the participants. The formal and informal evaluations by the participants indicate widespread and deeply felt agreement that Brazilian industry would profit greatly from a long-term and comprehensive project based upon the principles developed in the seminar. Details about the seminar and the participants' evaluations are presented in the body of the report. Also included is a plan for implementing a long-term comprehensive project.

INTRODUCTION

(a) This document reports on the content, presentation and response to the Pilot Seminar on Statistical Process Control that was presented to Brazilian industrialists and government officials last month in Sao Paulo. Also included is a discussion of the results of the post-seminar session in which the principals from the Management Development Center (MDC) and the Carlos Alberto Vanzolini Foundation (FCAV) evaluated the results of the seminar and drew up guidelines for operation of the center and a proposal for long-term assistance to the project.

(b) This project was presented in response to a request from the Government of Brazil for assistance in the implementation of an international center for productivity and quality that would serve as a continuing joint venture between the Carlos Alberto Vanzolini Foundation (FCAV) and a major foreign management center. The immediate objective of the seminar was to demonstrate to key Brazilian industrialists and government officials the importance of organizing the operations of manufacturing firms in a manner that identifies key cross-functional systems and of utilizing statistical techniques in the management of those systems. They were shown that these key systems often integrate aspects of production line processes, product design, marketing, cost management, procurement, logistics, etc. Case studies were employed to demonstrate the usefulness of this approach and how the statistical techniques support it.

The broader objective of the seminar was the initiation of a long-term joint venture between the FCAV and the MDC. The venture is known as the International Center for Productivity and Quality or Centro Internacional para Productividade e Qualidade) (CIPQ). Its purpose is to serve as a permanent conduit for the continuous transfer of the advances in total quality management. This soft technology transfer has several aspects. The transfer is international to the extent that the experience of the MDC is transferred to Brazil. Another aspect is the transfer of academic advances to manufacturing firms. Experience at the MDC has shown that a management institute associated with a major university is ideal for managing these transfers. Members of these institute faculties operate in both the standard university classroom and face-to-face with industry. In this fashion advances in knowledge and technology transfer can occur simultaneously.

Participants were asked to evaluate the contents of the seminar on the basis of the perceived usefulness for the promotion of productivity and quality improvements in Brazilian manufacturing firms. The participant responses were very favorable and served as the basis for critiquing the seminar and planning future developments in a three-day session that followed the seminar.

(c) The plan of the report is straight-forward. It begins with a complete set of descriptive data on the seminar, including date, place, participants names, description of the program that was presented and a summary of the evaluations. This is followed by a description of the three-day planning session and a report of the results and recommendations of those sessions. Several appendices are included: one gives a complete list of participants and their organizations; another is a comprehensive proposal for a long-term project to support the

development of the International Center for Productivity and Quality (CIPQ). The CIPQ will be designed to support all manufacturing sectors in Brazil and to assist in the development of affiliate centers in other countries of Latin America.

SEMINAR ON STATISTICAL PROCESS CONTROL: DEVELOPMENT, PRESENTATION AND CRITIQUE

I. THE PROJECT

The request for proposals and subsequent contract called for the design of a curriculum and the presentation of a seminar that would serve two basic purposes. One purpose was the initiation of a fundamental relationship between the Carlos Alberto Vanzolini Foundation (FCAV) and a reputable management institute in a developed market economy. The other purpose was to introduce a group of Brazilian manufacturing executives and government officials to new management methods that utilize statistical techniques. All of the actions reported herein were directed toward fulfillment of those purposes.

I. CURRICULUM DEVELOPMENT

On the basis of consultations with personnel of the Vanzolini Foundation, faculty members from the Management Development Center (MDC) constructed teaching materials for the seminar during the period June 18 through June 22, 1990. This task entailed both the writing of new material and revision of standard materials used in the regular programs of the MDC. The material consisted of lectures, two case studies, and exercises designed to train the participants in managing for continuous improvement with the use of statistical process techniques.

The case studies that were prepared for this program were the "Hornpad Case" and the "Four-Headed Machine Case." The "Hornpad Case" utilizes elementary statistical process control techniques and highlights the way that problems tend to overlap the functional divisions of the manufacturing firm. The "Four-Headed Machine Case" demonstrates how more sophisticated statistical techniques can be employed by the higher levels of management to discover and solve major problems of productivity and quality. The lectures of systems management emphasize the point that top management of the firm must be involved in the discovery and management of the major cross-functional systems. Otherwise, the potential gains to be achieved from utilizing the statistical techniques are severely circumscribed. On the other hand, those same techniques are shown to support continuous improvements of a substantial nature when the systems are organized and managed on the basis of producing best customer value. For a discussion of the "Customer Value Paradigm" see page 5.

In addition to the above mentioned materials, Gregorio Bouer and Melvin Cymbalista of the Vanzolini Foundation developed a case that utilized the technique known as "Quality Function Deployment" to illustrate both the complex nature of many commonly encountered quality problems and the management of cross-functional systems in the elimination of the problems.

III. MATERIALS PREPARATION

Participants were furnished with a notebook containing a full set of materials covering all of the topics. Materials were prepared with sophisticated word-processing programs and presented in note book form in both English and Portuguese. The pages were sequenced so that on whatever page the notebook was opened, the reader had the Portuguese version of the page on his/her left and the English version on his/her right.

IV. SEMINAR FOR THE IMPLEMENTATION OF THE INTERNATIONAL CENTER FOR PRODUCTIVITY AND QUALITY (CIPQ)

Dates: The seminar began the morning of August 13, 1990 and concluded in the afternoon of August 17, 1990.

Location: The seminar was presented at the Hotel Moíarrej Sheraton, 1430 Almeda Santos, São Paulo, Brazil.

Seminar Principals: The seminar instructors were Richard Sanders, Harlan Carothers, and Kenneth Kirby of the Management Development Center of the University of Tennessee and Gregorio Bouer and Melvin Cymbalista of the Carlos Vanzolini Foundation. These persons had responsibility for the design and presentation of the program. William Cole was also in attendance on a nonbudget basis as representative of the Management Development Center.

Participants: Senior executive officers from 24 Brazilian manufacturing firms, 3 assistant secretaries from the Brazilian Government, the Dean of the School of Engineering of the University of São Paulo formed the audience of seminar participants. A list of participants, their titles and their organizations is included as an appendix to this document. Peter Skupch, UNIDO Field Representative was in attendance and welcomed the participants and principals. Lorival Carmo Mônaco, Director of the Department of Development of the Secretary of Science and Technology also welcomed the group and endorsed the importance of this type of international cooperation in meeting the needs of Brazil in the area of productivity and quality.

Seminar Facilities: The seminar was presented in the Almedas Room of the Hotel Moffarej Sheraton. Participant seating was arranged in a "horseshoe" setting that promoted effective interchange between the participants and the principals. Teaching aids included an overhead projector and screen and a public address system. Simultaneous translation of the proceedings was provided to both participants and principals. The Vanzolini Foundation furnished a secretary to assist in administration of the seminar programme.

The Programme:

PROGRAMME FOR PILOT PROJECT IN SÃO PAULO

			Notebook Materials	Instructor
Monday, August 13:		Special session for top executives		
15 min.		Welcome		
15 min.	Vanz	Rationale for Joint Venture		
30 min.	MDC	Introduction of Participants		
2 hours	MDC	The Customer Value Paradigm (the key to identifying and managing cross-functional systems.)	Introductory Paradigm	Carothers
75 min.	Lunch			
1½ hour	MDC	The Customer Value Paradigm (continued)	Paradigm	Carothers
30 min.	MDC	The Institutes For Productivity Through Quality.		Carothers
30 min.	Vanz	International Center for Productivity Through Quality (CIPQ)		Bouer & Cymbalista
1½ hour	MDC/Vanz	Round Table with Participants		Carothers
Tuesday, August 14				
Morning	MDC	The Management of Systems: The Hornpad Case Systems Analysis	Hornpad Case System Management 0890	Kirby
Lunch				
Afternoon	MDC	Customer Value paradigm	Paradigm	Carothers
Wednesday, August 15				
Morning	MDC	Management of Systems: The 4-Headed Machine Case	4-headed Machine and Appendix	Sanders
Lunch				

Afternoon	MDC	Management of Systems: Measurement and Process Capability	Capability Studies 0790 Capability Studies 0190 Measurement 0389	Kirby
Thursday, August 16				
Morning	MDC	Use of Design of Experiments in Systems Change	Causes 0390 Causes and Effect 0390	Sanders
Lunch				
Afternoon	Vanz	Quality Function Deployment Case		Bouer
Friday, August 17				
Morning	Vanz	Quality Function Deployment Case		Cymbalista
Lunch				
2½ hour	MDC	Wrap-up Presentation that integrates the SPC presentations into the customer value paradigm.		Carothers
1½ hour	MDC/Vanz	Discussion and Evaluation		All Principals

Key Programme Components

A brief description of key programme components is given below.

The Customer Value Paradigm

This session focused on a discussion of the nature of global competition and problems with current management practices. It was emphasized that the ability to achieve and maintain a competitive position in the new global economy depends upon producing manufactured goods that feature increasingly higher levels of customer value. The three basic aspects of customer value are product quality, price, and timely product development and delivery. Furthermore, quality itself is defined broadly to include providing what the customer wants in terms of function, performance and serviceability. The necessity to consider product development time, delivery time, and

especially price, makes a single-minded focus on the elimination of production line flaws woefully inadequate.

A systems management model was presented as a strategic tool for surviving in a competitive environment. Because of the complexity of customer value, the most effective approach to the development of effective competitive behavior is the implementation of continuous improvement systems. A thorough understanding of the concepts of variation and statistical process control (SPC) coupled with a unique management approach dedicated to the identification and continuous improvement of crucial cross-functional systems has been a central component in the achievement of significantly superior manufacturing results. Discussion of the role for senior managers in this model was followed by discussion of the relationships between competition, quality, productivity, statistics, continuous improvement and comparative customer value.

The Management of Systems: The Hornpad Case

This session used a case study to illustrate how the tasks of traditional management will need to change in the new customer value paradigm. The study of the making of an automobile hornpad provided fertile ground for examining the differences between a traditional management approach to problem solving and a customer value approach to systems analysis based on statistical thinking.

Within this context, participants explored the use of such concepts as measurement variability and operational definitions and such tools as:

flowcharts
p and np charts
pareto diagrams
checklists
cause/effect diagrams
X and moving average charts.

The Management of Systems: A 4-Headed Machine

This session also utilized a case study to illustrate how managerial roles might change when a customer value paradigm is used. The study of the making of a powdered product across a 4- headed machine was the setting for the examination of some very powerful concepts related to the study of process and product variation.

Within this context, participants explored the use of such concepts as process stability and consistency across and within shifts and machines and such tools as:

R and X-Bar charts
Sampling and subgrouping

Control limits
Use of average
Use of standard deviation
Histograms.

Management of Systems: Measurement and Process Capability Studies

This session examined the concepts of process and measurement capability. System management issues around the relationship between engineering specifications and manufacturing capabilities were examined. The importance of the reliability of measurement information was also stressed.

Use of Design of Experiments in Systems Change

This session introduced the participants to the use of scatter plots, correlation analysis, and design of experiments in producing effective systems change. As case study on oxidation served as framework for a study of the use of these tools to determine the causes of unacceptable variation. System management implications were discussed as the links in delivering increasing customer value were explored.

Quality Function Deployment

This session used a case study to show how can we translate customer requirements into specific product development activities; how to use design of experiments to establish the level of the features and functions to improve product quality.

The Operating Philosophy of CIPQ. So that participants could better understand the nature of the joint venture between FCAV and MDC, a presentation was given of the operating philosophy of the CIPQ. This philosophy is closely patterned after the successful approach of the MDC. The underlying assumption of the philosophy is that industrial technology involves both hard and soft aspects. The soft aspects of technology include institutional arrangements such as organizational design and managerial strategies and actions. Productivity and quality are crucially dependent upon successful use of soft technologies. The basic tenet of the CIPQ philosophy is that the creation and assimilation of the knowledge that comprises the soft technology and its transfer to firms can best be accomplished through the same cadre of persons. In fact, the creation and assimilation of new soft technology knowledge and the transfer of that knowledge may occur simultaneously. This simultaneity is best accomplished by use of managerial institutes that are closely connected with major universities that have reputable faculties in both business management and engineering.

The typical approach of firms has been to accomplish the transfer of soft technologies through short-term contracts with consulting firms. Another standard method is to enroll middle and lower level managers in highly specialized short courses. In both cases the focus of training usually is narrow in content. In that scenario consulting firms and specialized private sector

training companies act as intermediaries between the groups that are contributing to the advancing body of knowledge and those groups that desire to put the knowledge to use. This means that research is often done at "arms length" from those who will ultimately use it, a fact which tempers the relevance of the research itself. The fact that "third parties" transfer the knowledge makes the feedback to the university tentative and imperfect. Accordingly, this distancing of theory from practice adds greatly to the time required to implement change. In the new global economy, time is more important than ever. In the MDC-CIPQ model, the same persons are responsible for creating and assimilating the soft technologies and for transferring them. This efficient feedback mechanism increases the relevance of the knowledge and the quality of its transfer and it reduces the time that elapses between the emergence of new scholarly approaches and their adaptation and validation in practice.

The MDC model that has been adopted by CIPQ calls for the creation of management institutes that are fundamentally tied to major universities and that utilize faculty from the schools of business management and engineering. This model also calls for long-term direct relationships between the management institute and manufacturing firms. In an era that features both rapid technological change in both hardware and software and escalating sources of global competition, the old model does not serve well. It is inadequate for both manufacturing firms and universities. The MDC-CIPQ model, on the other hand, provides quick and "high-powered" assistance in knowledge transfer for firms and rapid feedback an enhanced relevance for the university.

Intervention by the Director of Department of Industry and Commerce: Antonio Maciel, Director of the Department of Industry and Commerce in the Ministry of Economics requested time on the programme to address the seminar group on aspects of the Brazilian President's programme on productivity and quality that will be officially announced on November 8, 1990. His presentation of an outline of that programme was made on the morning of August 17. He also specifically endorsed the CIPQ's 'systems approach' to managing productivity and quality and predicted that the CIPQ would play an important role in assisting Brazilian industry excel in global competition. Director Maciel is in charge of the commerce and industry portion of the President's plan for productivity and quality. He pointed out that he is very familiar with the CIPQ approach to 'systems management," having received intensive training on that topic at the Management Development Center in 1989.

Endorsement by Dean of the Polytechnic School of the University of Sao Paulo: Professor Francisco Romeu Landi gave a strong endorsement to the unique educational philosophy of the Management Development Center and welcomed the development of that philosophy in Brazil through the participation of the Vanzolini Foundation in the joint venture. Professor Landi correctly noted that the MDC approach calls fundamental and ongoing inter-relationships between faculties of business and engineering and manufacturing firms. The important point is that new knowledge is created at this interface while long-term assistance is promoting to the firm. Therefore, more is involved than the transfer of knowledge.

V. PARTICIPANT EVALUATION OF THE SEMINAR

Participants in the seminar were asked to respond to a questionnaire about the usefulness of the presentations to their current problems of productivity and quality. A copy of the questionnaire is included as Appendix 2. They were also asked to comment upon the usefulness of the CIPQ joint venture for future development of their organizations. The responses were overwhelmingly affirmative. Typical comments were:

"Shows profound relevance for our situation."

"It will result in a major revision of our plans."

"[It is] highly appropriate for real world situations."

"[It] reflects the correct path to follow."

"[The program] is suitable for providing the firm with the necessities [for competing.]

"[The program] will bring an increase in productivity and quality."

VI. THE PLANNING SESSION

Dates and Location: The planning session was of three days duration, August 18-20, and took place in the Hotel Vacance at Aguas de Lindoia, S.P.

Participants. Gregorio Bouer and Melvin Cymbalista represented the Carlos Vanzolini Foundation and Harlan Carothers and Richard Sanders represented the Management Development Center. William Cole was present as a nonbudget representative of MDC and served as administrator and moderator for the sessions.

Goals of the Planning Session. The objectives of the planning session were three-fold: (1) an intensive review of the participant evaluations and a critique of the seminar; (2) agreement on a mission statement, a strategy, and a plan of implementation for future work of the joint venture, CIPQ; and (3) a draft proposal for long-term technical assistance support of the project.

Review of the Seminar. It was agreed that the formal and informal responses of the participants were very supportive of continuation and expansion of the joint venture known as CIPQ. The written responses were tabulated and summarized. Oral responses were also recalled and evaluated. In several cases presidents or directors of manufacturing firms indicated a desire that the CIPQ begin work with their firms in the near future. Antonio Maciel, Director of the Department of Industry and Commerce, asked that the CIPQ indicate to him those programs and sectors that it would like to use to support the President's program

in productivity and quality that will be announced in November. This request was the subject of much discussion at the planning session and is discussed below.

Statement of Mission. The following was agreed upon as the statement of mission of the CIPQ: To improve continuously the knowledge and behavior of industrial managers in Brazil and Latin America to the end that the better management will provide significant benefits to the respective societies. For these purposes it is deemed important that the CIPQ maintain a continuously updated perception of the needs of managers and continuously revise and design specific products to meet those needs.

Strategy of the International Center for Productivity and Quality. It was agreed that the strategy of the CIPQ will be to approach the topics of productivity and quality from the point of view of managing key systems within the firm to optimize customer value. Operationally, this will require helping firms to transition from old management behaviors to the new approach which focuses on the identification and management of key cross-functional systems and utilizes a wide range of available statistical techniques. This combination of a systems management approach and statistical techniques is used to move firms from a reactive problem solving mode to a proactive continuous improvement mode.

Implementation of the Strategy. It was agreed that it is imperative that the CIPQ make a quick, solid, and highly visible impact on Brazilian industry. At the same time, it was recognized that the resources available to the CIPQ are relatively scarce. The imperative fuels the rate of development of the program and the constraint guides the size and direction. It was therefore decided that the CIPQ should not begin by trying to offer courses in systems management and statistical techniques that would be open to all comers. Probable success with these courses would result in a demand that would tie up resources in a continuation of the same type of offerings, thereby precluding the development of a broadly based curriculum. The earliest offerings will therefore concentrate on step-by-step development of the curriculum. After resources and curriculum become more fully developed, course offerings will be made available to a full range of firms, large and small.

It was therefore decided that in terms of course offerings for the first six or so months, CIPQ would recruit four or five private firms and one government-owned firm to participate in a special program. These firms would participate in a multi-stage program with the CIPQ which would be designed to fully implement the new management approaches within their firms. The first stage would involve having five or six key persons from the top management of each firm trained in an initial one-week intensive seminar. That seminar would concentrate on the role of top management in designing and managing cross-functional systems. This would be a version of the Senior Executive Institute currently offered at the MDC, but tailored to the Brazilian industrial environment. The second stage would call for training of middle managers in both the systems approach to management and in specific statistical tools that should be employed by firms that feature continuous improvement in both products and processes. The curriculum for this stage is to be tailored to specific needs of the firms involved. The case studies will be redesigned to better reflect the environments of the specific firms. These programs will probably consist of two weeks of intensive training. The third stage involves the identification of critical systems in one of the significant manufacturing operations of each of the six firms and a determination of persons to accept

responsibility for managing those systems. The fourth stage involves actual installation of the systems management approach in the selected organizations and requires joint work by key personnel of the respective firms and the CIPQ. The final stage involves monitoring the progress of the newly installed systems, making necessary modifications and interventions as the new systems take hold.

It was also decided that an affirmative response should be made to the solicitation of the Director of the Department of Industry and Commerce that CIPQ formally participate in the Brazilian President's comprehensive program for productivity and quality. Specifically, it was decided to propose participation in the series of short programs designed to raise the level of consciousness of top managers about the importance of improved productivity and quality and to offer to produce seminars in improvement methods for one or more of the eighteen industrial sectors delineated by the President. It was thought that informatics would be an especially important sector with which to participate within the umbrella of the national quality program. We would also be willing to participate in any other sector in which global competitiveness is a requirement.

It was also emphasized that the CIPQ resource constraint had to be relaxed by (1) the training of additional Brazilian specialists, (2) the familiarization of key MDC personnel with the Brazilian industrial environment, and (3) the development of additional resources in other major Latin American countries. To that end, it was decided to suggest that there be an immediate request to UNIDO by the Brazilian Government for fellowships to begin training at MDC of other personnel from the Vanzolini Foundation. It was also agreed that faculty personnel from other Brazilian institutions would be encouraged to participate when their specialties would be useful to the CIPQ.

Proposal for Long-term Assistance. The participants in the planning session designed a three-year program for the full-fledged development of the CIPQ into an organization that would serve as a major force in the improvement of productivity and quality throughout Latin America. It calls for increases in human resources and the development of communications capacities so that the maximum effectiveness can be gained from those resources. It also calls for the development of affiliate centers in other Latin American countries, probably starting with Argentina and Chile and then moving to other important industrial centers. The magnitude of required resource development is such that it is recommended that a technical assistance request be made to UNIDO. A copy of the suggested draft proposal is found in Appendix 3.

APPENDIX 1

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APPENDIX 2

PARTICIPANT EVALUATION FORM

(Translation from the original Portuguese.)

INTERNATIONAL SEMINAR ON QUALITY AND PRODUCTIVITY
UTMDC/EPUSPFCAV

We thank you for your presence in our seminar. Furthermore, we hope to see you again in future events of this nature. In order to evaluate the appropriateness of our seminar material for your needs, we invite you to respond to the following questions.

Identification

NAME:
FIRM:
TITLE:

1. What plans does your company have to use quality and productivity for facing the national and international economic situation?

2. What type of support does your organization need for realizing its plans for productivity and quality?

3. What is your evaluation of the appropriateness of the new management concepts presented during the seminar?

4. Did the seminar materials and presentations do a good job of integrating statistical methods with the management philosophy and concepts?

5. Estimate the impact that the presented approach might have on your company's plans for productivity and quality.

6. Considering the range of topics presented in the seminar, should any have received more attention? Should any have received less?

7. Evaluate the totality of the material presented in terms of its ability to support the initiation of or increase the emphasis on excellence in quality and productivity in your organization.

8. Who else in your organization should have the opportunity to learn the material and concepts presented during this seminar?

9. What type of support do you think that the MDC and FCAV should offer to your firm in Brazil or in the USA?

10. What is the long-term interest of your organization in developing a project with MDC/UT and FCAV/EPUSP?

APPENDIX 3

TENTATIVE PROJECT PROPOSAL

Title: Support for the development of the International Center for Productivity and Quality (CIPQ)* in São Paulo: A Joint Venture of the Carlos Alberto Vanzolini Foundation and the Management Development Center

I. Objectives

A. Long-term Objectives:

To develop an international center in São Paulo that specializes in the implementation of management systems that promote continuous improvement in both productivity and quality in manufacturing firms. An important component of the program of the center will be the dissemination of statistical and other techniques that support the management of total quality and improved productivity. The Center is also to serve as a facility for developing similar institutions in other Latin American countries.

B. Short-Term and Medium-Term Objectives:
It is envisioned that a three year program will be required to make the Center fully operational and put it on a self-sustaining basis. The special assistance needs will focus on (1) the training of Brazilian faculty in the various specializations involved in the management of continuous improvement systems; (2) familiarization of the Management Development Center Faculty with the special conditions of Brazilian industry; (3) the design of special curriculum for use in Brazil; (4) initial enhanced presence of MDC faculty in the International Center's instruction and implementation efforts; and (5) support for the training of faculty for affiliate centers in other Latin American countries.

II. Rationale for a Continuous Improvement Systems approach to Productivity and Quality

The ability to achieve and maintain a competitive position in the new global economy depends upon producing manufactured goods that feature increasingly higher levels of customer value. The three basic aspects of

*The acronym is taken from the Portuguese and is derived for the Center's Brazilian name: Centro Internacional Para Produtividade e Qualidade.

customer value are product quality, price, and timely product development and delivery. Furthermore, quality itself is defined broadly to include providing what the customer wants in terms of function, performance and serviceability. The necessity to consider product development time, delivery time, and especially price, makes a single-minded focus on the elimination of production line flaws woefully inadequate.

Because of the attendant complexity, the most effective approach to the development of effective competitive behavior is the implementation of continuous improvement systems. A thorough understanding of the concepts of variation and statistical process control (SPC) coupled with a unique management approach dedicated to the identification and continuous improvement of crucial cross-functional systems has been a central component in the achievement of significantly superior manufacturing results. This has been the basic element enabling Japanese companies and the more advanced firms of other industrialized nations to produce higher quality products at a lower cost.

The key cross-functional systems are made up of components or activities from such traditional functions as product design, manufacturing operations, purchasing, cost management, logistics, and marketing. The evidence is clear, for example, that new product development is ideally viewed as a system that crosses all of these standard functions of the business unit. The cross-functional systems approach that is bolstered by application of sound statistical techniques reduces lead times for getting new products to market while simultaneously enhancing quality and reducing cost.

Techniques for identifying, fortifying, and managing those key suprasystems are crucial for the conversion of the firm into one that features a continuous improvement mode. Because improvements in management functions and the assumption of vastly new managerial responsibilities are required, intensive training must be given to all levels of management. Furthermore, because those key systems cut across the standard functional disciplines of the firm, top management must be involved in their identification and fortification.

While these effective techniques are becoming familiar to managers in many of the developed countries, they have yet to be implemented in any fundamental way by firms in most developing countries, including Brazil. Brazil's long-term prospects for economic development will depend significantly on her ability to compete with the advanced countries in the international markets for manufactures. It is therefore obvious that the issues which the new effective managerial and organizational techniques are intended to address are just as relevant to firms in Brazil as to as those in developed countries. Furthermore, there is no reason to doubt that these techniques will be equally effective in Brazil as in the developed countries and the newly industrializing countries of the Pacific rim.

The continuous improvement approach contrasts sharply with the standard approach thus far utilized by many Brazilian firms that have undertaken some efforts to improve quality. These firms have typically sent some middle and lower level managers to short training courses in statistical process control. The standard Brazilian approach has also included assignment of a middle level manager to be responsible for quality and with most of the actual training being given to lower level operatives. This, in effect, has created a quality department as a special and separate functional discipline and results in quality being considered in isolation from price. The fundamental need, however, is for the training of managers in the identification, effective design, and management of key cross-functional systems that promote total quality and at the same time enhance productivity.

III. A Strategy for Transferring Continuous Improvement Systems Technology

The usual mode of transferring soft technologies is through the use of consultants and short training courses from local specialists. Short courses of several days duration have been popular for teaching statistical techniques to operatives and have usually involved presentation of the bare basics with no direct assistance with implementation. The implementation of managerial and organizational techniques has frequently relied on the use of consulting firms for implementation. This format has drawbacks, however. Consultants usually extol one or a limited set of techniques that are relevant for only selected parts of the manufacturing process or establishment. Often, the consultants' expertise does not include the latest advances. Furthermore, the consultant's involvement is typically for a short-run duration and concerns only a particular functional group of a firm's employees.

To effectively implant all of the crucial aspects of managing for continuous improvement, a new form of institutional linkage has evolved that promotes a close affiliation between a comprehensive management institute and industrial firms in which the latter have a financial commitment lasting over a number of years. The links include not just basic training but also custom courses, in-plant consultative support, and audit team reviews. Ideally, the management institute has close ties with a comprehensive university so that it has access to a wide range of faculty from all engineering and business management disciplines. The management institute employs regular university faculty to staff its management training courses and to provide in-plant implementation assistance. In addition to a wide pool of talent, a distinct advantage over consulting firms is that the management institute's faculty is well-versed in the latest advances in theory as well as the current problems found in the field of applications. Their experience is expected to be strong in both types of activities. A prime example of a successful management institute of this type is the Management Development Center (MDC) of the University of Tennessee. It is for this reason that the Carlos Alberto Vanzolini Foundation (FCAV) has chosen to associate with the MDC in a long-term joint venture.

Effective transfer to Brazil of the soft technology of the continuous improvement systems will require the development there of a management institute equivalent to the MDC. It would be far too costly to send thousands of Brazilian managers abroad for the basic training and then import consulting services to support the implementation of the techniques. Furthermore, it is doubtful that a top quality management institute such as MDC has the capacity to provide such extensive in-plant services in an overseas setting. A far more desirable strategy would call for the development of a center in Brazil that relies heavily on the development of local talent while maintaining a long-run direct relationship with the foreign management institute. That is the rationale for the development of the International Center for Productivity and Quality (Centro International para productividade e Qualidade) - CIPQ.

IV. Philosophy and Organization of CIPQ

The philosophy of CIPQ is closely patterned after the successful approach of the MDC. The underlying assumption is that industrial technology involves both hard and soft aspects. The soft aspects include institutional arrangements, organizational design, and managerial strategies and actions. Productivity and quality are crucially dependent on the successful use of soft technologies. The basic tenet of the MDC-CIPQ philosophy is that the creation and assimilation of the knowledge base of soft technologies and their transfer to firms can best be accomplished by utilizing the same cadre of persons to accomplish both tasks. When the faculty persons have one foot in the university and one in the factory, so to speak, the relevance of research is enhanced as is the quality of its transfer. Importantly, there is a great reduction in the time between the emergence and assimilation of the new knowledge and its adoption and validation in practice.

When it is fully operational, the CIPQ will be sustained by revenues from its programs. It will operate as a joint venture between the FCAV and the MDC, fully affiliated with both parent organizations, but operationally separate from them. CIPQ will be governed by a board of directors made up of academic deans from the schools of engineering and business management of the University of São Paulo and the University of Tennessee, several presidents of manufacturing corporations, an official of the United Nations Industrial Development Organization, and one representative from each of the affiliate Latin American centers. When fully operational, the CIPQ, together with its affiliates may offer training and other support to firms in Brazil and other Latin American countries, as well as to industry in other member states of the United Nations under technical assistance programs.

V. Implementation of the Strategy

The implementation of the strategy will require financial support from an outside organization for approximately three years. This is due to the heavy start-up costs deriving from faculty training and curriculum development. The major components of

that start-up program are (1) orientation of foreign faculty, (2) training of the Brazilian faculty, (3) curriculum development, (4) support for a strong component of foreign instructors in the initial Brazilian program offerings and in-firm implementation efforts, and (5) initiation of affiliate centers in other Latin American countries. Each of these components is discussed below.

Orientation of MDC Faculty.

Key members of the MDC faculty should be made familiar with the industrial setting of Brazil and the major manufacturing problems that occur there. This will involve a short intensive seminar on the Brazilian economy and visits to manufacturing firms in and around São Paulo.

Training of Brazilian Faculty.

The persons who will comprise the Brazilian component of the faculty of the CIPQ should attend a series of intensive training courses at the MDC. The teaching strategy will involve three major aspects:(1) attendance at regular management seminars of the MDC. (2) short internships as assistants to MDC instructors, and (3) travel with MDC faculty to manufacturing sites to observe and assist the MDC faculty in the in-plant implementation work. A strong emphasis will be made throughout on demonstrating the best methods for teaching the material to industrial managers.

Twelve university faculty persons from Brazil should spend a total of 8 weeks each in intensive training at the MDC. This should probably be done in two separate sessions. Each participant would attend a senior executive seminar and two other courses selected from the following list in such a manner that all specialties are covered by at least two persons:

Statistical Process Control
Design of Experiments
Marketing for Continuous Improvement
Accounting
Continuous Process Industries
Logistics
New Product Design
System Implementation.

Design of Curriculum for CIPQ.

It will be important that a cooperative approach between MDC faculty and Brazilian faculty be taken in the design of course work that would be appropriate for use in Brazil. It will also be important that key members of the MDC faculty spend time in Brazil studying the manufacturing sector. The materials will therefore strongly reflect

the successful programs now in use by MDC, but will be tailored to fit the Brazilian environment. Materials for the full range of course offerings should be developed over the first 12 to 18 months of the three-year project. It is estimated that approximately 180 man days of effort will be required to revise existing materials and prepare new materials for a full range of course offerings.

Instructional Support for CIPQ Seminars.

While it is planned that the MDC and FCAV will cooperate in the supply of instructors to CIPQ over the long-run, it is expected that the MDC role will be especially heavy in the early stages. However, as the Brazilian faculty component gains experience, the role of MDC will be reduced. This means that instructional costs will be significantly higher in the early stages than over the long-run and will have to be subsidized if fees are to set at affordable levels.

It is estimated that 18 man-weeks of the initial direct instructional input by MDC should be supported through technical assistance sources. Because this will necessarily involve a large number of persons with different specialties, air fare costs will also be significant.

Development of Affiliate Centers in Latin America.

The CIPQ will assist UNIDO in selection of appropriate organizations in other Latin American countries to serve as bases for developing similar centers for productivity and quality. This proposal calls for training a total of 24 persons for eight weeks each in intensive courses at both the MDC and the CIPQ. That time would be split approximately equally between the U.S. and São Paulo. The content of the training would closely parallel that shown above for the initial training of Brazilian faculty. It is thought that the materials developed for Brazil would need relatively little adjustment to fit the other Latin American environments. In their roles as affiliates of CIPQ, these centers would also have direct access to the instructional resources of the MDC and the FCAV. It is thought that the synergism provided by the interaction of all of these centers will raise the greatly enhance the level of quality of each component.

VI. Suggested Timing (Very tentative)

Orientation of MDC Faculty:.....Jan. 1, 1991-May 31, 1991.

Training of Brazilian Faculty:.....Jan. 1, 1991-June 30, 1992.

Design of Curriculum:.....April 1, 1991-June 30, 1991.

Instructional Support by MDC:.....July 1, 1991-Dec. 31, 1993.

Development of Latin American affiliates:..April 1,1992-Dec. 31, 1993

VII. Hardware Requirements

- Classroom remodeling to conform to executive seminar needs
- Computers for design of experiments laboratory
- Equipment for simultaneous translation
- Equipment for satellite communication