
First appeared in *International Journal of Management Vol. 20 No.2. June, 2003*
Reprinted with permission of the editor of the Journal

TITLE: TOTAL QUALITY MANAGEMENT INFORMATION SYSTEM FOR AN AUTO PARTS MANUFACTURERS IN THE UNITED STATES

By

Jayanta K Bandyopadhyay
Central Michigan University

ABSTRACT:

In order to compete in the world markets, American businesses are striving to improve their competitive edges, and one of these competitive edges is quality. Now quality is not only a order winning criteria but also is an order qualifier for many companies. Total quality management (TQM) has been widely accepted as ways and means for achieving excellence in quality in this new millennium by many companies around the world. Multitudes of businesses in manufacturing industry have already implemented or started implementing TQM for achieving quality excellence and improving competitive edge in the world market place This paper presents the results of a survey determining the information needs for implementing total quality management by auto parts manufacturers in the United States and the presents a framework of design and development of a Total Quality Management Information System(TQMIS) for an auto parts manufacturers.

INTRODUCTION

.As advocated by A. V. Fiegenbaum in the U.S. and Kauro Ishikawa in Japan, Total Quality Management (TQM) involves management and control of quality through out the entire organization (7). In TQM marketing department collects the customer expectation data using market survey (customer / dealers) survey and provides them to product development and design department. Product development and design department in turn designs a selected variety of products to best match the needs and expectations of the target customers as provided by the marketing department. and pass the drawings to manufacturing department for fabrication and assembly. Then, manufacturing department makes parts and assembles the products according to design specifications. Quality control department regularly monitors and inspect production and assembly processes to make sure that parts and assemblies are produced according to product design specifications. Packaging and distribution's responsibility is to package and deliver the product to the customers undamaged and at just in time (8).

First appeared in *International Journal of Management Vol. 20 No.2. June, 2003*
Reprinted with permission of the editor of the Journal

TQM emphasizes on customer focus. Product quality is commonly defined as the product's fitness for its intended use which means how well the product meets the needs and expectation of its customers. Again different customers have different needs and expectations. Therefore a product must be designed to meet the needs and expectations of its target customers (1)

Marketing regularly collects and analyzes customers needs and expectation data from customer and dealer surveys and pass them down to product design department. When product design the product by incorporating as many quality characteristics as possible not just to meet but to exceed customers expectations. This is known as *design quality. Taguchi,* a Japanese Quality advocate, pointed out that products generally fail due to bad design even if manufacturing and quality control is very effective(20). In his book "*Taguchi's Method s for Product Design,* Taguchi introduced the concept of *House of Quality* for incorporating customers expectation information into technical specifications in product design. He also suggested the use of statistical methods of *Design of Experiment* for prioritizing the customers expectation data before incorporating them into technical specifications of product design. He also suggested the principles of *Robust Design* in which a product must be designed to withstand any changes in its operating environment (2).

After the product is designed, limited number of products are produced and used for test marketing to receive customer feed backs which are used for refining the design of the product to exceeds ever increasing customers expectations. Moreover, manufacturing must make the product conforming to design specifications and tolerances which is commonly is known as *quality of conformance* (1).

In current business environment, quality of a product has been regarded very often, as an order qualifier, an essential characteristics for doing business in world marketplace(3) Quality starts in the marketplace Quality is important for two reasons. First, quality is what is supplied to customers in a market place, They are known as *external customers*. and if the product is defective, these customers will be dissatisfied. and this will result in warranty repairs, return or lost sales and even in product liabilities. Second, if a process produces scrap, it creates disrupted schedules that delay supplying the customer, increases inventory or causes shortages, wastes time and effort on work centers, and increases the cost of the product. Again, the users of the product are also the company's customer, The user could also be the next work station/operation in the production/assembly lines, commonly known as *internal*

First appeared in *International Journal of Management Vol. 20 No.2. June, 2003*
Reprinted with permission of the editor of the Journal
customers. Quality at any one work center should meet or exceed the expectations (needs) of the next step in the process. This is important in being able to maintain the uninterrupted flow of material along the production/assembly line. If defects occur at one work center and are not detected until subsequent operations, then time will be wasted and the quantity needed will not be supplied (8).

In current business environment quality has been considered as *order winning criteria* (an essential criteria for winning order) or an *order qualifier* (a criteria essential to bidding for an order in world marketplace). For survival and developing competitive edge, businesses must include quality planning as an essential component in their strategic planning process. Strategic planning which involves long-term commitment of significant amount of resources must aim at producing high quality products to meet the customer demand just-in-time. On the contrary, strategic quality planning involves long-term plan and commitment of resources for developing and maintaining a quality assurance system through out the entire organization (15).

Philip Crosby waged a quality crusade through his book "*Quality is Free*", in which he disputed and challenged the traditional concepts of quality and costs. Traditionally, quality of a product can be improved by improving quality of its components and by using more back up parts which eventually increases the cost of the product. Contrary to this concept, Crosby advocated that if a product is designed and made without defect, it would increase customer satisfaction resulting in increased sales and market share, and significant decrease in costs due to bad quality such as product liability, warranty repair, and scrap costs. With increased sales, products may be produced in large volume using mass scale production technique which eventually increase productivity and reduce cost per unit (3)..

Philip Crosby advocated that products must be made without defect at the first place. High quality products increase customer satisfaction resulting in more sales. Satisfied customers not only come back again and again but also bring more new customers. Thus, the market share of a company producing high quality products increases rapidly, On the contrary, that of a company producing low quality product decreases very rapidly (3).

If the requirement is zero defect quality, then manufacturing must assure that defects will not be produced in the first place. This means that the process must be capable of producing the required quality consistently and with as close to zero defects as possible. Manufacturing must do all it can to improve the process to achieve this and then monitor the process to make sure it remains under control Various types of *statistical quality control charts* may be used for monitoring and controlling the

First appeared in *International Journal of Management Vol. 20 No.2. June, 2003*
Reprinted with permission of the editor of the Journal
production processes. Daily monitoring can best be done by the operator. If defects are discovered, the process should be stopped and the cause of the defects corrected. Again, *Poka Yokay Systems* (mistake-proof devices) may be installed in the processes so that only good quality work-in-process can move to the next work station (5). This technique was introduced by Shingo and is also known as *autonomation.* Moreover, for a process to continue to produce the required quality, machinery must be maintained in excellent condition, and this can best be achieved through a program of preventive maintenance. This is important for more reasons than quality. Low work-in-process inventories means there is little buffer available. If a machine breaks down, it will quickly have an effect on other work centers. *Preventive maintenance* starts with daily inspections, lubrication, and cleanup. Since operators usually understand how their equipment should "feel" better than anyone else, it makes more sense to have them handle this type of regular maintenance (4).

In order to carry out all processes involved in total quality management effectively starting from product design to delivery of the product to customers just in time, a large number of data must be collected, stored, processed, analyzed and retrieved(11). Proper and speedy collection, processing, storage and retrieval of data using a total quality management information system is critical to the success of TQM in a manufacturing organization (2).

DETERMINING INFORMATION NEEDS FOR TQMIS

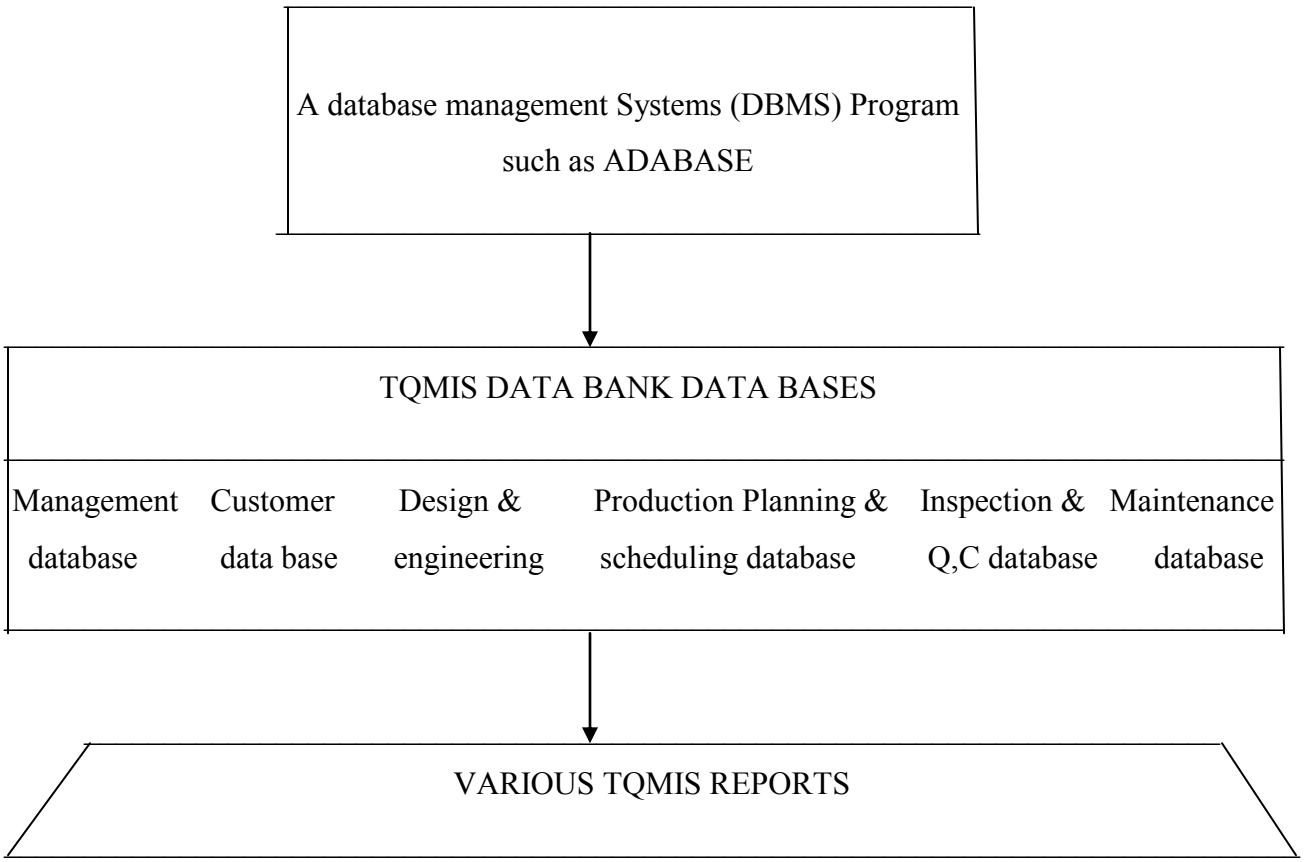
In order to design and develop a realistic Total Quality Management Information System (TQMIS), it was necessary to determine the information needs for successfully implementing total quality management by auto parts manufacturers. For determining critical information needs, 300 Michigan auto parts manufacturers were surveyed, and their Quality manager were asked to identify the critical data bases needed for successfully implementing TQM in their organization. The results of the survey revealed that the following eleven categories of data are essential for successful TQM implementation: (1) quality Policies, (2) quality Procedures, (3) quality Instructions,(4) customers needs & expectations, (5) customer satisfactions and complaints, (6) design specifications and tolerances, (4) engineering & processing instructions, (7) inspection & quality control data, (8) repair & preventive maintenance schedules, (9) employees training & development schedules, , (10) production planning & scheduling data, (11) marketing & sales data. For regularly storing, updating, retrieving, and manipulating these

First appeared in *International Journal of Management Vol. 20 No.2. June, 2003*
Reprinted with permission of the editor of the Journal
critical data a total quality management information system (TQMIS) must be designed developed and installed for successful implementation of TQM by an auto parts manufacturer.

TOTAL QUALITY MANAGEMENT INFORMATION SYSTEM(TQMIS)

The total Quality Management Information System (TQMIS) is designed as a Database Management System (DBMS) for regularly collecting, storing, retrieving, and manipulating quality related data for effectively implementing total quality management across the manufacturing organization. The TQMIS is designed with a data bank containing six distinct databases viz.

(1) Management database, (2) Customer database, (3) Design and engineering data base, (4) Inspection & Quality Control data base and (5) Maintenance database, (6) Production planning and scheduling database and a database management system (DBMS) such as ADABASE. as the data storage, organization, retrieving and processing system as shown in figure 1.



First appeared in *International Journal of Management Vol. 20 No.2. June, 2003*
Reprinted with permission of the editor of the Journal

Figure 1. A schematic diagram of a Total Quality Management Information System (TQMIS)

Management database includes management related information and data such as quality policies , quality procedures and quality instructions. Quality policies are management policy declarations for achieving quality excellence and for offering total customer satisfactions, whereas quality procedures are sets of procedures established by the management for implementing the quality policies, and quality instructions are detailed instructions for successfully carrying out quality procedures. Since 100% top management commitment is the essential element of TQM, the management data base is considered to be the most important database in a TQMIS. Management data base is updated when new policies, procedures, and instructions are introduced or any existing policy, procedure or instruction is changed or modified.

Customer database includes customer needs and expectation data, as well as customer complaints data. Customer needs and expectation data are collected regularly by marketing department through customer survey whereas customer complaints are received as they come, summarized , analyzed and recorded.

Design and engineering database includes design specifications and tolerances, processing, tooling and other engineering data. Design engineers translate customer needs and expectation data into design specifications and tolerances. On the other hand, customer complaints and suggestions are used for design corrections or modifications. Design data are stored in a Master design file, while design data are updated as design modification are made.

Inspection and Quality Control database includes Quality standards, Quality Control (QC) charts, Inspection and Quality Control procedures, rejection and rework data, instrument calibration schedules and logs and other quality related data. While Quality standards, QC charts and QC procedures are stored in a Master Quality file, rejection and rework, and calibration data are stored as they occur, while all other quality related data are updated regularly , and retrieved on demand for analysis and production of management reports.

Repair and maintenance database includes machine tools failure, repair and preventive maintenance data. Machine failure, repair and maintenance data are recorded as they occur, and are analyzed for developing effective repair and maintenance schedules.

First appeared in *International Journal of Management Vol. 20 No.2. June, 2003*
Reprinted with permission of the editor of the Journal

Production Planning and scheduling database includes sales forecast and firm orders data, bill of materials, lead times, and other planning data. While sales forecast and firm orders are used to prepare the Master Production schedule, bill of materials and lead time data are used for developing Material requirement planning (MRP) and procurement planning schedules.

The **Data Base Management System(DBMS)** is the systems program (software) such as ADABASE which loads, stores, retrieves and manipulates data and reproduces necessary outputs in desired formats for implementation of TQM through out the organization.

CONCLUSION

Since gathering data and analyzing them is essential for decision making and implementing control, a Total Quality Management Information System(TQMIS) is essential for successful implementation of TQM in an organization. Besides many small manufacturers, particularly auto parts suppliers are striving to achieve ISO-9000/QS-9000 registration with involves gathering, analyzing, and documenting enormous amount of quality related information, a TQMIS could definitely help in achieving their objectives.

REFERENCES:

1. Anderson, E and Adams D.A., "Evaluating the success of TQM Implementation" *Production and Inventory Management Journal,* APICS, Falls, Church, VI, December, 1997, p.1-6.
2. Aft, L.S., *Industrial Quality Control, Third edition,* St. Lucie Press, Boca Raton, Florida 1998.
3. Bandyopadhyay, J.K. *"* Internationalization and Harmonization of Automotive Industry Standards With QS-9000", *International Journal of Management,* London, December 1996
4. Bandyopadhyay, J.K., *QS-9000 Handbook for Implementation and Audit,* CRC Press, Tampa, FL, 1995.
5. Bandyopadhyay, J.K. " QS-9000: The new quality systems requirement for automotive industry" *Production and Inventory Management Journal,* APICS, Falls, Church, VI, December, 1996,
6. Berg, Douglas L. and William M. Harral. "The Small Company Route to ISO 9000" *Quality Digest* , July, 1998.
7. Besterfield, D.H. *Total Quality Management,* second edition, Prentice Hall, 1999.
8. Ferguson, B. " Implementing Supply Chain Management" *Production and Inventory Management Journal,* APICS, Falls, Church, VI, May , 2000, p.64-67

First appeared in *International Journal of Management Vol. 20 No.2. June, 2003*
Reprinted with permission of the editor of the Journal
9. Fletcher, Anthony G. and Rebecca M. Sukes. "Why Implement ISO 9002 If You Don't Have To?" *Quality Digest* ,November 1999, p. 37-41.

10. Geisler, Cathi D. and Richard Justus. "Training: A Strategic Tool for ISO and QS-9000 Implementation." *IIE Solutions* ,April 1998 p. 24-27.

11. Gitlow, Oppenheim & Oppenheim, *Quality Management Tools and Methods for Improvement,* second edition**,** McGraw-Hill, 1995.

12. Monden, Y. *Toyota Production System, second edition,* Industrial Engineering & Management Press, 1993

13. Gupta, Praveen and Dan Pongetti. "Are ISO/QS-9000 Certifications Worth the Time and Money?" *Quality Progress,* October 1998 p. 19-24.

14. Handfield, R. and E. Nichols, *Introduction to Supply Chain Management,* Printece Hall, 1999.

15. Inman, R.R., and Gonsalvez, D.J.A., "The Causes of Scheduling Instability in an Automotive Supply Chain" *Production and Inventory Management Journal,* APICS, Falls, Church, VI, May ,1997,

16. Larson, Melissa. "Tips for ISO 9000 Preparation: It Starts with Top Management" *Quality,* January 1999, p. 57-58.

17. Litsikas, Mary. "QS-9000 Scores High Among Suppliers." *Quality*, October 1997, p. 24-30.

18. Norris, Leslie. "The Pros and Cons of Sector-Specific Standards." *Quality Progress* ,April, 1999, p. 92-96.

19. Reid, R. Dan. "Why QS-9000 Was Developed and What's in Its Future." *Quality Progress,* April 2000, p. 115-117.

20. Wilson, Hilary W. "Do the Right Things Right ".*Quality Progress* ,December 1998, p.27-30

First appeared in *International Journal of Management Vol. 20 No.2. June, 2003*
Reprinted with permission of the editor of the Journal

C. STATEMENT OF OBJECTIVE

The primary objective of this research is to design and develop a total quality management information system for a an automobile parts manufactures. More specifically, the objectives are:

1. determine the information needs for TQM for auto parts manufacturers
2. Analyze and organize the data into various important relational data bases

First appeared in *International Journal of Management Vol. 20 No.2. June, 2003*
Reprinted with permission of the editor of the Journal

3. Design and develop a data base management system(DBMS) for collection, storage, manipulation, retrieval and usage of data for total quality management. for auto parts manufacturers.

D. RESEARCH METHODOLOGY

The information needs for total quality management of a auto parts manufacturing company will be determined by running a questionnaire survey among 300 auto part suppliers randomly selected from Directory of Michigan Manufacturers. The quality Manager of these organization will be asked to identify the specific information needs and their usage in total quality management in their organization.. A copy of the questionnaire is enclosed in the appendix.

Once the information needs and their usage are determined, they will be analyzed, organized into a matrix of data base structure using relationship among various data bases.

Then a data base management system (DBMS) will be designed and developed using relational data base design.

This database management system will be implemented and tested in CMU computer for its effectiveness.

TIME TABLE

From May 1 through August 31 : Questionnaire survey

From September 1 through October 31 : Data analysis

From November 1 through November 30: Developing data bases and

From December 1 through January 31 : designing TQMIS and testing TQMIS

First appeared in *International Journal of Management Vol. 20 No.2. June, 2003*
Reprinted with permission of the editor of the Journal

BUDGET & FUNDING SOURCES

DESCRIPTION OF THE ITEM	**ESTIMATED COST**
900 2-page Questionnaire printing @ .10c/page	$180.00
1800 envelopes @10c/envelopes	$180.00
Postage (sending return)@68c(34+34)/survey	$612.00
Data analysis and organization using computer 200 hr. @10.00/hr	$2000.00
Miscellaneous (computer disk, and supplies)	$100.00
Total	$3072.00

* We are sending 900 questionnaire expecting a 33% response rate.
** We are also enclosing a stamped return envelop for return of the questionnaire.
: for this research $300 support is expected from Management department and the rest is expected from FRCE.

RESPONSIBILITIES OF PERSONNEL

This research will be carried out solely by myself. I wish to use a graduate student (@$10/hr.)for tabulation, analysis, and organization, storage, manipulation, and retrieval of data, and testing of the TQMIS.

OUTCOMES: Outcomes of this research will be sent for editorial review and possible publication in a refereed Journal in POM/MIS area and/or will be presented in a National/International Conference in POM/MIS area.

BENEFIT TO APPLICANT & UNIVERSITY: The applicant professor will benefit from the real life experience from this applied research in his primary area of research and teaching and will be able to share his experience with his students in classroom and with his peers by publishing articles in scholarly Journals, and the university will benefit from his enriched teaching and scholarly activities.

This research will also be a learning experience for the student in analyzing data and testing the computerized data base management system.

REFERENCES:

1. Aft, L.S., *Industrial Quality Control, Third edition,* St. Lucie Press, Boca Raton, Florida 1998.
2. Bandyopadhyay, J.K. ″ Internationalization and Harmonization of Automotive Industry Standards With QS-9000", *International Journal of Management,* London, U. K., December 1996
3. Besterfield, D.H. *Total Quality Management,* second edition, Prentice Hall, 1999.

First appeared in *International Journal of Management Vol. 20 No.2. June, 2003*
Reprinted with permission of the editor of the Journal
4. Gitlow, Oppenheim & Oppenheim, *Quality Management Tools and Methods for Improvement,* second edition**,** McGraw-Hill, 1995.

5. Hall, R.W., *Attaining Manufacturing Excellence,* McGraw-Hill , 1987.

6. Monden, Y. *Toyota Production System, second edition,* Industrial Engineering & Management Press, 1993

TQMIS INFORMATION NEEDS QUESTIONNAIRE

1. Has your company implemented Total Quality Management? ____ yes, ____ No.

2. Do you already have a Total Quality Management Information System(TQMIS) ___ yes, __ No

3. Rank in order of importance from 1(lowest) through 10 (highest), the following information needs for your TQM efforts:

_____ customers needs & expectation data

_____ customer satisfaction data

_____ design specifications data

_____ engineering & processing data

_____ inspection & quality control data

_____ repair & preventive maintenance data

_____ employees training & development data

_____ scrap & rework data

_____ production planning & scheduling data

_____ marketing & sales data

_____ costing & accounting information data

_____ other data, specify _____

4.How frequently you collect the following information? d= daily, w= weekly, m= monthly,

_____ customers needs & expectation data

_____ customer satisfaction data

_____ design specifications data

First appeared in *International Journal of Management Vol. 20 No.2. June, 2003*
Reprinted with permission of the editor of the Journal

_____ engineering & processing data

_____ inspection & quality control data

_____ repair & preventive maintenance data

_____ employees training & development data

_____ scrap & rework data

_____ production planning & scheduling data

_____ marketing & sales data

_____ costing & accounting information data

_____ other data, specify _____

To

The V.P. of Quality,

ABC Manufacturer

Motor City , Michigan

RE: Total Quality Management Information Needs Survey

I am running a survey to determine the information needs for total quality management in auto parts manufacturing and supply. Please take a few minutes to fill out the survey and mail it to me

First appeared in *International Journal of Management Vol. 20 No.2. June, 2003*
Reprinted with permission of the editor of the Journal
with the enclosed stamped envelop. Your input is very important for developing a total quality management information system for auto manufacturers. Any information supplied by you will be treated with strict confidentiality, and once we develop and design the system, we shall be glad to share with you.

Thanking you,

Sincerely,

J..K. Bandyopadhyay, Ph.D in I.E. CFPIM, CQA, IQA

Professor of Production & Quality Management

March 23, 2001

Dr. Bob A. Howell, Chair
FRCE Committee of Academic Senate
Office of Research
Foust 2444451
CMU Campus

RE: Resubmission of my research proposal entitled TQM Information System

Dr, Howell,

Thank you very much for your letter dated March 22, 2001. I also like to thank your committee members for reviewing my original proposal and for their suggestions for improving the proposal.

Regarding their concern about the significance of the project, I like to state that TQM is the way of achieving competitiveness in international marketplace, and TQM implementation is being currently considered as the number one strategy by auto parts suppliers in America and

First appeared in *International Journal of Management Vol. 20 No.2. June, 2003*
Reprinted with permission of the editor of the Journal
probably all over the world. Total quality Management may be defined as a strategy for achieving quality excellence through out an organization . It involves continuous improvement of all functions of an organization using rigorous training of quality personnel, upgrading machinery and equipment, and continuous monitoring and control of manufacturing and other operations. Its goal is to achieve total customers satisfaction. Therefore, customers needs and expectations data must be collected, prioritized and passed down to the design department which translates them into product design specifications, then processing manufactures the product conforming to product design specifications, Conformance is generally checked by quality control and inspection. Products are then packaged and delivered to customers. Customer satisfaction data are collected and fed back to design again for further improvement of the product. Thus, implementation of TQM involves processing of large volume of data such as customers needs and expectations, design specifications, engineering and processing capabilities, and quality control standards, charts, and inspection results.

Therefore, developing an well organized Management information system (MIS)with appropriate databases is essential for implementing TQM in any organization. The purpose of the questionnaire survey is to seek the type of TQM related data being regularly collected, stored, retrieved and used by auto parts suppliers for implementing TQM in their organization, so that a more generalized Database management system (DBMS)can be developed for implementing TQM by auto parts supplier in general. Such a DBMS, when developed will be of significant benefit to multitudes of auto parts suppliers in the United States and possible in the whole world, Just like the way SAP has benefited the multitudes of businesses in the whole world. I am quite sure, that after completing this research, I shall be able to publish this paper in a Journal of International reputation, and with this idea I shall be able to apply to U.S. Gov. technology development fund for external funding for developing a full scale TQMIS.

According to ORSP guidelines, I shall accept $.05 per envelope, and $.05 per page for copying, but if I do not include a stamped envelope, I am afraid that response rate will be significantly reduced far below 33%. Also, I shall be using a graduate student in MIS for data analysis and organization of data, and possibly programming in dBase, therefore, I need at least $10./hr.

With the above explanation I am resubmitting my proposal and I hope that the committee will reconsider my proposal and approve it, so that I can start working on this project without further delay.

Sincerely,

.J. Bandyopadhyay, Professor
Production & Quality Management