

# Total Quality Management, Just-In-Time, And Their Effect On Small Manufacturers

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## ABSTRACT

*This paper examines components of TQM/JIT as they relate to small manufacturers. Particularly, those components that specifically relate to small volume manufacturing firms are discussed within the framework of the authors' experiences with small manufacturers in Southern California. Common difficulties encountered in small businesses in their effort to implement TQM/JIT are examined.*

## INTRODUCTION

The nature and the rules of competition are changing as rapidly for small businesses as for the large ones due to increased domestic competition and the competition from such countries as Japan, Korea, Taiwan, and others. This has put increased pressure on U.S. managers to adopt the same strategies and tactics as their foreign competitors in their manufacturing operations. Many small businesses are striving to use technological and managerial innovations to increase their productivity and competitiveness by adopting new methodologies or technologies in product, process and operational control of their enterprise. Developing global standards for service, quality and pricing is now a requirement, especially when considering changes that are taking place in the Far East and in Europe. Deregulation in the fields of transportation and communications and advances in computers and information processing systems have highlighted the need for small businesses to enhance the efficiency and effectiveness of their operations. Mittelstadt succinctly states, as reported in *Industrial Engineering* (8):

*"The importance of small business to the economic and social vitality of the country makes it essential that the same means of achieving greater efficiencies increasingly employed by the large manufacturers be brought within practical reach of the thousands and thousands of shops and plants—small industrial concerns—that support local communities all across the land."*

However, small businesses are encountering problems in their implementation efforts which are different from those faced by larger organizations. Small businesses typically lack the financial and human resources, technical expertise, and the lower volume nature of their manufacturing, making it more difficult to capitalize on the benefits of TQM/JIT. Smaller traditional companies are increasingly threatened by foreign competition. To be a world competitor, products and services will have to achieve high quality, reasonable cost, and

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excellent on-time-delivery. Total quality management (TQM) and just-in-time (JIT) are the current management and industrial philosophies and methodologies that aim to achieve the above objectives simultaneously. TQM and JIT are mutually supportive and form an integrated system. Small and large Japanese manufacturers have been most successful in applying the two-pronged approach (6).

Total quality management represents a structured approach to improve quality and productivity. It requires participation by everyone in the company, from top to bottom, cooperation with suppliers and dealers, and usage of statistical process control. JIT attempts to produce or procure products and services at the right time in the right quantity in the right place. It emphasizes reduction in: 1) inventory and space requirement, 2) production and delivery leadtime, 3) set-up time, 4) lot size, and 5) defective rates. Both TQM and JIT rely heavily on teamwork.

Major corporations such as Ford, Hewlett Packard, Motorola, IBM, and Xerox are undertaking the implementation of TQM/JIT and are requiring their suppliers to do likewise. Motorola, in particular, is now encouraging its suppliers to compete for the Malcolm Baldrige National Quality Award. In 1988, Motorola and a division of Westinghouse received the coveted Baldrige Award; the winner in the small business with outstanding quality category was Globe Metallurgical (5). Milliken and a division of Xerox won the 1989 award (22). However, no small business was awarded the prize in 1989! Small businesses will have to do more in quality improvement.

Most of the Fortune 1000 companies have some kind of JIT efforts underway (24). In a national survey of manufacturing managers, respondents agreed by a two-to-one margin that broad based improvement systems such as TQM, JIT, and CIM (computer integrated manufacturing) offer the greatest potential for improving quality and reducing manufacturing costs (17). According to Manoochehri, "small companies, as well as large ones, in variety of industries, could be adopting JIT. In fact, many Toyota suppliers that have adopted JIT are very small companies, as are many suppliers of Hewlett-Packard, GE, Ford, and Xerox (19)."

JIT manufacturing is a philosophy and a practice with a solid history of success in Japan and growing success in the U.S.. JIT is a manufacturing control system that impacts all sectors of a manufacturing enterprise. However, when managers of a number of small manufacturers were asked if they implemented JIT in their organization (29), the unanimous response was "we do not carry enough financial clout to make demands of our suppliers the way our JIT customers do of us." Additionally, small manufacturers are subjected to a variety of demands from their larger customers who demand documented proof for quality compliance. However, even when documents do exist, they are mainly inspection related and do not tell the whole quality story. Finally, capital expenditures that are needed for successful implementation of productivity improvements systems are always in short supply in small manufacturing companies.

This article examines components of TQM/JIT and their effect and applicability as they relate to small manufacturers. Particularly, individual components of TQM/JIT that specifically relate to small volume manufacturing firms are discussed within the framework of the authors' experiences with small manufacturers in Southern California. Common difficulties encountered in small businesses in their effort to implement TQM/JIT are examined.

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## TOTAL QUALITY MANAGEMENT AND SMALL BUSINESSES

TQM is a system for planning and implementing quality at each stage of design, production, sales and service. We have summarized the main features of TQM/JIT in Table 1. The objectives of TQM can be approached from different vantage points. However, Deming has formulated a consistent system of continuous improvement that applies to large manufacturers as well as small businesses (8). Deming emphasizes:

- Create constancy of purpose toward improvement of product and service and adopt a new philosophy of continuous improvement.
- Cease dependence on inspection; build quality into the product.
- End the practice of awarding business on the basis of price tag. Instead, minimize total cost and move toward a single supplier on a long-term relationship of loyalty and trust.
- Institute rigorous program of training, education, and self-improvement.
- Provide leadership to help people and machines to do a better job and eliminate numerical quotas, rigid goals and management by objectives.
- Drive out fear, so everyone may work effectively for the company.
- Break down barriers between departments.
- Remove the barriers that rob the employee of his or her right to pride of workmanship.
- Put everyone in the company to work to accomplish the transformation.

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**Table 1. The Important Attributes of TQM/JIT**

COMPANY-WIDE QC
FUNCTIONAL AND CROSS-FUNCTIONAL QC
TOP-DOWN
BOTTOM-UP QC CIRCLES/QUALITY TEAMS
TQM FOR COOPERATING COMPANIES
STATISTICAL PROCESS CONTROL
SOURCE-INSPECTION & SELF INSPECTION
ANDON OR VISIBLE CONTROL SYSTEM
FOOLPROOF DESIGN
SMALL LOT PRODUCTION
MIXED MODEL PRODUCTION
JIDOKA OR STOPPING OPERATION WHEN PROBLEMS ARISE
MULTI-SKILL TRAINING AND ASSIGNMENT
INVENTORY AND KANBAN CONTROL
MULTI-FUNCTIONAL TRAINING AND ASSIGNMENT
SET-UP TIME REDUCTION
SINGLE MINUTES EXCHANGE OF DIES
GROUP TECHNOLOGY AND CELLULAR MANUFACTURING
U-SHAPED LAYOUT
JIT PURCHASING AND DELIVERY

Our experience and research indicates that the implementation of TQM for small companies usually moves forward along the time table as depicted in Table 2.

**Table 2. A Prototype TQM Implementation Schedule for Small Businesses**

MONTH	ITEMS	TIME
1	<b>Top Management Sessions</b> TQM Concept, Methodology and Practice Corporate Philosophy and Policy	2 days
2,3	<b>Middle Management Sessions</b> TQM Concept and Methodologies Statistical Process Control Group Dynamics and Teamwork	2 days
3, 4	<b>Professional and Technical Personnel</b>	3 days
4, 5	<b>QC Team Facilitators</b>	1 day
6	<b>TQM Introduction: Kick-off</b> Announcement: Selection of Projects	
8	<b>TQM for Cooperating Companies</b>	
11, 12	<b>QC Presentations, Quality Fair</b>	
14	<b>Follow-Up/Review</b> Setting Goals For Next Year	
18	<b>Intermediate Review and Feedback By Top Management:</b> Feedback on Improvement	
23, 24	<b>Long-range Review and Feedback</b>	

## JUST-IN-TIME AND SMALL BUSINESSES

JIT consists of a set of manufacturing techniques/philosophies that affects all areas of manufacturing. JIT attempts to eliminate unnecessary activities and inventories by making only what is needed. Different authors emphasis distinct aspects or methodologies of the JIT system. Gun (11), for example, has identified major components of JIT as: multi-functional employees and employee involvement, workplace organization for performance and good housekeeping, preventative maintenance, standard containers, and minimizing setup time. Based on our own experiences, we believe the following techniques/methodologies are useful for small businesses.

### Inventory Control System

Inventory has always been used as a buffer for production variation. JIT used to be viewed primarily as an inventory reduction technique. However, it is also related to the questions of how and when to automate and how to take advantage of new technology in a manufacturing setting.

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It considers inventory to be one of the wastes in manufacturing and the cause of major expenditure in excess storage facility, material handling equipment, expensive information and control software (e.g., MRP systems), pilferage, obsolescence and even excess taxes. JIT avoids relying on inventory stocks to provide a steady workload, but instead relies on demand to "pull" the products through the production line using the Kanban system (Kanbans are cards that authorize production or withdrawal of products at each stage of manufacturing process (25)). In actual practice, the work-in-process (WIP) inventory does not decrease very much for small manufacturers since majority are operating under a make-to-order environment; however, there is some reduction in purchased (raw) material inventory. In any case, most small manufacturers try to keep minimal inventories because of cash flow constraints.

A smooth production schedule is necessary for JIT to function, otherwise, buffer inventories will be needed to avoid material stockouts. However, under this system, deviations in excess of 10% in the production schedule have an adverse impact on JIT implementation and the system begins to break down. JIT tries to eliminate or minimize the sources of uncertainty and variation in the production and distribution system. JIT uses a less than full capacity to schedule production to ensure that the daily production satisfies the demand requirement. Furthermore, this allows for stopping the production line and rectifying difficulties should problems arise. The lower production puts a lesser demand on the workers, machines, tools, and the support staff.

### **Multi-Functional Workers**

Cross-training of employees, both vertically and horizontally, is an aspect of JIT that is equally applicable to small manufacturers as to large ones. Often, this occurs naturally since there are fewer employees to accomplish a variety of tasks. Multi-trained employees provide employers with greater flexibility to accomplish day-to-day activities. Surprisingly, it seems the cross-training is not as extensive as one might expect in many small businesses. For example, in one company with over twenty employees, workers are divided into three major classifications of machinist, painters and welders with very little cross-training among the groups. The management considered the skills to be totally different and cross training not justified at all.

One of the most important aspects of JIT is the production line workers ability to stop the line. The concept focuses on the workers identifying problems or defectives from previous work stations and defective material parts from suppliers. If there are any perceived problems, the worker is allowed and encouraged to stop the work on the line and then begin to solve the problem. The most important element in problem solving is the line worker; he/she has the most experience on the machine since the day by day observations makes the machine worker an "expert."

### **Setup Time**

One of the greatest benefits derived from a JIT system is in the area of machine setup times. Any machine shop whether large or small can reap economical benefits by reducing its machine setup times. The shorter setups reduce the lot sizes. The biggest advantage of a small lot size is that problems can be identified soon before any defective products are made. A major impediment to setup reduction in small businesses has been lack of technical and engineering support such as industrial and manufacturing engineers. This is mainly due to cost consideration and not having the proper or adequate staff. For example, in one company the numerically controlled milling machines had to be re-programmed for the slightest change to each part moving through the machining station. Considering the pure cost pressure, there is an inadequate number of employees to perform this task efficiently. Furthermore, many small

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businesses use equipment that are very old, e.g., 20-40 year-old equipment is not unheard of with setup processes that can not or have not been altered since the equipment was first purchased. This can be a great opportunity for instituting setup time improvements.

### **Group Technology and Cellular Manufacturing**

The goal of group technology (GT) is to reduce the amount of material movement within the plant. The benefits of GT include reduced material handling equipment and transportation time between operations. GT uses parts classification coding to eliminate redundancies and to describe the part by its manufacturing process. The important contribution of group technology is that once the manufacturing process is defined the machines can be arranged to produce the part. This means that the set-up time is reduced since the same machine can work on a family of products. Although, conceptually, grouping of machinery may be useful in small manufacturers as in larger ones, the experience shows this to be untrue. Small manufacturers tend to be classified as job shops, i.e., having low volume and high variety products. Under this circumstance the application of JIT is more difficult than in flow shop environment. Contrary to arguments made by Manoochehri (19), it may be more difficult to implement group technology in a small company than a large or medium size company because of the limitation in the number of equipment and resources. More often than not, a small company can not convert to a more repetitive operation. It is, however, possible to reduce production lead time which can in turn help increase flexibility for production planning purposes. In practice, except for minor changes or revision to layout, the job shop environment usually does not change very much.

### **Purchasing and Delivery**

Whether JIT is introduced to a small or a large business, some of the changes most likely to occur will be experienced in the area of purchasing. One of the goals of JIT is to ultimately eliminate all receiving inspections. This requires a good, close working relationship with suppliers. The primary attributes to be considered include:

1. Developing longer-term contracts with smaller and more frequent deliveries
2. Shrinking the supplier base.
3. Taking an active role in the selection of transportation.
4. Establishing a close buyer-supplier relationship.
5. Establish a system of negotiated prices

Small manufacturers need to analyze and identify high volume, high dollar parts that lend themselves readily to JIT environment since it can increase the financial benefits. In general, many small manufacturers do not spend much effort on supplier relationships because they rightly assume there is not sufficient leverage to make this a viable relationship. Although increased communication is helpful, this is not sufficient to change the approach to the production processes of their suppliers.

Under the JIT philosophy, price considerations becomes less important than adherence to delivery schedules and quality standards. Since deliveries become more frequent under JIT, the issue of transportation becomes more important. The potential transportation costs incurred can be enormous. Thirty percent of motor carriers are currently offering services to meet JIT delivery standards (4). Since zero quality defects and on-time deliveries are two of the cornerstones of JIT, price takes on less importance when evaluating suppliers. Additionally, by coordinating the

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compatibility of in-plant containers as well as supplier's containers and material handling equipment, substantial cost savings can be recognized. Only stock items that can be purchased off-the-shelf can usually be made to be delivered on schedule for small manufacturers. Many of the sole sources are not geared to schedule orders closely nor provide precise delivery times. One must realize that prices of items that are negotiated are not only determined by the quantity of the order but also the release schedule accompanying the orders. The longer the supplier has to carry the inventory the higher the price.

## CONCLUSIONS

Small manufacturers have a number of disadvantages with respect to larger ones in their quest to fully utilize a JIT system. Generally speaking, small manufacturers do not have much leverage with their own vendors. However, because of deregulation and increased competition in the trucking business it is possible to obtain fast delivery (JIT delivery) provided one is willing to accept the additional costs that are involved (4). Also by reducing the number of suppliers to as few as possible and by approaching small suppliers, one can obtain a certain degree of leverage that might otherwise be minimal or non-existent. Because of the smallness of the business, training multi-skilled workers is relatively easier and more beneficial. When ordering from suppliers, not all orders need to be processed immediately but can be delayed to increase the uniformity of production plans. One of the main advantages of JIT for small manufacturers is its rather simple information system requirement. Often times a full module MRP package is not required and a data base of parts and prices would suffice for determining the required inventory and financial data.

Many small businesses often insist that their operations are non-repetitive, and process-oriented; hence, TQM/JIT would not apply. Many techniques of TQM/JIT are appropriate regardless of the type of manufacturing (2). The proper attitude should be to investigate those TQM/JIT approaches that are most pertinent and attempt to adopt them for a particular operation. Listed below are some suggestions for use in the application of TQM/JIT techniques:

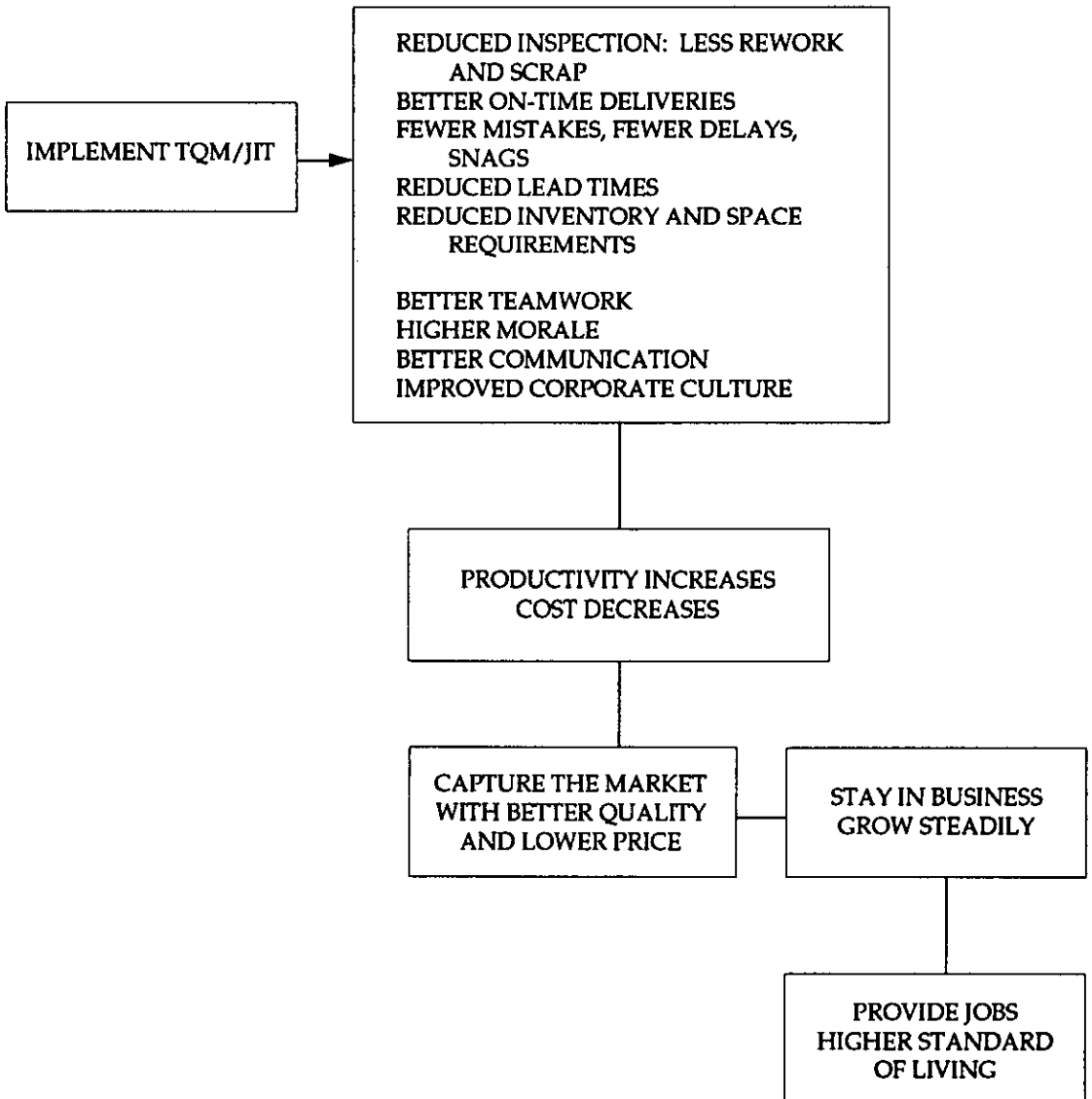
1. Recognize repetitive procedures that are most appropriate for JIT application.
2. Expand market to realize a high volume repetitive production.
3. Use statistics that are more appropriate for short-run production, including run charts and c-charts.
4. Examine TQM/JIT techniques that are appropriate for job shop operations, e.g., company-wide quality management, source inspection, foolproof design, multi-functional training and assignment, group technology and cellular manufacturing, small lot production, reduction of set-up time and lead time, and cooperation with suppliers.

A schematic of the evolutionary steps of TQM/JIT is depicted in Figure 1 to indicate the direction of the implementation process.

Competitiveness is the aggregation of management know how, process capability, and employee expertise and discipline. Small manufacturers, as larger ones, can improve their competitive position by improving their quality, shortening their lead times and improving their flexibility [See for example, Simmers, Priest, and Gary (26)]. Although employing JIT concepts is very useful, small businesses must proceed with caution. Because of the advantage that a large company may have in pressuring a supplier, small suppliers are at a relative disadvantage and there is a definite need to cooperate in the TQM/JIT undertaking to benefit both.

The introduction of TQM/JIT should be gradual. Training and informational seminars should precede any actual physical implementation. It is important to establish ownership of TQM/JIT internally before approaching suppliers. The transition stage to TQM/JIT is a difficult process at best and it can take a long time without any guarantees of success. A successful TQM/JIT implementation provides for a more flexible, balanced and simpler production process. As a result it may become easier to implement an automation project such as robots, automated guided vehicles (AGV's), etc. Small businesses must strive to meet the requirements of their customers who are putting pressures on them to comply with TQM/JIT implementations.

**Figure 1. Chain Reaction of TQM/JIT Improvement**





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