THE APPLICATION OF FOCUSED MANAGEMENT IN THE ELECTRONICS INDUSTRY

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Focused management technology (FMT) is a managerial approach to increasing profitability by reducing response times, increasing throughput, improving quality and broadening the product portfolio.

FMT offers a synergy of the new and already well-established management philosophies and techniques [1, 3 ,5, 10], namely, Just-in-Time (JIT), total quality management (TQM) [4], the theory of constraints (TOC), group technology (GT), global and effective performance measurements (GEPM) [7], and the complete kit (CK) [8]. These techniques and their underlying philosophies are modified and tailored to meet the special environment and the specific needs of the electronics industry. In this article the integration of FMT into the electronics industry is explained, and a successful implementation of FMT concepts in a leading Israeli electronics company is demonstrated.

THE COMPANY

The company is a leading Israeli developer and manufacturer of ground and airborne radar systems and other high-technology military equipment. A subsidiary of a $1.5 billion sales conglomerate, it has annual sales of over $250 million, and more than 2,500 employees, a third of whom are engineers. This case centers on a five-year $100 million project consisting of "build to print" mechanical and electronic subassemblies, in which the company operated as subcontractor for a multibillion dollar American contractor. The case described focuses on the assembly of surface-mounted-component (SMC) circuits.

Initial Situation

The project produced 30 types of modules, utilizing 6,000 types of components manufactured by 50 suppliers. Circuits required up to 2,000 soldering points per board. The assembly of the SMC modules consisted of 21 steps (Table 1).

Production layout centered around the supervisor, in a star-type architecture (Figure 1). All circuits in the production process were brought to the supervisor's desk after completion of each step. The supervisor would examine the circuit, report its status into the mainframe computer employed to monitor production status, and personally transfer it to the next station.

Batch processing in the mainframe delayed the production of a status report by a day, by which time the status had usually already changed. Moreover, the status report was plagued with errors due to the large number of status options and the high levels of work in process (WIP)—about 300 circuits in 21 stations. These status report errors strained the communication between production and quality control departments and resulted in reciprocal finger pointing.

The Problems

Because of the company's poor due-date performance (DDP) the contractor was about to cancel the contract. Supply was one year behind schedule.

There were also acute quality problems. The military standard (MIL STD) quality specifications applied to this project were very strict: defining a supplier's quality yield as "the number of acceptable modules divided by the total number of modules received." The contractor stated that "rating below 80% is considered to be unacceptable performance and may impact future procurement activity with your firm." The project's yield was at the 50%–55% level. The main reason for the failure to meet the quality standards was a corrosion problem with the boards, on which a circuit

TABLE 1: Initial Assembly Steps

1. Kit preparation	11. Laboratory tuning
2. Placement of components	12. Jumper installation
3. Component soldering	13. Final inspection
4. Jumper installation and soldering	14. Cleansing
5. Mechanical assembly	15. Lacquering
6. First inspection	16. Cleansing and lacquering inspection
7. First repair	17. Repair
8. Second inspection	18. Customer inspection
9. Second repair	19. Customer repair
10. Third inspection	20. Customer inspection and approval
	21. Packing

technology expert consulting to the company was unable to offer any significant help. The contractor was seriously considering terminating the contract.

IMPLEMENTATION OF THE FMT METHODOLOGY

Implementation of the FMT methodology was carried out by the employees of the company. The goal was to improve DDP and quality and save the contract.

The first move was an in-house management workshop in which the basic concepts of FMT were presented and the problems defined in terms of these basic concepts.

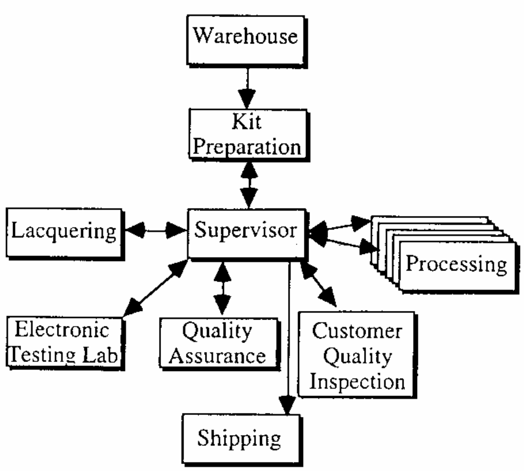

FIGURE 1: Initial production flow in the department

This workshop was followed by a four-day seminar held in two sessions of two days each. All top- and middle-level managers participated in this seminar. The first two days were devoted to a general detailed introduction to FMT. The participants were exposed to JIT, TOC, GT and the complete-kit concepts and techniques. Then there was a ten-day break. An assignment was given to all participants: to check the validity of FMT to the organization as a whole, and to their immediate environment in particular.

In the second two-day session, quality principles and techniques were presented. During the rest of the time the participants described and defined problems, and evaluated the application of FMT solutions. The seminar ended with a consensus on the appropriateness of the FMT solution for the company's problems, and with a clear, agreed-upon operational plan for process improvement. The plan consisted of two stages:

- Streamline the production process to reduce the DDP backlog.
- Improve the quality yield to levels acceptable to the customer via the TQM methodology.

Management By Constraints

An important component of the TOC methodology is the constraint-management cycle [3] delineated in Figure 2.

The supervisor was identified as the system's constraint; it was considered a "policy" constraint [9]. The position's key responsibility in quality assurance and process monitoring resulted in its becoming a bottleneck with a large backlog and high levels of WIP.

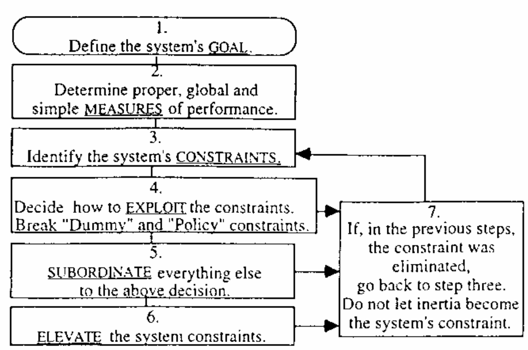

FIGURE 2: TOC's constraint management cycle

The tools used were the drum-buffer-rope (DBR) technique (see [11]), the gating mechanism [8], and the cost/utilization diagram [9]. Exploitation of the bottleneck station [6] increased the process throughput significantly.

The drastic measure introduced to break this constraint was to redesign the process and apply group-technology principles to it.

Group Technology

Two types of modules were identified and each was assigned a dedicated path in the process. By splitting the 50 persons working in the process into two groups, each responsible for a single type of board, the process became more manageable. In addition, knowledge for each group was more specific and accessible. Transfer batches were no longer transferred through the supervisor, but were passed upon completion to the next station (Figure 3).

Individual stations were responsible for their own WIP management, processing and quality assurance. The reorganization of work in the department resulted in a reduction of the number of steps in the process from 21 to seven. Streamlining the operation and simplifying it meant shorter lead times, less WIP and more throughput (see [1]).

Complete-Kit Management

One of the fundamentals of good operations management practices is the complete-kit (CK) concept, which suggests that work should not start until all the items required for completion of the job are available. These items (the kit) include components, tools, drawings and information.

Starting a job with an incomplete kit means more labor time to finish the job, longer lead time, more WIP, reduced throughput, poor quality and impairment of DDP.

The complete-kit philosophy was introduced into the organization as follows:

1. The introduction of CK processes as part of the FMT implementation was treated as a major change in the organization.
2. Top management was involved in the process.
3. One person was appointed to be in charge of CK. This person (the gater) was charged with the release of kits to the floor.
4. The process was monitored; Pareto charts were drawn, classifying incomplete kits.
5. Employees and internal customers were informed of the change.

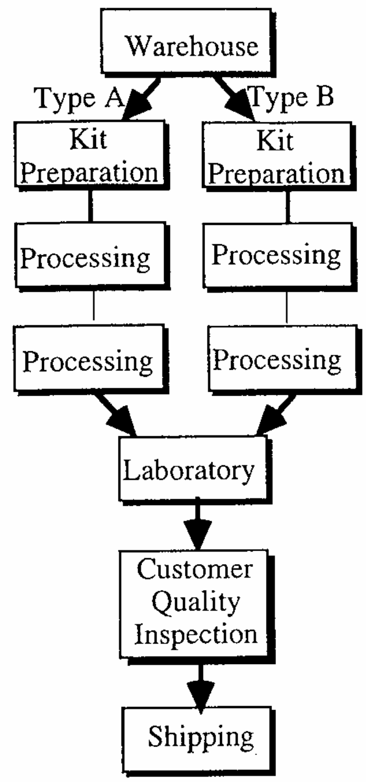

FIGURE 3: Redesigned production flow in the department

6. External customers were notified that they would get better DDP and better quoted lead times if they submitted a CK.
7. The contents of the CK were redefined from time to time, according to the circumstances.
8. Components and materials for both internal and external suppliers were ordered in CKs.
9. Operations were synchronized, ensuring that the outkit of the current operation would be the inkit of the next operation.
10. Components and procedures were standardized and common assembly parts used whenever possible.

The JIT philosophy was applied throughout the process by reducing production and transfer batch sizes.

Prior to the introduction of FMT, the kit preparation station withdrew batches equal to six months of supplies from the warehouse. This figure was reduced to five kits (less than a week's supply). Also, prior to the introduction of FMT, WIP consisted of about 300 boards. This number was reduced to 60 boards.

TOC's DBR [11] methodology for the reduction of WIP and for streamlining the production process was introduced. The constraint in the redesigned process was at the soldering station—the position selected by management. Thus the drum was defined as the soldering department. The DBR methodology tied the rate of warehouse supplies to the rate at which the soldering station completed its processing.The buffer of WIP was designed as follows:

- One circuit at each station
- One circuit at inspection / rework
- One circuit in buffer awaiting soldering.

Thus for about 20 soldering workers there was an inventory of about 60 boards in assembly prior to the electronic inspection in the laboratory. The rope—the mechanism for managing the flow in the process—was determined to be board completion and delivery to the laboratory. This guaranteed a fixed number of boards in the buffer.

Prior to the introduction of FMT, shipping batches to the customers had been performed on a monthly basis, towards the end of the month. Following the introduction of FMT, batches were shipped every two weeks, eliminating the end-of-the-month anxiety syndrome. DBR reduced WIP turnover from four months to a mere two weeks. Management's responsibility was to:

- Guarantee the flow of boards
- Reduce the lead time for board assembly by controlling processing, waiting and transfer times
- Improve process quality.

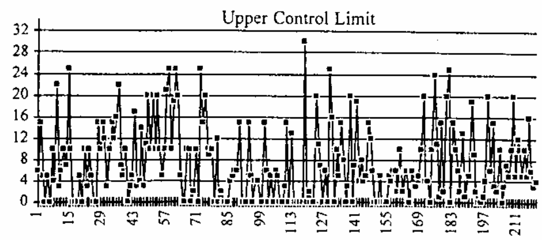

FIGURE 5: Control chart of soldering defects per SMC board.

Total Quality Management

Line workers were introduced to the principles of TQM. Assuring the final quality to the client became their responsibility rather than that of the quality control department. They were trained in performing visual inspection, fault prevention, electrostatic impact on the board and flake prevention.

The quality management cycle [2], a structured combination of FMT tools into a cycle of ongoing improvement, was introduced. The tools employed included Pareto charts (Figure 4).

The reduced WIP contributed greatly to reducing corrosion. The quality yield following the last stage of FMT implementation was 90%–99%, depending on the type of board. This is demonstrated by the control chart (Figure 5) monitoring soldering defects, which shows that the introduction of FMT brought soldering

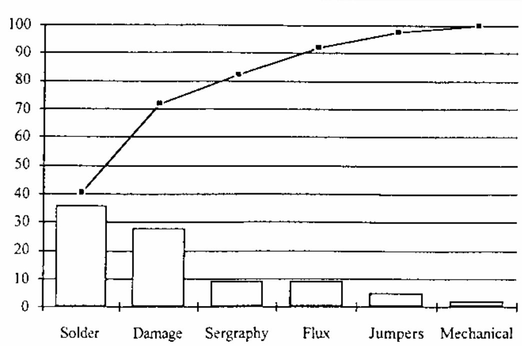

FIGURE 4: Pareto analysis of pre-lab reject causes

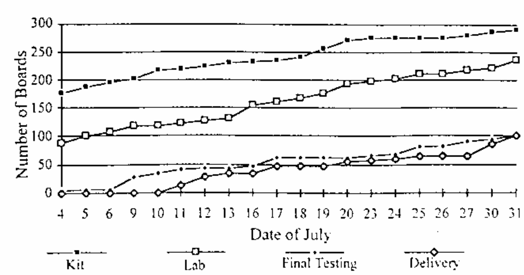

FIGURE 6: Production monitoring report for SMC boards

TABLE 2: Before and After Performance Measures

Measure	*Before*	*After*
Throughput		
Worker hours/circuit	1.5 weeks	1.5 days
Sales	$0.5 million/month	$1.5 million/month
Operating expenses	No increase in personnel or equipment	
Lead time	6 months	3 weeks
Due-date performance	One-year delay	100% on time
Work in process		
WIP turnover	4 months	2 weeks
Number of circuits	300 circuits	60 circuits
Warehouse batch size	Six months' components	5 kits
Shipping batch size	One-month production	Bi-weekly production
Quality yield	50%–55% yield	90%–99% yield
Process steps	21	7

(indicated as an "A" type problem in the Pareto analysis) within control limits. These limits were set at three standard deviations, with a lower limit of 0 defects and an upper limit of 32 defects per board (out of a potential of 3,000).

Information Systems

The information system employed prior to the introduction of FMT required elaborate status reporting. Given the 300 circuits in 21 stations, there were about 6,300 status reporting possibilities. The supervisor reported into the system at the end of the day and batch processed output was produced by the next day. As a result, data were untimely, status reports were outdated and data entry errors were many.

Following FMT's process streamlining, this system was replaced by a spreadsheet program run on a personal computer. The spreadsheet was also used to produce control charts and Pareto diagrams.

The streamlined production flow coupled with FMT's gating and complete-kit techniques enabled a simplified and intuitive production monitoring tool in the form of the report shown in Figure 6. The report traces boards from the withdrawal of kits from the warehouse, through testing in the electronic laboratory, on to final testing, and concluding with final delivery to the customer.

The effects of FMT are summarized in Table 2; policy changes are summarized in Table 3. The increase in production throughput is demonstrated by Figure 7, which shows that actual monthly board shipping rose from the 50 boards per month level to over 250 boards per month, following the implementation of FMT.

The effectiveness of the FMT implementation was summarized in a telex sent by the contractor: "Workmanship on boards over the last four months has been excellent. Congratulations. You have turned the corner."

TABLE 3: Policy Changes

	Before	*After*
Production policy	Make to stock	Exclusively for orders
Computer system	Mainframe	PC spreadsheet
Quality assurance	Quality control department	Production employees

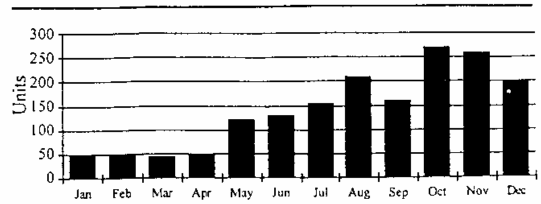

FIGURE 7: Actual monthly SMC board shipping

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