

Workshop Report: Southeast Region

Breaking Down The Functional Silos: Motorola Paging Division "Bandit" Plant

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The "Functional Silo Syndrome," a phrase coined by Phil Ensor, has been a popular AME discussion topic for about two years. An AME study group defined the Functional Silo Syndrome as tall organizational hierarchies in the various functions of a company such that communication between them was difficult and often emotional.¹ When faced with strong foreign competition in their pocket pager business, the Motorola Paging Division found that their response demanded that they address this organizational problem as well as technical ones.

In 1983 the Motorola Paging Division moved into a 365,000 square foot facility in Boynton Beach, FL with about 1800 associates. The product line includes the familiar clip-on pager and the base equipment necessary to support pagers. The presence of foreign companies in this market stimulated vigorous competition. Product life cycles have dropped from 6-8 years in 1975 until a life cycle by 1990 may be as short as two years. Reaction times in production must also decrease. The Motorola Paging Division realized that quick, significant action — and something more than technical response — would be necessary to run with the new competition.

What Was The Challenge?

According to T. Scott Shamlin,

director, manufacturing operations, the situation called for more than a Band-Aid. A complete revitalization of Motorola's culture and operational philosophy was the only satisfactory course of action. The charter for Operation Bandit challenged the project to use, borrow, or "steal" ideas and technology which would be appropriate, regardless of the source.

To satisfy their charter, the Bandit team had to simultaneously design a totally new product and manufacturing process. The objective was to significantly reduce the cost to manufacture each unit while dramatically increasing the complexity or number of features per unit. Operation Bandit took less than two years. The project started in June 1986 and the facility was running by February 1988. This effort emerged from a typical bureaucratic organizational structure and culture. To be successful, significant changes had to be made to the culture of the Paging Division and their approach to new product development.

The Physical Characteristics of Bandit

The Operation Bandit manufacturing process is a significant departure from the previous manufacturing process. The Bandit portion of the Motorola facility is enclosed to maintain priority control but has a complete wall of windows. Em-

ployees not directly involved with development of Bandit could easily see the progress of the project. The glass wall also prevented feelings of isolation within the development team.

Operation Bandit's manufacturing line is a 450-foot-long, C-shaped cell. Within this area, 27 robots, high-speed surface mount machines, and five computers are organized into five cells. There are 34 work stations in the five cells. The robots are table-top Seiko RT3000 D-Tran 4-axis cylindrical coordinate robots, modified by Motorola to perform the specific operations required by Operation Bandit. Work stations are connected by a conveyor that carries each printed circuit board on a uniquely identified pallet. Embedded in each pallet is a 10-digit binary code which is combined with a customer order number at the start of the operation. This code can be read at each work station to identify the specific components to attach or work to be done. In this manner, Operation Bandit is able to build pagers in lot sizes of one and accommodate approximately 29 million different Bandit pager combinations.

Design Objectives

Motorola's new approach to product/process design required that the objectives of the design process be clearly understood by

Bandit Design Objectives

1. No touch labor on any board
 2. Less than one hour total board and product assembly
 3. A minimum of 99.94 percent (6 sigma) first time realized yield
 4. Maximum of 3.4 assembly defects per million units completed
 5. No permanent inspection stations
 6. No repair of defective units
 7. Annual capacity of over 500,000 units
 8. Simple, flexible manufacturing line that would be modular and movable.
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Fig. 1.

all personnel. One can quickly realize the challenges of the Operation Bandit design team by reviewing their design objectives in Fig. 1. The personnel requirements are also evident in the objectives. "No-touch labor" building any board means that only a completely automated assembly process was acceptable. In addition, the quality objectives required closely coordinated design and building of the final pager to meet the 99.94 percent or 6 sigma first time yield. The requirement to build a product in less than one hour dictated a drastic reduction of assembly time from weeks to under an hour and that the assembly be completely accomplished at the Boynton Beach facility. Building a product in such a short time and at a very high level of quality actually made planning for repair of defective production units unnecessary. Replacement units could be made in a shorter time than defects could be repaired and the high first time yield meant that repair stations would be uneconomical.

Other objectives such as no inspection stations — which placed the inspection function in each workstation — and a simple, modular, movable manufacturing line transferred the importance of Operation Bandit to the supplying areas of the Paging Division facility. During the tour of the back-end assembly area, signs of the technology transfer were evident. Some of

the functions from Operation Bandit transferred to this area are distinguishable by the distinctive robotic work stations. Although redesign of the back-end assembly and products is not complete, benefits from Operation Bandit have spread to the Paging Division as a whole.

How Did Motorola Solve The Functional Silo Syndrome?

Before Operation Bandit, an organization chart in the Paging Division looked similar to those in most manufacturing firms. Neat boxes with position titles connected by a series of lines denoted supervisory relationships. In other words, the division had a traditional bureaucratic culture.

The procedures used by Motorola are listed in Fig. 2. They are not steps, as many were accomplished simultaneously. Doing business in the normal manner would not accomplish the Bandit objectives. Initial efforts concentrated on getting everybody to raise their level of expectations. A quantum leap forward could only be accomplished if all persons associated with Operation Bandit worked toward the highest possible set of expectations.

The Bandit team was interdisciplinary. Members came from several parts of the organization and the team composition was not always fixed. Needs for particular skills may dictate that specific people be temporarily assigned to address a particular problem. While

assigned to the team, team members were asked for loyalty to Operation Bandit so that all their efforts supported a successful outcome.

Benchmarking and Flexibility

It is necessary to know how good the competition is before one can develop products and manufacturing systems which are better. The Bandit team benchmarked their present position and how far they had to go. Benchmarking efforts were not restricted to the electronics industry. Any known process or system was benchmarked if it was considered to be the best in the particular activity, and the results were used to drive Operation Bandit.

Motorola people also recognized from the first that the requirements for Bandit might change. The final system would have to be flexible enough to survive in this imperfect, changing world. A "not invented here" attitude can stifle many efforts and result in little or no progress. At Motorola, this attitude was not allowed to come into play in any manner, shape, or form.

The name Bandit came from the directive to seek ideas from any source. If they work, use them. Team members had freedom to experiment and explore new techniques and ways of doing things, borrowing freely from other institutions. Also implied in this attitude was the feeling that mistakes should not become a hindrance to the free spirit of Operation Bandit. Allow people to learn from their mistakes, and penalize failure only if it is repeated.

Motorola also learned that the completion date for each project must be set and then *never* allowed to move forward, insisting that each project be completed on schedule. This approach created a sense of urgency and made the team raise its level of performance.

Another important aspect of the success of Operation Bandit was the development of supplier partnerships. The Bandit pager was to have no more than 25 suppliers. They are product lifetime suppliers as long as they perform

Actions to Overcome the Functional Silo Syndrome

1. Raise levels of expectations
 2. Benchmark world-class performers from any source
 3. Create interdisciplinary teams
 4. Design for an imperfect world
 5. Abolish the "not invented here" attitude
 6. Structure time base goals
 7. Create supplier partnerships
 8. Manage the mission and lead the people.
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Fig. 2.

to standards. In this manner, Motorola insured sources of high quality parts which were paramount to six sigma quality in the end product. Motorola actively sought the expertise of the suppliers during the design process. They provided a significant amount of information and knowledge that greatly improved the overall design of both product and process.

Motorola management learned that leadership of a highly-technical and innovative project is complex and challenging. Garnering resources and acting as coaches may sound simple, but when dealing with multidisciplined teams of highly skilled individuals, management must be especially aware of how they fit together into the effort.

Encouragement and direction is needed rather than dogmatic pushing. At the same time, a firm schedule without moving the "stake in the ground" or deviating from the mission is needed. The commitment of management must be visible but not suffocating. It's a tough challenge.

What Were The Lessons Learned?

The major lessons learned during Operation Bandit are listed in Fig. 3. The formation of interdisciplinary teams was vitally important to Operation Bandit. Only in this manner could people from the various areas of expertise contribute to the project with the proper timing and coordination. Interdisciplinary team members reinforced each other and provided continuing help when necessary.

Projected gains made the effort of forming multidisciplinary teams worthwhile. Goals stretched the capabilities of the people working on Operation Bandit to their limits so they remained interested and maintained their sense of urgency.

Only by taking risks can new frontiers be conquered. Operation Bandit could not punish team members for honest mistakes. Team members had to recognize that benefits were possible even from mistakes. Every experience in a project the size and scope of Operation Bandit is a learning experience.

The final lesson shared by Motorola was the feeling that one does not have to imitate the Japanese to be successful. Sound, proven management techniques developed here in America, when properly used, allow a firm to gain a competitive edge. Little or nothing in the management techniques of Operation Bandit was actually of Japanese origin. World-class can be American in style and content.

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The Major Lessons Learned During Bandit Development

1. Create interdisciplinary teams
2. Establish and enforce outrageous goals
3. Reward risk taking
4. Avoid Japanese management techniques.

¹See "Organizational Renewal — Tearing Down the Functional Silos," *Target*, Summer 1988, p. 4 and "The Functional Silo Syndrome," a one-page overview by Phil Ensor in *Target*, Spring 1988, p. 16.

Fig. 3.