Cycle Time Reduction

Changing attitudes, not processes.

Mike Hills

Although continuous-flow manufacturing (CFM) has revitalized many failing companies, PCB plants have been slow to adopt this management philosophy. After trying CFM twice in the 1980s, the IBM-Austin PCB operation remained so far behind its competitors that closure of the thoroughly modern plant was being considered. There was nothing wrong with the processes and equipment in the plant; the problem was in how they were being used. After examining past mistakes, it was decided to try CFM again under a new identity. Cycle time reduction (CTR) resulted in a complete plant turnaround.

When the CTR team began its work in December 1992, the plant's manufacturing cycle time was 24 days compared to a worldwide benchmark of 12 to 15 days. Six months into implementation, cycle time was down to eight days, with some orders being shipped in six, and work-in-progress (WIP) was cut from 50,000 to 1,000 innerlayers. Composite WIP was reduced from 50,000 to 25,000 units. Continuing implementation is realistically aimed at reaching six-day cycle time within a year.

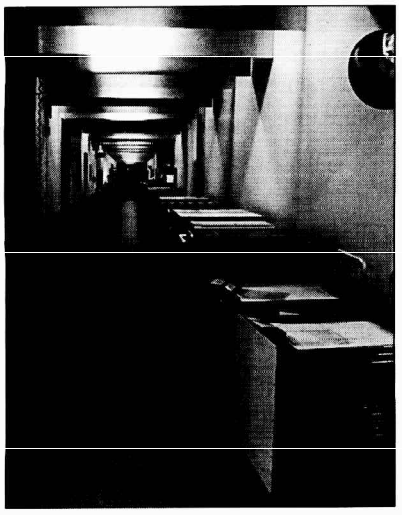

Figure 1. Large quantity of innerlayer WIP at chlorite.

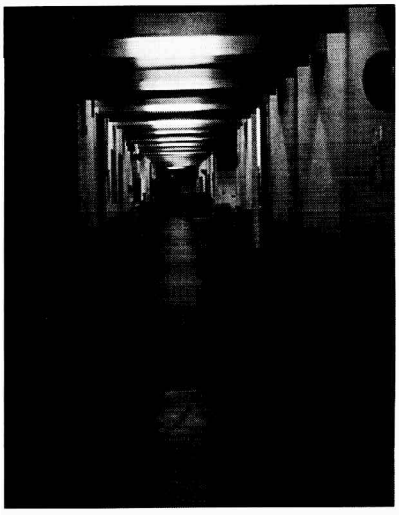

Figure 2. Reduced WIP resulting from pull system with kanbans.

Looking at this success, one wonders How CFM managed to fail twice at IBM-Austin. CFM's promoters blamed resistance to change, lack of commitment, and failure to get the full attention or buy-in of plant personnel. These negative attitudes set the tone for more failures, continuing production problems, and deepening financial losses.

The Change

The, first segment of CTR implementation was designed to cut cycle tired by focusing on changing basic plant manufacturing philosophy, placing heavy emphasis on the internal customer/supplier relationships existing between process centers. Follow-through CTR will extend to equipment maintenance issues, reliability, and crisp run rules for specific process centers, as well as a continual focus on the education.

As CTR got underway, IBM-Austin's unacceptably long cycle time (the result of high WIP levels) impacted the plant's ability to respond to ECOs and shifts in demand. This left customers waiting for boards. Since IBM assembly plants were captive customers, manufacturing profits and losses

were not being compared with industry benchmarks, and cost and delivery problems had been downplayed. Fortunately, IBM policy was changed in the early 1990s, when all sites were allowed to purchase components from any source and pursue OEM contracts.

For the first time in its history, the PCB fabrication plant had to assess its capabilities and compare its costs to outside competition. As expected, the comparison was poor. The IBM ECAT plant (Electronic Card Assembly and Test), then and now the PCB plant's primary customer, could buy many of its boards from non-IBM sources at better prices. Plant management emphatically decided that a strong attempt at reducing cycle time should be tried again. A CFM consulting team was brought in and a team of ten local employees was formed to implement CTR.

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The plant manager scheduled a plant-wide meeting to kick off the effort. Because it was associated with failure, CFM wasn't mentioned as plant employees were told about goals for cycle time improvements, with near target dates set and even more aggressive goals in place for 11994. The message delivered at the meeting was "CTR is a key commitment that will provide outstanding value to our customers. "

Some plant personnel were openly skeptical, but general attitudes were greatly improved by excellent participation] during two days of volunteer plant clean-up. After many tens of thousands of dollars of scrap boards, old equipment, an just plain trash were hauled away, the plant looked like new. When the CTR team went to the plant workers with their next idea, it was willingly considered.

Attitude and buy-in are vital to the success of any CFM-based process. To keep the human factor foremost in their n reds, team members constantly challenged themselves by asking: "Why would the workers buy into this change ? How do they want

to be treated? How does this change help the manufacturing process? Does it make line tasks easier to do? Can any major change be simple and clear enough to consistently operate on all three shifts?"

For weeks the team assessed existing factory processes, logistics, rework loops, and tried to honestly measure cycle time. The CTR team met with the consultants daily and often met in smaller groups to compare notes and create wish lists and strategies. A 'clean sheet' approach was devised that redefined factory cycle time, set monthly cycle time goal , and revamped reporting methods. The plant's basic manufacturing philosophy was changed from a "push" to a "pull" system, with factory loading entirely dependent on cutomer requirements. First order in would be first order out, with provisions made for high-priority customer requests.

A simple Kanban system was installed to set run rules between customer and supplier process centers, highlight problem areas, and keep WI clutter from becoming temporary inventory. Throughout the plan the line changed from bubbles of WIP to a steadier flow. Reduced WIP made bottlenecks more visible, which helped prioritize problem areas.

Proper control of WIP soon enabled plant personnel and the CTR team to develop a sense for the rhythm of operations. This rhythm, the hear beat of factory, is called *takt,* the German word for rhythm or beat. Consistency in takt (average output per unit time), as well as an understanding of the reasons for takt variation (detractors), gave workers and managers a focused, hourly measure f process success.

A scheme for releasing and sequencing FIFO production lots was implemented in which a sequence o different colors was established for a given week's releases. Each production lot had a colored card, with high-priority orders, constituting no more than 5% of a day's releases, specially flagged. This simple system replaced one in which production control loaded the factory and editors, department managers, an even line operators could change lot priorities by written report or word of mouth. The color card system has contributed immensely t cycle time reduction and has helped sustain focus on improving process flexibility with regard to setups and discipline.

Innerlayer lot size went from 150 to 32, and composite lot size from

67 to 32. Using an extremely detailed "block-and-tackle" approach, setup times were slashed at least 50%. These changes were met with strong buy-in and their implementation went smoothly, in this instance.

A key change was needed in innerlayer processing. The change, called matched cores, meant that operators would no longer mass-produce innerlayers and later match them with composite batches. The change met with stiff resistance because department managers and lead technicians would be under extreme pressure to deliver high-quality product at high volume every day. Their attitude was "Don't fix what isn't broken." Therefore, agreed-upon run rules were not being followed. It was felt that resistance to this major change might ruin the entire CTR effort. However, if the conflict could be resolved and processing change accepted, the likelihood of CTR success would significantly improve.

The CTR team called a conflict resolution meeting that included all affected parties, which resulted in reluctant agreement with the new plan. Following implementation, inner-layer cycle time dropped from five days to two and a half days, and the CTR process gained momentum.

As CTR changes continued, line workers were the easiest to convince that the plan had merit. They often went beyond compliance to take real ownership of the new system. Department managers were slower to buy in. Not only did they have to learn a new manufacturing philosophy, some lost identity as department leaders. CTR changes often took decision-making out of their hands by incorporating decisions within department run rules being executed at the lowest level. Even after successful implementation of CTR, the vast majority of managers were only in the compliance phase.

Conclusions

Thanks to its vastly improved cycle time, the IBM-Austin printed circuit board plant continues to operate with improving financial performance, flexibility and responsiveness.

CTR is still evolving. As managers respond more quickly to change, buy-in continues to proceed from compliance to ownership. With ownership being taken at all levels, accomplishment of the six-day cycle goal will result in numerous advantages to both the plant and its customers. **FAB**

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