



HOLONIC PLANNING IN A HIGH-MIX, LOW-VOLUME MANUFACTURING ENVIRONMENT

Author: R. Michael Mahoney



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Competitive advantage in high-mix, low-volume manufacturing environments is driven by the organization's ability to effectively plan resource requirements. For any given customer response strategy, adequate resources must be in place to ensure efficient factory execution. There are three holons (i.e., autonomous yet cooperative sub-wholes) required to effectively plan high-mix manufacturing resources:

1. Capacity resource planning holon
2. Operations planning holon
3. MCS™ (Multiple Constraint Synchronization) planning holon.

An autonomous and cooperative sub-whole is referred to as a holon. The word holon is derived from the Greek word 'holos' meaning whole and 'on' in reference to part such as electron, proton, etc. The integration of these three holons forms a holarchy.

Capacity Resource Holon

The capacity resource holon plans structural and infrastructural medium-long term capacity. Structural capacity requirements (e.g., plants, buildings, etc) are planned using the lead, lag, and tracking strategies.

A combination of the lead and tracking strategies are the most effective for augmenting structural and infrastructural capacity requirements. Proactive incremental changes in structural and infrastructural (e.g., additional workers, overtime) capacity are associated with the tracking strategy while the lead strategy changes structural capacity in larger increments. The lead strategy requires a longer lead-time planning horizon than is required for the tracking strategy. The lead strategy is therefore riskier than the tracking strategy. The lag strategy is a "wait and see" do-nothing strategy that should be avoided.

Operations Planning Holon

Given the resulting structural and infrastructural capacity position derived from the resource holon, the operations planning holon develops a capacity

utilization strategy. The strategic driver for achieving the value propositions cost, quality, delivery, and responsiveness performance is lot sizing. Increasing lot sizes will increase constraint capacity utilization. This comes at a price. Quality, delivery, and responsiveness performance will decrease while costs (particularly inventory) will increase. The converse is true under the condition of decreasing lot size. The price paid is now decreased constraint capacity utilization due to the large number of setups required. Even under the condition of world-class setup time performance (i.e., single minute exchange of die (SMED) where setup time is less than ten minutes), Constraint capacity utilization can be degraded to the point where a high-mix manufacturers competitive performance is put at risk.

A decision to produce a level (i.e., linear) master plan will increase constraint capacity utilization while inflating inventory. Using a tracking (i.e., chase) strategy will decrease inventory requirements while reducing constraint capacity utilization. A compromise between the level and tracking strategies will trade-off the adverse cost of excess inventory with decreased constraint capacity utilization and should be used. This is referred to as a postponement strategy.

MCS™ Planning Holon

The MCS™ planning holon develops the detailed tactical response strategy that aligns with the resource and operations holon requirements. Schedules based on "actual" customer demand are developed to ensure minimum makespan criteria (i.e., maximum throughput) while maximally achieving all customer value propositions within the constraints specified by the other holons.

Although the resource, operations, and MCS™ holons functions are autonomous, they work in cooperation with each other in the holarchy. 21st century holonic high-mix manufacturing planning, execution, and control systems offer the differentiating competitive advantage required to win the battle for customers in the global marketplace of the future.