



High-mix, low-volume environments: Challenges and new journeys for SMEs

Productivity, processes, and people

SMEs have always been pivotal to the economy and it is important that they remain competitive. With a large percentage of job creation and workforce employment created by and stemming from SMEs, productivity levels need to increase above and beyond inflation rates to be sustainable. Statistics for these are abundant; the numerous studies carried out by government organizations, business federations, and SME associations around the globe are not cited here.

To achieve a higher level of productivity, processes need to be streamlined. We should learn from best practices as a result of kaizen events arising out of our current industry verticals and importantly, from those across the horizontal. It is this cross-functional learning that allows us to leapfrog in our quest for continuous improvement. To enable streamlined processes, people play a crucial role. With reference to the Harada method (Harada T. and Bodek N. *The Harada Method of Self-Reliance*, PCS Inc., 2012), individuals should be self-reliant and in turn facilitate a company's process improvement journey. It can be useful to couple the Harada method with Scrum, an iterative and incremental agile software development framework, as it aids in the facilitation process.

Evolution of manufacturing

With changes in consumer demand, SMEs have begun to move from an environment of mass production to one of mass customization. Larger corporations operate in the former through the aggregation of orders or product families. This is important for volume leveraging, which in turn improves cost-to-serve metrics. Instead of economies of scale and their inherent benefits, SMEs that are further down the tiered structure of value chains typically need to leverage economies of breadth. Such diseconomies of scale present both challenges (e.g., tradeoff between set-up times and batch sizes) and, if managed well, provide tremendous opportunities such as the ability to react more quickly to demand shifts with reduced flow times. High-mix, low-volume (HMLV) environments are complex unless an SME competes in a market segment that has infinite demand and with customers who are time insensitive. Unfortunately, these are rare occurrences.

Quick Response Manufacturing

Quick Response Manufacturing (QRM) is rooted in the

concept of time-based competition pioneered by Japanese enterprises in the 1980s and emphasizes the beneficial effect of reducing internal and external lead times. The four concepts at the heart of QRM are:

- 1) Realizing the power of time. Lead time is much more important than most managers realize; long lead times create many organizational costs that are four to five times greater than labor costs.
- 2) Rethinking organizational structure. QRM transforms traditional functional departments into a network of advanced QRM cells that are applied across the company.
- 3) Exploiting system dynamics. By getting managers to understand how capacity, batch sizes, and other factors impact lead times, QRM enables them to make improved decisions that result in shorter lead times.
- 4) Implementing a unified strategy enterprise-wide. QRM is not just for the shopfloor; it is applied throughout the enterprise, including material planning and control, purchasing and supply chains, and new product development.

This discussion focuses on point 3 for a company involved in HMLV turnkey manufacturing of equipment and parts for the defense, oil and gas, and process industries. Putting in measures to control and understand system dynamics was key for the manufacturer, especially in an environment where variability is generally the norm. A useful approach is to identify a process boundary (or an area of interest) in which the benefits outweigh the cost of effort. In this study, a primary concern was throughput and the parameters surrounding it.

Skillsets affect throughput

The manufacturer was interested in quantitatively understanding the effects of employee skillsets on production throughput. To do this, it had to:

- 1) identify its primary and secondary skills;
- 2) provide cross-training, thus enabling flexibility in production; and
- 3) develop talent and leadership potential.

An example of an employee skillset matrix is shown in Figure 1. The output of the analysis is shown in Figure 2, and there are two general observations:

- 1) Unskilled/unproductive workers contribute to a significant reduction in throughput.
- 2) Throughput reduces exponentially, after which a steady state is achieved, i.e., the rate of decrease becomes insignificant.

Name / Skill	TPS	5S	7W	JIT	Standard Work	Visual Management	Kaizen Event
Ben	☐	●	☐	☐	☐	●	☐
Gerry	☐	☐	●	☐	☐	☐	☐
Jon	●	☐	☐	☐	●	☐	●

Figure 1. Sample skillset matrix. The shaded area depicts the level of development in a particular skill. For example, Ben is skilled in 5S and visual management. Reproduced, with permission, from Using a Skills Matrix to Identify and Improve Employee Skills (http://www.fgcu.edu/CEd/professional_development_programs.html).

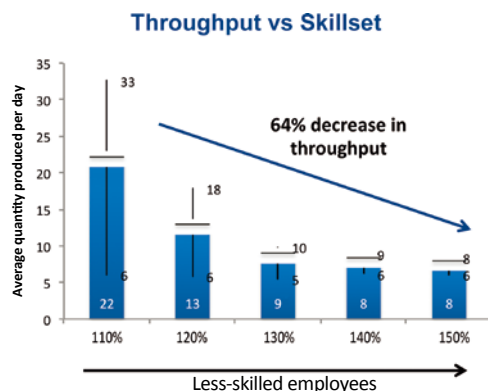


Figure 2. Effect of skillsets on throughput.

Cell utilization affects throughput

When measuring the productiveness of a manufacturing facility, process utilization can be a useful metric. It allows us to understand the demand, factors affecting the flow rate, and many other exciting insights. High utilization levels are achieved when:

- 1) Process capacities are high. Utilization of individual processes is an important metric. With the presence of bottlenecks, i.e., a process that limits increased throughput, it becomes difficult to leverage fully the capacities of remaining processes. There are several strategies commonly used to reduce this mismatch one of which is optimizing batch sizes.
- 2) Batch sizes are large, i.e., value-added activities dominate the total available production time.

In HMLV environments, the tradeoff lies in lower volumes and a higher product variety, implying that there will be several setups or changeovers (generally viewed as non-value adding). The output of the analysis is shown in Figure 3 and there are two general observations:

- 1) Throughput increases exponentially as the utilization of a cell increases with the process capacity as the limiting factor.
- 2) Throughput increases 11-fold after the 70% utilization mark.

The goal is to get access to reactive or spare capacity in the attempt to delay at least some production until better demand information is learned so that multiple orders can be placed during the selling season. This is an integral part of QRM. Such practices are designed to reduce the cost of mismatches between supply and demand.

Throughput vs Cell Utilization

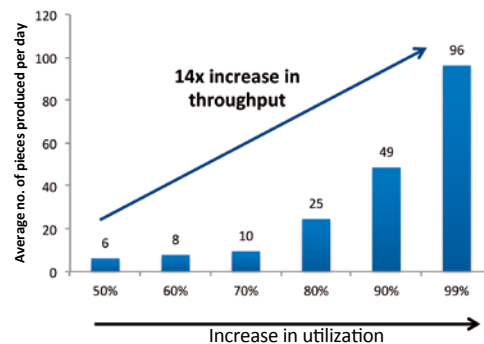


Figure 3. Effects of cell utilization on throughput.

What this means

Spare capacity can be a competitive advantage if quantified and managed effectively. This can be achieved through a deeper understanding of both internal and external dynamics. Here are some suggestions to leverage this opportunity:

- 1) Invest in your team with an enterprise-wide skill development structure. This can be either formal or on-the-job training.
- 2) Analyze how the interdependencies between set-up times, batch sizes, processing times, and capacities affect overall productivity.
- 3) Be a spare capacity channel for downstream partners so that their capacity can be reactive but only if it is aligned with your core competencies. 🔄



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