Chapter 8

S&OP and Continuous Improvement through Lean Manufacturing and TQM/6 Sigma

Is S&OP really needed in a company using continuous improvement methods like lean manufacturing or TQM/6 Sigma? Is S&OP part of continuous improvement or an alternative to it? What are the experiences of companies that have used all these methodologies - S&OP, Lean, and TQM/6 Sigma? How do they work together?

For almost three decades now, leading companies have been implementing effective S&OP processes in order to plan and execute strategy, to prioritize market and plant improvement opportunities, and to monitor results.

At the same time, much of Western manufacturing has "gone Lean", using the tools of lean manufacturing and 6 Sigma[1] to drive continuous improvement - reduce defects, cut setup times and order quantities, slash lead times, increase productivity, reduce obsolescence, and cut costs.

We believe the widespread adoption of continuous improvement through lean manufacturing and 6 Sigma, and of sales and operations planning, have been the outstanding events in manufacturing in the last twenty years.

But do they actually help each other? Can a company using S&OP leverage it to get even better results with continuous improvement? And can a company effectively using the lean manufacturing and 6 Sigma tools of continuous improvement, get even better results from their S&OP process?

Our thirteen best practice companies certainly think so. According to Malcolm Jaggard, Director, Supply Chain Management, ***AGFA US Healthcare***: "*Continuous improvement is embedded in the S&OP process, and continuous improvement cannot be maximized without S&OP.*"

With regard to continuous improvement, many (including us) believe that lean manufacturing and 6 Sigma go hand-in-hand. You probably can't do an effective job of lean manufacturing without using the problem solving and statistical tools that are part of 6 Sigma. Conversely, if you have a manufacturing environment where any key Lean

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[1] The terms TQM (total quality management) and 6 Sigma are both in widespread use today. There are some differences between the two, but there are many, many similarities. Since many companies today use the term 6 Sigma to describe their quality improvement activities, we are going to use the term 6 Sigma alone to refer to all quality improvement initiatives. If your company is doing TQM and not 6 Sigma, don't worry, our comments about S&OP and quality apply just as much to your situation.

concepts - like standardizing work activities and instructions, leveling of production, reduced setup or mistake-proofing - are not applied, you'll probably have problems making headway with 6 Sigma.

Yet even though many people correctly see the two toolsets going hand in hand, the vast majority of companies implement them as two separate initiatives. As matter of fact, according to a 2004 Census of Manufacturers by Industry Week magazine, in the US:

- 42% use lean manufacturing
- 14% use 6 Sigma
- 11% use lean manufacturing and 6 Sigma

For that reason, we will talk about lean manufacturing and 6 Sigma separately in this chapter.

S&OP and Lean Manufacturing

Sales and operations planning and lean manufacturing go hand in hand. They do different - and very necessary - things, and you need them both.

A principal objective of lean manufacturing is to create the physical environment that will allow material to flow - from raw material to finished product to the customer. Doing this means eliminating waste and wasteful practices, reducing costs and cutting lead times - while synchronizing all production and purchasing activities. S&OP, integrated with the other detailed tools of resource planning, is a set of forward planning tools to help balance future demand and supply, to predict capacity and material problems with enough time to do something about them, and to understand the financial consequences of production and purchasing decisions.

If you create a manufacturing environment where material flows with minimum waste (Lean), but you can't predict capacity and material availability problems in enough time to avoid them (S&OP), you will inevitably revert to firefighting, finger-pointing and poor results. Similarly, if you do an excellent job of future planning but have poor flows, you can almost count on higher inventory levels, longer lead times, and lower profitability.

Traditionally lean manufacturing has been stronger on workplace management; S&OP on decision-making for the future. The tools and methods of lean manufacturing have tended to look most closely at the plant, and its immediate customers and suppliers, mostly over a short horizon. This leads to improvements like: "shorter, quicker, fewer, lower cost, more flexible, and better aligned".

S&OP provides distance vision - providing the ability to predict capacity and material availability problems before they become crises, to identify market issues while they are still opportunities, and to prioritize improvements in a way that will create the most

favorable results.

What company wouldn't want both? Hundreds of companies have proven that you can have both, and that each approach amplifies the benefits of the other. In other words - they work best when they work together.

Bill Kerber, the consultant for ***EMS***, who specializes in lean manufacturing and S&OP says "*The S&OP process fits nicely around Lean concepts such as leveling volume and mix for a value-stream and using inventory as a strategic buffer for customer service. As management's steering wheel for the business, it serves as the logical starting point for any Lean transformation.*"

Let's take a look at the areas where lean manufacturing and S&OP complement each other:

Objectives and Key Tools of Lean Manufacturing

A key objective of lean manufacturing is to get inventory to flow to the customer, ideally without interruption - and ideally one piece at a time. To achieve uninterrupted flow, several Lean concepts have important connections to S&OP. These include:

- **Takt time** is the key Lean concept for synchronizing production rates with customer demand, and as such is arguably the most important idea in Lean. Takt times drive cell designs and operator balancing processes, are used for leveling production, for scheduling finishing processes, and for monitoring production performance in time increments small enough for rapid response to problems.

  Takt time expresses the sales rate - how fast must the plant must produce a product in order to be perfectly synchronized with the customer. One unit every twenty-three seconds in a company making visors for automobiles, one unit per hour in an organization producing large pumps, or one unit every two weeks for a manufacturer of fighter jets would be practical examples takt times in real companies.

  "Operational takt time" expresses the anticipated build rate, taking into consideration finished goods inventory adjustments or work time adjustments like overtime. For the examples cited above, the operational takt time might be one unit every twenty-three seconds (no inventory adjustment or overtime), one unit per 1 hour 15 minutes (finished goods inventory is being lowered to reduce working capital), or one unit every 1.5 weeks (overtime has been added and the build rate increased because of a subsequent planned shutdown).

  Since S&OP also tries to synchronize the plant (supply) with customer demand, it shouldn't be surprising to hear that Lean and S&OP are complementary. In many Lean companies, the demand plan from S&OP establishes the takt time and the

supply plan from S&OP sets the build rate and the operational takt time. And over time, as supply and demand are brought into balance through S&OP, takt time and operational takt time converge as well.

- **Value-stream mapping and improvement** is an essential methodology for a very specific kind of process mapping. Basically the idea is to document every value-adding and non-value-adding activity for each product - start to finish, raw material to finished product - and then use this as the basis for improvement. The current value-stream map shows what the overall flow is today. Future value-stream maps show what the desired future state should be.

  Comparing value-stream maps of the current states to the future states then drive improvement projects to streamline and simplify the manufacturing environment by reducing setups, improving yield rates, cutting unplanned downtime, etc.

  Generally speaking there are two important connections between S&OP and value-stream mapping:

  First, value-stream mapping is oriented towards identifying distinct product families and then, as much as possible, disentangling any shared manufacturing processes so as to make the simplest, most streamlined production environment. Distinct value-streams here typically correspond to distinct product families in S&OP.

  Second, this mapping tries to improve each value-stream by reducing waste and improving flow, increasing flexibility and reducing lead time. These improvements enhance S&OP's ability to respond to changes as well.

- Equally important from a lean manufacturing perspective is a **balanced and managed capacity plan.** Rough cut capacity planning (performed during the supply planning step of S&OP) provides distance vision to Lean. Imbalances between supply and demand, and between planned capacity and required capacity can be predicted long in advance, and fixed long before they become a problem for the Lean execution systems.

  And S&OP provides future visibility for internal manufacturing, new product development resources, and for key supply chain partners.

- **Streamlined production means simplified planning processes** and that certainly holds true for S&OP. Shorter lead times mean improved flexibility to respond to changes, the possibility of reduced planning horizons, less inventory with the same or better customer service - all big benefits to the business. And in a simplified environment, S&OP can be used to directly calculate and communicate future detailed requirements to suppliers and partners. This might come directly

out of a rough cut planning calculation, rather than the traditional method of deriving it from a detailed material planning technique like MRP.

Kanban (or *demand pull*) is a primary execution technique of Lean that can simplify or eliminate traditional execution or ordering systems, and reduce even further the need for MRP type techniques. Kanban can be used anytime material cannot be made to flow continuously between two processes. For example if the supplying process and the consuming process cannot produce at the same rate (the cycle time is different, they have significantly different setups, operate to a different work day, or a host of other reasons), kanban can be used to signal when more material is required from the supplying process. In a kanban system, the only work that happens is that authorized by a kanban pull signal - without the use of traditional work orders or purchase orders. The use of kanban has no direct effect on the mechanics of S&OP.

Notable Practices of Our Model Companies:

Lean Without Good S&OP:

- ***EMS*** started to implement lean manufacturing, only to realize that their existing S&OP process was not working as well as it should. Before launching full stride into Lean, they had to upgrade both their forecasting and S&OP processes.

Takt Time:

- At ***EMS***, the supply plan rates for each S&OP family are used to calculate takt times, and the inventory plans authorized by S&OP link to the production rates used in both S&OP and Lean. While it isn't always the case, at ***EMS*** the families as defined by Lean matched fairly well with the pre-existing S&OP groupings. This made it very easy to use S&OP to set takt times and provide valid demand numbers for each value-stream.

- At ***Danfoss***, operational takt time derived from S&OP is now being implemented to govern the Lean production processes in the factories.

Value-stream Mapping and Improvement:

- At ***EMS***, value-stream mapping was used to prioritize Lean initiatives and to implement one S&OP product family at a time. For each family, a current

state value-stream map and multiple future state maps guide improvement activities.

- Thanks to several years of lean manufacturing initiatives at ***UMC***, S&OP is seen as "*easier*" and less linked to short term decision-making. Overall, lean manufacturing led to better responsiveness to mix changes and improved inventory turnover.

  Specific Lean improvements that helped with improved flexibility at ***UMC*** included:

  - plant flow improvement (moving from functional plant arrangements to cellular manufacturing, arranged by product line)
  - moving to a demand pull finishing schedule concept where production is triggered by customer pulls from small finished goods inventories (*supermarkets* in "lean speak")
  - redesigned products, allowing some product options to be installed at the customer site
  - improved material availability due to the high reliability developed in manufacturing and at the key suppliers
  - lead time reductions on manufactured and purchased materials ranging from 25% to 75%%.

- Since reorganizing its factories into cellular configurations several years ago, ***Danfoss*** has pursued a variety of lean manufacturing initiatives: value-stream mapping, synchronizing to takt time, cycle time reduction, streamlined changeover, utilizing kanban, implementing total preventive maintenance, and pursuing a range of small group improvement activities.

  Generally speaking, results in manufacturing have been very good. For example, in one process, lot sizes of two weeks' usage have been eliminated. Today, every part is produced every day, increasing the line's responsiveness to the final assembly process and customer needs.

  For a second product line in another factory, customer order lead time from order placement to delivery was reduced from eight weeks to ten days, a 75% reduction. And the ten days includes order processing time of two days and transportation time of five days, which means that assembly takes only three days.

  At ***Danfoss,*** the impact of Lean with its shorter lead times, along with better