INTRODUCTION

Over the last twelve years the author has presented numerous APICS and SAPICS educational courses in-house as well as conducted consulting activities for well over 100 different companies. Mainly these companies have been in the manufacturing sector and are generally of a medium size. These manufacturing companies range from food and beverage, to electronics, plastics, packaging, heavy and light engineering, fruit and clothing industries.

One observation, over the years, that has come to the fore is that a vast percentage of these companies do not have effective master planning processes in their organisations. Planning in the majority of these companies is carried out by unskilled people enclosed in a room near to the factory reacting to orders that are constantly being thrown into the planning office. These orders are then converted into strips of cardboard and shuffled on a short-term planning board to try and achieve some semblance of customer service. There is very little thought as to materials and capacity availability or to what is likely to be required into the future.

In these companies, management have little understanding of current and future capacities let alone any decent planning systems that will ensure they have the materials available to satisfy their customer’s requirements. Management needs to put a window in the planning office, open the curtains and look down the road at the demand that is likely to hit the company in the future and make decent plans to accommodate this demand with a high level of customer service. This in essence is what master planning will accomplish for a company.

MASTER PLANNING

APICS defines the Master Planning process in their dictionary as:

“A group of business processes that includes the following activities: demand management (which includes forecasting and order servicing); production and resource planning; and master scheduling (which includes the master schedule and the rough-cut capacity plan).”

Master planning therefore includes the three separate, very distinct but integrated, business processes of Demand Management, Sales and Operations Planning and Master Production Scheduling.

Figure 1: Master Planning
In this paper, we will examine each of these processes, looking into the objectives of each as well as their inputs and outputs.

In addition, the paper will examine what SCOR has to say about the master planning processes together with best practices and metrics for this level of planning.

Lastly, the paper will look at a methodology for assessing your current master planning processes and some suggestions as to how you might improve these processes in your business.

DEMAND MANAGEMENT

Demand management has to be the first process that any company must complete prior to doing any form of planning within the organisation. If you do not have a reasonable idea of what the demand is on your business, how are you ever going to be able to plan the supply to support that demand?

If we look at what APICS defines demand management as, we have:

1) The function of recognizing all demands for goods and services to support the market place. It involves prioritizing demand when supply is lacking. Proper demand management facilitates the planning and use of resources for profitable business results. 2) In marketing, the process of planning, executing, controlling and monitoring the design, pricing, promotion and distribution of products and services to bring about transactions that meet organizational and individual needs. Syn: marketing management.

The author has rarely come across a company that would be regarded as having a good demand management process. Often the sum total of demand management is the salesman ‘sucking-his-thumb’ at the end of the month and the company trusting its future on this schedule of demand.

Demand management is far too important to the company to leave it entirely in the hands of the salesman. When asking a company what their budget is for demand management one is usually met with a blank stare. Surely, we have budgets for sales, marketing, product development, distribution, all important business processes, why not one for demand management. There are a few companies that are now realising the importance of this function and are employing demand managers.

Demand management is a monthly process. It usually starts just after month end when the latest sales history figures are available. The demand manager needs to maintain a demand file for each of the companies’ products that have been ‘massaged’ to reflect the real demand as opposed to what was shipped to the customer. This file is then appended with the latest demand / sales data on a monthly basis.

From this demand management file the demand manager should then use a computerised forecasting package to look for trends, patterns and seasonality in the time series and project these into the future. These forecasts should then be passed back to the sales force for their input. Rather than looking at all the products, which could be a mammoth task, we suggest the salesman analyse and update the 20% of products that gives them 80% of their sales. In this way, we apply our valuable time to what is important in the business.
These updated forecasts can now be presented to the demand management team. The demand management team should consist of people in the organisation that have insight into what and how, external forces affect the business and hence can revise the forecasts accordingly. External forces such as product life cycles, economic cycles, foreign exchange rates, interest rates, weather, oil prices, international terrorism, etc (the list is endless) can have a profound effect on our business. The output from this part of the process should be a consensus forecast for each of the company’s products out to the various planning horizons and to the right level of detail and aggregation required by the next two levels of planning in the master planning process. This output needs to be ratified by sales and marketing prior to release, as they have to be happy that the plan is feasible.

The above process needs to take place within the first week of the month so that sales and operations planning can take place early on in the month.

Therefore, the inputs to the demand management process are the future customer orders and at least two years of each products demand / sales history. The output is an aggregated consensus demand plan, out to the capacity time fence, for the sales and operations planning team and a detailed consensus demand plan, out to the planning horizon, for the master production scheduler.

**SALES AND OPERATIONS PLANNING**

Prior to any detailed planning taking place in a manufacturing company, an aggregate ‘Game Plan’ needs to be developed by top management to give direction to the company.

Looking at what APICS defines as sales and operations planning, it says:

> A process to develop tactical plans that provide management the ability to strategically direct its businesses to achieve competitive advantage on a continuous basis by integrating customer-focused marketing plans for new and existing products with the management of the supply chain. The process brings together all the plans for the business (sales, marketing, development, manufacturing, sourcing and financial) into one integrated set of plans. It is performed at least once a month and is reviewed by management at an aggregate (product family) level. The process must reconcile all supply, demand and new-product plans at both the detail and aggregate levels and tie to the business plan. It is the definitive statement of the company’s plans for the near to intermediate term, covering a horizon sufficient to plan for resources and to support the annual business planning process. Executed properly, the sales and operation planning process links the strategic plans for the business with its execution and reviews performance measurements for continuous improvement. See: aggregate planning, production plan, production planning, sales plan, tactical planning.

The primary objective of the sales and operations planning is for top management to determine when they will need to significantly change their levels of capacity. Since significantly changing levels of capacity not only is expensive but it usually takes a considerable amount of time, good long-term warning is required. Hence, the sales and operations planning needs to extend to the company’s capacity time fence. In most capital-intensive organisations, this can be at least twelve to 24 months and in others up to five years, take an oil refinery, chemical plant or the generation of electrical power for example.
Figure 3: Sales And Operations Planning

In addition, the resultant sales and operations planning must also support the Strategic Plan of the business and hence is also a major input to the process. It is in this process that the strategic plans of the business are integrated into the operational plans of the business.

The sales and operations planning is not developed in detail but the individual products are aggregated into product families that revolve around the company’s production facilities. The idea being that we need to determine when demand for the products in these product families will outstrip the capacity currently available.

The sales and operations planning team is basically the top management team of the company. One needs top representation from the following areas of the business with their inputs:

- **Managing Director** – This is his plan and he ensures the process is adhered to on a monthly basis. The sales and operations planning is how he directs and tracks performance in the business.
- **Sales / Marketing Manager** – This department produces the information on demand from the customers and together with the demand plan, this enables the sales and operations planning team to develop a production / supply plan for the business.
- **Product Development Manager** – Most forecasts are the result of projecting current customers and current products into the future. Hopefully, the company is developing both new customers and new products and these need to be factored into the total demand on the business out into the future.
- **Production Manager** – His job on the team is to report on new capacity availability, planned maintenance schedules and old capacity going off line. Ultimately, he will have to agree that the production plan derived from this sales and operations planning process is feasible in the plant.
- **Human Resources Manager** – All companies requires well-educated, trained and empowered employees. This takes time to achieve and hence the HR manager is determining from the sales and operations planning plan what will be required and by when so he can develop an education and training schedule to support the sales and operations planning.
- **Financial Manager** – All plans require money and hence the FM is calculating what this plan will cost and whether more funds will be required and when so they are available when needed.
- **Master production scheduler** – Although not necessarily part of the top management team this person needs to be included in the sales and operations planning process. The more the Master Scheduler can learn about all demand and supply issues for the company, the better the Master Production Schedule that can be developed at the next level of planning.

From information from all the above a production plan is developed that will support the sales plan based on the agreed strategy for the business. Generally, strategies are either chase or more commonly a level strategy where the company tries to produce on a level output basis and satisfies the customers by keeping stock in the low seasons and using that stock up in the high seasons.

In order to determine if sufficient critical resources are available to support the plan, or to determine when current resources will no longer be sufficient to support the plan, a resource requirements process is developed. This process will only consider the critical / bottleneck resources, which in most businesses
will revolve around equipment, work centres or skilled employees. In some instances these critical resources could include suppliers, materials and/or money.

The result of the sales and operations planning process is an aggregate sales plan that will be given to the Sales Department to execute and an aggregate production plan that will be taken away by the Master Scheduler to be used as a major input into the master production schedule process, discussed next.

So, the major inputs to the sales and operations planning are the strategic plan and the aggregate demand plans for each of the company’s product families. The outputs are two fold; an aggregate sales plan and production plan for the business. These plans will be tracked daily by the sales and operations planning team and any deviations addressed timeously to keep the plans on track.

In order to confirm that the company is performing well and that any issue is not seriously compromising the company’s ability to plan and control production properly, a set of high level KPIs need to be developed and viewed by the sales and operations planning team on a continuous basis. A typical set of measures could include:

- Return on investment
- Performance of sales plan
- Performance of production plan
- Master Schedule performance
- Performance of material plans
- Performance of capacity plans
- Inventory accuracy
- BOM accuracy
- Routing accuracy
- Supplier performance
- Shop floor schedule performance
- Customer service

**MASTER PRODUCTION SCHEDULING**

Once the company has a viable aggregate ‘game plan’ for the business, the master production scheduler can take over and prepare the detailed ‘anticipated build schedule’ for the company’s finished products.

APICS defines the Master Production Schedule as:

> The master production schedule is a line on the master schedule grid that reflects the anticipated build schedule for those items assigned to the master scheduler. The master scheduler maintains this schedule and in turn, it becomes a set of planning numbers that drives material requirements planning. It represents what the company plans to produce expressed in specific configurations, quantities and dates. The master production schedule is not a sales item forecast that represents a statement of demand. The master production schedule must take into account the forecast, the production plan and other important considerations such as backlog, availability of material, availability of capacity and management policies and goals. Syn: master schedule.

The task of disaggregating the production plan from product families into individual end items and breaking it down from monthly into weekly time buckets is not a particularly easy task. On the completion of this task the sum of all the products in each product family in the weekly master production schedule buckets must sum to the quantity in the monthly buckets in the ‘production plan’, to within an agreed tolerance.
Whilst accomplishing the above the master scheduler must take into account the detailed end item forecast and current customer order such that he can not only support the ‘production plan’ but also the actual demand out in the market place.

The major objectives of the master production scheduler are:

- To develop a supply plan that supports the company’s demand plan to the required level of customer service.
- To maintain a plan that is as stable as possible to avoid nervousness in the materials planning systems.
- To create a plan that can be economically produced in the factory.

Master scheduling is a two-tiered process. Monthly the plan is updated with the information from the sales and operations planning and weekly, if not daily, the plan would be updated with the latest detailed sales order data.

The Master Scheduler should convene a weekly meeting with Sales and Production to discuss demand and supply and gain consensus for his master production schedule from these departments. In addition, it is a good idea that the Master Scheduler visit major ‘A’ companies on a regular basis with the sales department to get a better understanding of demand issues out in the market place.

On a daily basis, the Master Scheduler should attend the daily planning meeting with the shop floor schedulers to gain a first hand knowledge of problems on the factory floor that could affect the master production schedule and require the need to re-plan.

At this level of planning, the Master Scheduler needs to confirm that his anticipated build schedule has a good chance of being executed on the factory floor. To do this the schedule is tested against the critical resources available. At the sales and operations planning level the capacity check was made assuming a product mix in the product family. At the Master Scheduling level we now know the actual product mix so we can determine and confirm, in more detail, that the critical resources needed to support the master schedule will be available.

The position of master production scheduler needs to be regarded as a ‘very important position’ and in many companies, this is not the case. The Master Scheduler is the ‘helmsman of your ship’ and you certainly do not want to end up on the rocks going out past Robben Island due to incompetence. It is the view that the person holding this position should at least have a CPIM level of qualification or equivalent.

In addition, the position cannot be filled from outside the organisation, the requirements are that this person has a high level of knowledge of your business with regards to customers, suppliers, materials, production processes and most of all, your people. This level of expertise cannot be bought, only developed over a long period of time. Hence, succession planning for your Master Scheduler is very important and something that seems to be neglected in most companies.

So, the inputs to this master production schedule process are the production plan from the sales and operations planning process, the detailed demand plan from the demand management process together with current customer orders. The output is a set of Master Scheduler firm planned orders that will drive
the materials requirements planning process at the next level in planning hierarchy. This process will
determine, by an explosion process through the bills of materials, what needs to be bought or made, in
what quantity, in what time period to support the Master Schedule, which supports the sales and
operations planning, which supports the strategic plan for the business.

MASTER PLANNING – METRICS

If we consult the SCOR Model to determine what metrics are important in the master planning process we
are recommended to introduce the following.

SCOR MODEL METRICS

P1 – Plan The Supply Chain

The development and establishment of courses of action over specific time periods that represent a
projected appropriation of supply chain resources to meet supply chain requirements.

If we want a reliable supply chain, forecast accuracy is important. If responsiveness is key for you then
the cumulative source / make cycle time is important. Flexibility in the supply chain requires a fast re-
planning cycle time.

If cost is the performance attribute you regard as important, then planning costs should be minimised and
if you wish the maximum the use of supply chain assets then return on assets, capacity utilisation,
inventory days of supply and cash-to-cash cycle time will be metrics on which you will focus.

P3 – Plan Make Process

The development and establishment of courses of action over specified time periods that represent a
projected appropriation of production resources to meet the production requirements.

For a reliable supply chain it is important to have a high degree of adherence to the production plan. For
flexibility in the supply chain the minimisation of the cumulative make cycle time is key. If the best use
of assets is important then the minimisation of total work-in-process inventory is required.

MASTER PLANNING – BEST PRACTICES

Again, if we consult the SCOR Model it suggests that a few of the best practices that should be
implemented in the master planning portion of the supply chain are as follows.

SCOR MODEL BEST PRACTICES

P1 – Plan The Supply Chain

- That the supply / demand processes are highly integrated from customer data gathering to order receipt
- Having the capability to run simulated ‘What-if’ scenarios
- The ability to reconfigure the supply / demand plans instantaneously on the receipt of a change in demand
- In order to be responsive, the company needs to develop expertise in making business processes re-
programmable, re-configurable and continuously changeable
- That all the functions within the organisation understand their impact on supply / demand balancing.
**P3 – Plan The Make Process**

- That there are distinct and consistent linkages existing to ensure that disruptions and opportunities in production are quickly and accurately communicated and responses made.

**ASSESSING THE MASTER PLANNING PROCESS**

There are as many methodologies for assessing business processes as there are consultancies. The one the author uses is based on a five-stage map or matrix. Stage 1 refers to a company that has very little in place with regards to master planning, whereas a company at Stage 5 would be regarded as a world-class operation with regards to this business process. If a company can achieve Stage 3, they would be regarded as well on the way to their world-class goals.

This methodology has been structured to take management from a ‘disorganised’ (Stage 1) state to one that is fully ‘integrated’ (Stage 5). At the integrated stage, the organisation will be providing its customers with high levels of service and will be both flexible and agile to customer demands.

**STAGE 1: DISORGANISED**

At this stage, the company has no strategy with regards to the implementation of master planning processes. Little or no technology is being used to assist with the planning and control of priorities, materials and capacities. Any planning carried out is likely done on a manual basis or using spreadsheets.

**STAGE 2: REACTIVE**

The company now recognises the importance of the master planning processes and has considered the appropriate technology. At least a partially implemented ERP system, together with spreadsheets, is being used to assist in the planning and control of priorities, materials and capacities at both product family and SKU / end item level.

**STAGE 3: ORGANISED**

At this stage, the master planning processes are integrated throughout the planning hierarchy using at least a monthly planning cycle. An ERP system has been implemented to assist with the planning and control activities at both product family and SKU / end item level. The company is beginning to research advanced planning systems (APS) to optimise the processes.

**STAGE 4: PROACTIVE**

The master planning processes are now well integrated into the lower level MRP / CRP planning processes. Company performance is improving due to the master planning processes. The use of APS is beginning to optimise the master planning processes.

**STAGE 5: INTEGRATED**

An APS system is being used in conjunction with the ERP system to optimise plans at the product family and the SKU / end item level. In addition, the planning systems are being integrated with the external supply chain. Collaborative planning is taking place with digital links and joint service agreements. An effective benchmarking process is in place.
The following gives a guide as to what a company may have achieved at each of the five stages for the three basis master planning business processes; demand management, sales and operations planning and master production schedule.

**DEMAND MANAGEMENT**

**Stage 1.** There are no formal demand management processes in place. The salesmen, on an ad hoc basis, are carrying out forecasting. Production is generally being driven by current customer orders using a short planning horizon.

**Stage 2.** Forecasts are made using the sales history as a basis to predict the future. These forecasts are being used in an integrated demand plan together with customer orders. Measurement of the forecast accuracy has started.

**Stage 3.** A monthly forecasting process using qualitative as well as quantitative and event management tools is in place. A structured demand management process is in place including time fence and planning horizon policies. Demand management is in place for both product families and SKU / end items.

**Stage 4.** The demand management process is fully integrated into the ERP system. The total demand on the organisation is discussed with all sales and operations planning personnel on a regular and structured basis. The demand management team have integrated extrinsic data into the demand management process.

**Stage 5.** A fully integrated, continuous and automated demand management process is in place. This process has a high level of real time integration with the customer’s demand information and a CPFR process is in place with on-line visibility and pull based demand signals.

**SALES AND OPERATIONS PLANNING**

**Stage 1.** No formal and structured sales and operations planning and resource requirements planning processes are in place.

**Stage 2.** Top management are involved in the SOP process and meet on at least a quarterly basis to discuss, at product family level, what to make, sell and stock. Any aggregate capacity planning is done in a non-structured ad hoc manner. A SOP pre-meeting will have been introduced.

**Stage 3.** The formal monthly sales and operations planning process is being managed on a computer system. A manual check is made to confirm that sufficient critical resources are available for each aggregate product family. New product introduction information is now being included in the SOP process.

**Stage 4.** Sales and operations planning and resource requirements plans are integrated with the organisation’s ERP system. Product life cycles and product rationalisation is being considered by the sales and operations planning team. APS is being researched to optimise the company’s strategy to minimise cost, maximise profit and give greater asset utilisation.

**Stage 5.** The sales and operations planning process is being used by top management to drive the business to higher levels of performance and achieve the strategic plans of the business. There will be a high level of communication and collaboration with customers and suppliers to achieve high levels of performance to maximise profit and minimise costs in the supply chain.

**MASTER PRODUCTION SCHEDULING**

**Stage 1.** There is no master production scheduling or rough-cut capacity planning process in place. The factory is driven by current customer orders only.
Stage 2. A master production scheduler has been appointed and is planning at least 80% of the organisation’s production. The master production scheduler uses information from the demand management process to create a weekly master production schedule on a monthly basis.

Stage 3. Some critical resources are defined and are checked for each end item being master production scheduled using the rough-cut capacity planning process. Master production scheduling is integrated into the company’s ERP system and is run on a weekly basis.

Stage 4. There is a fully automated, integrated and continuous master production schedule. Rough-cut capacity planning processes are in place to provide improved levels of service to the customer. The master production schedule systems are used to prepare what-if scenarios as and when required. APS systems are being researched to optimise the master production schedule.

Stage 5. APS systems are in use to create the optimum master production schedule for the company allowing it to maximise profit and customer service whilst minimising cost. On-going demand signals are continuously reconfiguring the production and supply plans.

Determining at what stage a company is operating is a matter of developing a series of questions to which the answer is either ‘yes’ or ‘no’. Below is a sample of some of the questions that might be asked to determine if a company has reached Stage 2.

SAMPLE ASSESSMENT QUESTIONS

DEMAND MANAGEMENT

Stage 2: Reactive

2.1 There is a forecasting process in place using the sales history to predict sales into the future.
2.2 The demand plan is created from a combination of customer orders and forecasts.

SALES AND OPERATIONS PLANNING

Stage 2: Reactive

2.1 Top management meet on a regular basis to discuss what the company expects to sell, make and stock at product family level.
2.2 Top management understand the importance of the sales and operations planning process and have bought into its implementation.
2.3 Sales and operations planning meetings take place on at least a quarterly basis.

MASTER PRODUCTION SCHEDULING

Stage 2: Reactive

2.1 Top management has appointed a master production scheduler.
2.2 Master production scheduling is being carried out for at least 80% of the company’s end items.
To ensure success in the project it is essential that the company hire expertise in the area of master planning, as we assume it is not available in-house otherwise the situation would be different.

In addition, good education in the master planning process, for all those involved, is going to be essential to ensure a process that will be maintained and be sustainable into the future.

**SUMMARY**

In summary, the master planning process consists of three very distinct and important processes:

- Demand management
- Sales and operations planning
- Master production scheduling

The purpose, inputs and outputs of these three processes are as highlighted below.

**DEMAND MANAGEMENT**

- **Purpose** – To provide the company with a ‘reasonable’ demand plan or consensus forecast on which the company can plan its materials and capacity requirements with relative accuracy.

- **Inputs** – Customer orders and forecasts and the company’s sales / demand history. In addition, those external environmental issues that affect the business also need to be taken into account.

- **Outputs** – A reasonable demand plan in aggregate, out to the capacity time fence for sales and operations planning purposes and a detailed demand plan out to the planning horizon for the master production scheduler.
SALES AND OPERATIONS PLANNING

- **Purpose** – To determine when the company will need to significantly increase its capacity into the future to allow sufficient time to accomplish this increase.

- **Inputs** – Strategic plan for the business as well as the aggregate demand plan for the business. In order to determine resource requirements the critical resources required for each of the company’s product families will need to be determined.

- **Outputs** – The two outputs are an aggregate sales plan for the sales / marketing department and an aggregate production plan for the master production scheduler.

MASTER PRODUCTION SCHEDULING

- **Purpose** – To create and maintain an anticipated build schedule out to the planning horizon to allow sufficient time to order the longest lead time raw materials.

- **Inputs** – The major input is the sales and operations aggregate production plan together with the actual customer orders and the detailed demand plan. In addition, the actual critical resources required to build each individual item need to be determined for rough-cut capacity planning purposes.

- **Output** – the output is a schedule that will drive the materials requirements planning process that explodes through the bills of materials to calculate raw material, component and sub-assembly requirements.

In essence, master planning is vital to the success of any manufacturing business, but in all honesty, which companies can really say that they have best practice implemented at this level of their planning?

ABOUT THE AUTHOR

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During this time he has worked with over 100 companies in Southern Africa in many sectors including, automotive, engineering, electronic, electrical, food, agriculture, fishing, clothing, medical and mining, to mention a few.

Ken has been a member of SAPICS since 1989 serving on the Cape Town Chapter since this date. He has also been a member of the SAPICS national board for many of those years, serving as President for two of them.

Ken has regularly presented papers and workshops at SAPICS and other supply chain conferences over the years in South Africa. In addition, he presents SAPICS education courses, seminars and workshops both publicly in Cape Town or in-house to his clients around the country.
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