OLIVER WIGHT PAPER series

Integrated Planning and Control

The Lost Art of Managing the Supply Chain



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Excellence

James G. Correll — Oliver Wight Americas

OliverWight is Concerned

about a trend in industry in which planning processes are disconnected.



When plans are disconnected, a company's customer service, operational, and financial performance suffer.

The examples of disconnected processes are legion. The impact of disconnected planning processes are highlighted almost weekly in business journal articles about companies that suffer supply chain glitches.

Oliver Wight knows, from our work with clients, that the situation is widespread. Our concern is that companies have neglected building competency in Integrated Planning and Control. There is now a generation of people, for example, who don't know what Integrated Planning and Control is, how it impacts a supply chain, and how to develop interconnected planning and execution processes in their companies and supply chains.

Contributors: The author gratefully acknowledges the insights shared and review of the article by Dennis Groves, Michael Effron, and Larry Curry.

In this article, we provide an overview of Integrated Planning and Control (IPC), focusing on what each element in IPC is and how it connects to other business planning processes. Finally, we'll provide examples of results that companies achieve through the integration of their business processes.

THE CONNECTED MODEL

Figure 1 is the "Oliver Wight Integrated Business Model." Much like the body, it has many parts. Integrated Business Planning (advanced Sales and Operations Planning), an executive-level aggregate planning process that extends over at least a 24-month planning horizon, is like the brain. The purpose of Integrated Business Planning is to ensure all functional plans are aligned, to detect gaps between the latest projections and the company's business and strategic plans, and to take actions to close those gaps, minimize risk, and leverage opportunities in the marketplace.

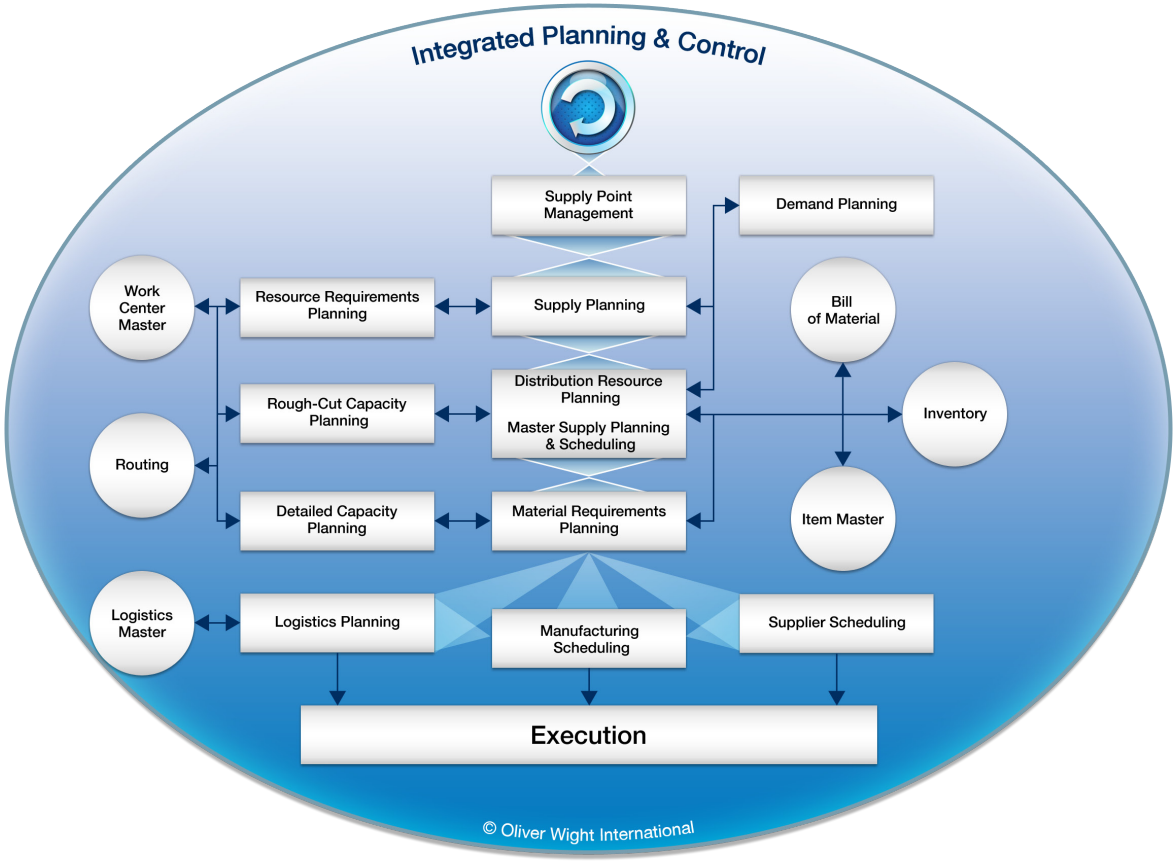
Figure 1. Integrated Business Model



The functional aggregate plans must be aligned with the functional detailed plans. This is accomplished through a combination of verbal and electronic signals acting much like the nervous system in the human body. This alignment occurs daily, weekly, and monthly. A feedback loop, like neurons in the body, exists to communicate back to the aggregate level when plans become misaligned and cannot be corrected. This is one purpose of a 24-month planning horizon for the aggregate executive planning process of Integrated Business Planning. Identifying problems that will occur sometime out in the future, say, 12 months from now, provides time to respond in the most effective manner possible.

The detailed planning processes must be connected as well. We find that companies have increasingly lost the knowledge base and competency to connect the detailed planning processes that support the supply chain. These processes are depicted in Figure 2 below, "Oliver Wight Integrated Planning and Control Model", and are

Figure 2. Oliver Wight Integrated Planning and Control Model



the equivalent of the nervous system which keeps all parts of the body operating in a synchronized manner.

The first step in the process consists of translating the aggregate demand and supply plans into the level of detailed information required to support the supply organizations. The Master Supply Planning and Scheduling process is a crucial process for developing and keeping up-to-date detailed supply plans which are, in turn, used to develop and keep up-to-date capacity plans, material requirements plans, supplier schedules, factory schedules, and logistic plans.

Alarmingly, many people are of the opinion that their supply chains do not require a Master Supply Planning and Scheduling process. Without this important translator, the supply organization must guess at the mix of product. In aggregate, the plan may be in alignment with Integrated Business Planning; but if the mix is wrong, the correct products won't be produced, and the customers won't get what they want.

THE CHALLENGES OF INTEGRATED PLANNING AND CONTROL

The observation above about diminished understanding and competency with Master Supply Planning and Scheduling is just one challenge companies face in operating an effective Integrated Planning and Control process. Another example of common challenges – and loss of competency – is what we call data integrity.



For all of these processes to work properly, accurate data and information is required. One reason supply planning people complain about forecast accuracy is that the demand plan, or forecast, is an input into the master supply plan. Because demand plans will always change, companies that utilize

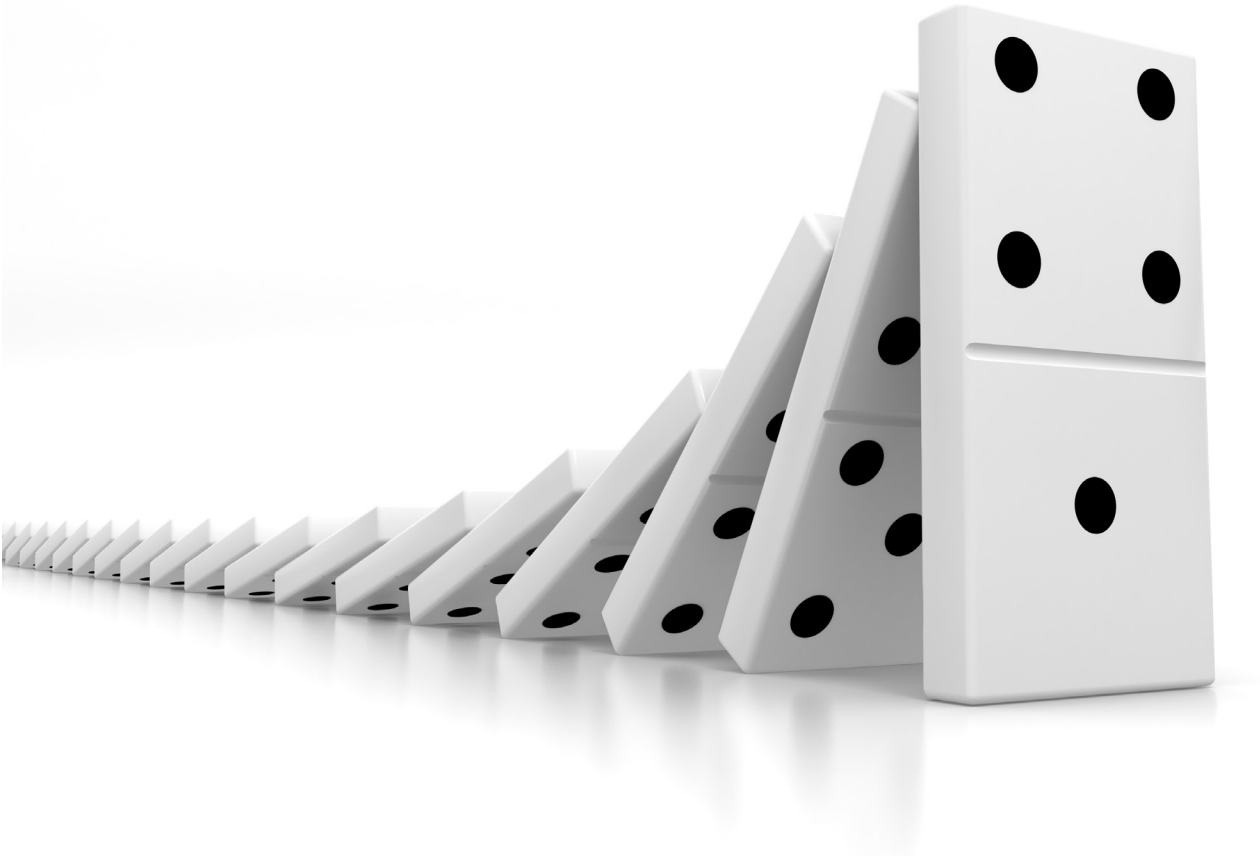
> *"Companies 'leave money on the table' through needless investment in inventory and resources and through lost sales caused by product availability problems."*

best practices establish a demand control process for managing near-term changes to demand.

Frequently, demand plan accuracy is a convenient scapegoat for why supply planning processes operate poorly. Rather than point fingers at the sales and marketing organizations, we first recommend that supply chain executives and managers review the accuracy of the information contained in their transactional enterprise planning systems.

If bills of material are not up to date, the wrong products and materials will be purchased – either in insufficient quantities or to the wrong specifications. If the item master is incorrect, the material plan will not be correct, resulting in ordering that is incorrect in timing or quantity. If the work center data and/or routing data is in-correct, the priorities in manufacturing will be incorrect, and the capacity plans will not reflect reality. If the inventory records are incorrect, either too much product or material will be ordered resulting in excess inventory, or not enough product or material will be ordered resulting in shortages.

Oliver Wight has not started work with a company in the last five years that had sufficiently accurate data. Most companies are not even close to "Class A" standards. (See Figure 3 on Page 16.)



"Alarmingly, many people are of the opinion that their supply chains do not require a Master Supply Planning and Scheduling process."

Even with a perfect demand plan or forecast, delivery problems will persist, and operating costs will be higher than necessary if the data required to support the supply planning processes are not at least at the minimum level. (See Figure 3 on Page 16.)



ELEMENTS IN AN INTEGRATED PLANNING AND CONTROL PROCESS

Let us assume that the data supporting the Integrated Planning and Control process is accurate, and processes have been established to keep the data accurate. Now, let us turn our attention to each element within the IPC process. We will define each element and provide an overview of the role it plays in ensuring a company can meet customer expectations as well as the company's financial expectations.

The major elements of Integrated Planning and Control are:

1. Master Supply Planning and Scheduling
2. Material Requirements Planning
3. Capacity Planning
4. Manufacturing Planning and Execution
5. Procurement Planning and Execution
6. Data Accuracy

MASTER SUPPLY PLANNING AND SCHEDULING

The Master Supply Planning and Scheduling process should be designed, and the enabling software configured, to support the company's tactical strategies for providing optimum customer service at a cost that the company can afford. Examples of these strategies are make-to-stock, make-to-order, assemble-to-order, and engineer-to-order.



These strategies alarmingly are being dictated by some software companies, who mandate that companies must choose either a make-to-stock or make-to-order strategy. In our experience, the most effective processes are supported by a system that can operate with the range of strategies that is needed to support the tactical choices to provide customers what they want when they want it while, at the same time, providing the supply chain an opportunity to meet the customer demand efficiently and cost effectively.

Input into the master supply plan is from the demand plan and production plan that are approved in the aggregate planning process of Integrated Business Planning. These plans that are approved in Integrated Business Planning are in the form of quantity (volume) by month. The plan must be "disaggregated" into detailed plans. The detailed plans are the time-phased volume of end items or options within each family over at least 12 months into the future. The detailed demand plan is required to ensure that the master supply plan supports the demand that is being requested. Keeping the two plans in alignment day to day and week to week requires close

collaboration between the master supply planners and demand planners.

Even though the production plan and demand plan most likely will not equal each other for any particular month, executive management authorization requires the sum of the master supply plan equals the production plan and the sum of the detailed demand plan equals the demand plan for each month. Keeping the sum of the master supply plan equal to the production plan is not always easy. If the senior management decides to adjust the production plan up or down (due to demand plan changes, inventory position changes, or customer lead time considerations, etc.) the master supply plan must be adjusted accordingly. These changes should not be made by simply applying percentages to the new production plan. The master supply plan must be adjusted by master schedule items to support the new production plan.

Once what to produce in support of the demand plan is determined, the master supply planner must now create a supply order in the Enterprise Resource Planning system that supports the demand while considering the capability of the supply chain. When these two objectives are achieved, the master supply planner has a "valid plan." The role of the master supply planner is to ensure that the supply plan is valid. That means it is aligned with demand, and the capability exists to execute the plan.

> *"Frequently, demand plan accuracy is a convenient scapegoat for why supply planning processes operate poorly."*

One of the major complaints about an Enterprise Resource Planning system is "nervousness." This term describes the impact of the large number of messages sent to the planners of the items in the lower levels of the bills of material. These messages can cause planners to expedite an item one day and then de-expedite the same item the next day.

The generation of action messages can also be caused by the other elements of



the Integrated Planning and Control process, but the major cause is the master supply plan. The master supply planner's job is to "firm" the master schedule through cumulative lead so that the system will not automatically replan. When the logic in the master plan indicates that replanning is needed, the master supply planner will receive a message that the supply and demand are not in alignment. At that point, the master supply planner needs to decide if the change is reasonable or whether some other option should be explored. A major consideration is the impact of making a change on the rest of the company as well as the rest of the supply chain. For example, if a sales order is put in the planning system, but there are not enough resources in the supply plan to support it, the system will recommend that a supply order be accelerated to support the demand. Before rescheduling the order, the master supply planner must check to see if material and capacity are available to support the supply order. If material or capacity isn't available, the master supply planner should adjust the master plan to when they will be available, thus assuring the supply order will be delivered. Just following the recommendation of the system may cause a material shortage and overload the capacity of the company and its suppliers causing further confusion regarding what to produce. Unless by luck all decide to work on the same items first, multiple shortages are created, and much less in total is shipped.

Master Supply Planning and Scheduling is a daily function. We mentioned earlier that an increasing number of companies do not have a Master Supply Planning and Scheduling process. We find that those companies that do have a Master Supply Planning and Scheduling process frequently only review the messages generated by the Enterprise Resource Planning system once a week or less frequently and then may still not take appropriate action.

Messages generated by the master supply planning system should be reviewed every day. Occasionally it may take a couple of days to balance the master plan when the production plan is received as output from the approved monthly Integrated Business Planning process or when there has been some other significant change. When additional time is required, there should be maximum effort by the master planners to complete the work as quickly as possible because the supply plan is invalid until the new master plan is completed.

Ignoring the messages either by just not working them, suppressing them, or just not running the system for extended periods of time is like sticking one's head in the sand when bullets are flying everywhere. Every time a message isn't worked, we are lying to the supply chain about what is really needed. Lack of performance by one person is causing hundreds of people to do the wrong thing. If the data is wrong, then fix it so the number of messages is reasonable to deal with.

MATERIAL REQUIREMENTS PLANNING

Material Requirements Planning is similar to Master Supply Planning and Scheduling in that a "valid material" plan is the objective. The major difference is that the material

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planner doesn't have to break down the forecast or "firm" orders through cumulative lead time. The master supply planner should have sent them a "valid plan." The master supply planner should have also done preliminary research to understand the impact of any change on the supply chain prior to changing the master plan, thus eliminating the nervousness. If the master supply planner has done his or her job correctly, the material planner can plan for thousands of parts while making adjustments, as needed, to maintain a "valid plan." Again we have assumed accurate data.

Action messages come to the material planner from the master supply plan. Action messages are also caused by scrap, rework, inventory adjustments, bill of material changes, and a whole host of other reasons. The ERP system must be run daily so that the plans can be adjusted and communicated. Like the master supply planner, the material planner must work the messages daily. If the messages are not worked immediately, the supply chain will be executing the wrong plan.

CAPACITY PLANNING

In the Integrated Business Model (Figure 1) capacity planning is done at three levels:

1. Resource Requirements Planning – a rough cut of **critical** constraints or resources at the Integrated Business Planning level
2. Rough-Cut Capacity Planning – a rough-cut capacity plan of **major** constraints at the master supply planning schedule level
3. Detailed Capacity Planning – a detailed capacity plan of **all** resources, including people, at the Material Requirements Planning level

For each of the above planning levels, the capacity plan is generated by different people in the organization. A supply manager may generate the Resource Requirements Plan for Integrated Business Planning to see if the aggregate plan is achievable in the mid to long term on the critical constraints of resources. A master supply planner may generate the Rough-Cut Capacity Plan to determine whether the master supply plan driven from Integrated Business Planning in the short to mid term (disaggregated into specific end SKUs or options) is achievable and, if it isn't, what actions must be taken.

The capacity planning process for both Integrated Business Planning and master supply planning uses a resource profile on the selected resources that is contained in the master supply planning system and the Integrated Business Planning tool respectively.

A capacity planner may generate a short-term detailed capacity plan derived from Material Requirements Planning (all components and raw materials) which use routings and work center data to create capacity plans for all work centers, whether the work centers consist of equipment, people, or a combination of both. The detailed capacity plan is used by the shop supervisors and capacity planners to ensure that machine capacity and people capacity are available in the appropriate week. If the plan needs to be changed, the capacity planner contacts the material planner, and they discuss the best alternatives. When detailed capacity planning is done properly in combination with Resource Requirements Planning and Rough-Cut Capacity Planning, shortages caused by capacity constraints virtually disappear, and significant productivity improvements are achieved because the right people are in the right place at the right time.

MANUFACTURING PLANNING AND EXECUTION

The material plan for manufactured items is used by the system, along with the routings and work center data, to create a schedule for work centers. This schedule is sometimes called a "dispatch list."

The schedule by work center gives the operation start and completion dates of every order that will move through each work center. The schedule is aligned exactly with the material plan and capacity plan. This means that if the schedule is executed, there will be no shortages.

If good lean practices are in place, and the batch process has been converted to a flow process, the shop floor schedule becomes greatly simplified. Kanbans can be helpful in simplifying the process, but caution has to be taken to assure the Kanbans are properly applied and are linked to the schedule.

PROCUREMENT PLANNING AND EXECUTION

Supplier requirements are driven from the master schedule through Material Requirements Planning to purchasing or procurement. Purchasing or procurement



people then plan the output for the purchased items, using the Enterprise Resource Planning system in the same mode as the material planner.

The Purchasing group's main objective is to create and maintain a "valid plan" using the same criteria as the master supply planners and material planners. This "valid plan" can be communicated to suppliers via the Supplier Schedule so they can see their demand requirements a year or more into the future. The sharing of purchasing plans eliminates the need for suppliers to forecast – they can rely on their customers' buying intentions. When valid plans are communicated to suppliers, with a process to manage adjustments to plans within agreed-upon lead times, inventory can be reduced in the supply chain.

Suppliers are also better able to plan and manage their resources, which results in improved operating efficiencies and reduced costs. In addition, lead times can be significantly reduced because the supplier can rely on the schedule from the customer to plan long lead-time material. The customer can operate using their suppliers' manufacturing lead times, not cumulative lead times. With lead times well understood between customer and supplier, the two partners can work together to reduce lead times and better adjust to changes in demand.

Ultimately this level of accuracy leads to the elimination of individual requisitions and purchase orders. At the shortened lead time, the customer must still approve the order but only to approve the plan that was already sent or make minor adjustments. This process is a real time saver on both ends.

DATA ACCURACY

The five elements of planning master data accuracy are inventory, item master, bill of material, routing, and work center. If any of this data is incorrect, it will drive errors into the planning and execution system causing both inappropriate actions and excessive messages in the ERP system. All of the data must be audited for accuracy. Let us look at each data element individually.

Inventory Accuracy: The Enterprise Resource Planning system nets demand against what is in inventory. Inventory can exist in the storeroom, floor stock, or on a shop order. Many companies struggle to establish inventory accuracy and keep an accurate perpetual count in the system.

"If any of this data is incorrect, it will drive errors into the planning and execution system..."

Ironically, establishing and maintaining inventory accuracy is relatively simple.

An accurate stockroom can be operated with fewer people than an inaccurate one. Inefficiencies and greater costs are caused by trying to locate items and by carrying inventory that is not needed. Perhaps what is most important is a regular and routine process for ensuring inventory accuracy, which significantly reduces the number of shortages, which, in turn, improves on-time delivery.

Regular audits to check for inventory accuracy must be performed. Cycle counting is an excellent method to find the root cause of inventory inaccuracies and drive corrective action to ensure that a high level of inventory accuracy is maintained.

Bill of Material Accuracy: The Enterprise Resource Planning system uses the bill of material to perform level-by-level planning. If an item is missing on the bill of material, the Enterprise Resource Planning system will not order it, creating a part shortage. If an item is not needed but it is on the bill of material, Enterprise Resource Planning will order it, creating excess inventory. The structure must represent how a product is made.

The main elements of the bill of material are proper structure (parent component relationship, complete and nothing extra), quantity required for the parent, and unit of measure. Many companies complain about their bill of material accuracy without fixing the problems. A simple feedback process should be instituted from the shop floor so that inaccurate bills of material are quickly corrected. Without corrective action, the problems persist, and people incorrectly blame the system for the problems. Most data accuracy errors are caused by people and process issues.

Item Master Accuracy: The Enterprise Resource Planning system uses the item master to determine how the item should be planned. Things like safety stock, lead time, etc. must be accurate in the master data in order for the output to reflect a "valid plan."

The item master is one of the most misused capabilities in an Enterprise Resource Planning system. For instance, safety stock is often applied inappropriately to cushion against shortages. Not only is excess inventory created, but also the supply chain receives false information regarding the real requirements. In addition, greater costs and inefficiencies are created by producing items that are not needed.



Routing Accuracy: To create accurate detailed capacity plans, shop floor schedules, and costs for an item, a routing is required. The routing defines how the product is going to be made and how it flows through the factory. The main elements of the routing are the sequence, work center, set-up time, and run time. If these elements are inaccurate, the capacity plan and shop schedule costing information will be inaccurate. Like the bill of material accuracy, routing accuracy can easily be established and maintained with a feedback process.

Work Center Accuracy: Like the routing, the work center file must be accurate to have accurate detailed capacity plans, shop floor schedules,

> *"The resulting lack of institutional knowledge is causing companies needless erosion of operational and financial performance."*

Figure 3. Performance Measures

Function	Measurement	Minimum Acceptable
Master Scheduling	On-time delivery to master schedule	95%
	Valid plan	100%
Material Planning	On-time delivery to work orders	95%
	Valid plan	100%
Data Accuracy	Inventory; quantity; hit/miss	95%
	Bill of Material; all elements; hit/miss	98%
	Routing; all elements; hit/miss	95%
	Item master; all elements; hit/miss	95%
	Work Center Master; all elements; hit/miss	95%
Capacity Planning	Input and output hours	95%
Shop Floor Execution	Operation due dates	95%
Procurement	On-time delivery from suppliers	95%
	Valid plan	100%

*100% seems unachievable, but the plan must be valid (accurate and doable) to the best of the planner's knowledge. This is achievable and must be the culture.

and costing information. The work center file simply describes how that work center is currently operating. It contains things like how many shifts, how many hours per shift, days per week, number of operators, and number of machines. This should be the easiest file to keep up to date because during the weekly detailed capacity planning meeting attended by the shop supervisor and the capacity planner, the first thing that should happen is for this file to be updated based on the current situation and then revised to complete the amount of work required in the future.

FINANCE ELEMENTS

If all the elements of the Integrated Planning and Control process are configured correctly, accuracy is maintained, and the costs and prices are correct in the system, the financial output from the ERP system will be accurate.

The ability of today's systems to "slice and dice" data for analysis is incredible. Coupled with accurate data, the financial organization can do more financial analysis, draw conclusions, and make more meaningful recommendations. Instead of trying to adjust the financial information to reflect reality, finance can take the data "as is" and evaluate the implications of the plans.

The Finance organization should also conduct audits to ensure the financial data in the system is accurate.

PERFORMANCE MEASURES

In order to know if any process is performing as desired, performance measures are needed. The performance measures must reflect the behavior a company desires to achieve and must also reflect the level of acceptable performance. A good rule to use is 'any measure not used for control or improvement should be trashed'. The backside of that is, any measure you don't have that is needed for control or improvement, get it.

Some critical performance measures of the processes described above are shown in Figure 3 (Page 16). A performance measurement process is needed. It is insufficient to merely measure and report. The performance measurement process needs to include ways for determining the root cause of poor performance and determining and assigning accountability for corrective actions.

"The ability of today's systems to 'slice and dice' data for analysis is incredible. Coupled with accurate data, the finance department can evaluate the implications of the plans."



TEAM WORK

Most people say a company operating in the environment described above is "motherhood and apple pie." It may sound like it, but when you see a company operating in the environment described above, you realize it isn't impossible. Those companies ask themselves, "How did we survive in the old environment?"

In our work, however, we are alarmed at how many companies lack the basic fundamentals of Integrated Planning and Control described in this article. Of even greater concern, the people who once had the competency to design, configure, and operate Integrated Planning and Control processes have retired. The resulting lack of institutional knowledge is causing companies needless erosion of operational and financial performance.

If we have done a good job describing the major elements, it should be clear that if any of the pieces of Integrated Planning and Control are not done well, the result will be that the other pieces won't be able to operate effectively. What happens then?

The people described in each planning process are forced to figure out how to work around inaccurate data. Instead of using the ERP system to plan, they use spreadsheets. Spreadsheets are difficult to link and integrate, and the efficiencies and effectiveness gained from integrated processes and systems are negated.

As a result, everyone works to different plans at the detailed level, and no matter how accurate the aggregate plans are from Integrated Business Planning, companies struggle to execute. Companies waste time, money, and energy trying to satisfy customers. Companies "leave money on the table" through needless investment in inventory and resources and through lost sales caused by product availability problems.

This situation does not have to exist. Companies must develop competency in Integrated Planning and Control to achieve and maintain an industry leadership position.

To talk to an Oliver Wight expert on implementing or improving Capable Integrated Planning and Control processes, please contact www.oliverwight-americas.com or call 800-258-3862.

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Jim Correll, a principal with Oliver Wight Americas since 1984, served eight years as chairman of Oliver Wight Americas and co-chairman of Oliver Wight International. As a consultant, he has assisted more than 20 companies attain Class A performance. These companies include numerous Caterpillar Divisions, Imperial Tobacco, General Dynamics Land Systems, Martin Marietta Astronautics, Boeing Portland, and Tektronix, Inc. At Tektronix he served as the Class A implementation manager. In that capacity, he developed a new organizational structure, implemented new software, and designed and delivered an effective educational training program for both the new software and the behavior changes required to obtain bottom-line results. Jim has an extensive background in instructing public and private courses. In addition to several articles and white papers, Jim co-authored two books: *Gaining Control: Managing Capacity and Priorities, Third Edition*, and *Achieving Class A Business Excellence – An Executive's Perspective.*

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