

Dealing with Emperor's new clothes

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From MRP¹ II to Advanced production schedulers

"The Emperor's New Clothes" is a short tale by Hans Christian Andersen about two weavers who promise an Emperor a new suit of clothes that are invisible to those unfit for their positions, stupid, or incompetent. The Emperor cannot see the cloth himself, but pretends that he can for fear of appearing unfit for his position or stupid; his ministers do the same. When the Emperor parades before his subjects in his new clothes, the subjects also play along till a child cries out, "But he isn't wearing anything at all!". The Emperor cringes, suspecting the assertion is true, but holds himself up proudly and continues the procession².

@Wikipedia, 2011

History of Manufacturing Management: A case of emperor's new clothes?

If we look into the history of manufacturing management, it is rather perplexing how the entire industry has learnt to live with seemingly contradictory facts without confronting it for decades. The market of MRP II or its extended version, the ERP solutions, grew up to more than a few billion US dollars across the globe. But at the same time, there were overwhelming numbers of stories of companies not getting the desired results from the initiative and in many cases, experienced a deterioration of performance.

The solution, when invented, offered a compelling logic of how it can help organizations reduce inventory, improve delivery performance and reduce product costs. With a feasible master production schedule, along with a clean bill of material, routing and inventory data, one can easily compute using available processing power and determine the time phased schedules for every work centre using lead time data. If every work centre follows exactly the planned schedule, not only can one control the inventory but also ensure on-time delivery performance.

How is that a solution, so simple and seemingly powerful not delivered the promised results? There are many cases where organizations bought the software but never really used it to manage their shop floor. If this is the widespread case, how did the market grow up to such a huge size? Is it a case of emperor's new clothes?

To unravel this mystery, we need to understand how a solution becomes popular. A solution becomes very popular when opinion leaders, industry associations and consultants promote it in a big way in the industry. MRPII and ERP were widely promoted by the thought leaders and industry associations in the 80s and the early 90s. If we have to analyze how some solutions retain the popularity despite the wide spread "failure" stories, we have to check how opinion leaders have analyzed and explained the "failures". The analysis of the various articles trying to explain the MRP II fiasco shows two types of explanations. One dominant school of thought tries to put the blame on the obstacles to the implementation like lack of top management commitment, difficulty in maintaining data integrity, lack of trained manpower etc. When obstacles are widely presented as a reason of failure, it always makes sense for another organization to give it a try, particularly when the solution looks like the lone saviour. Throughout the 90s, the obstacles were presented as the reason for failure and new organizations kept on trying. The market expanded year on year across the world.

Towards the late 90s, the dominant opinion against MRPII challenged the basic validity of the solution. Articles started appearing which questioned the very essence of the solution. The foremost argument against MRPII system is that it assumes infinite capacity. The so called “closed loop” check of capacity for a given master production schedule, actually never provided an answer which was optimal on either capacity utilization or due date commitment. Some experts dismissed the solution as heuristics which depends heavily on the intelligence of the scheduler. Now the problem looked like a puzzle of mathematics which can be solved by having the right algorithm – this gave rise to a new solution: Advanced production scheduling and optimization. These solutions are supposed to provide the optimal solution given the seemingly conflicting needs of meeting due dates and ensuring capacity utilization without overloads. The problem which was categorized as a “visibility” issue now became a mathematical problem. These complex solutions allow us to commit dates after considerations of finite capacity of many constraining resources. At the same time these solutions claim to have “combined” planning and execution, a gap in MRPII solutions. While it is almost practically impossible to frequently reschedule in an MRPII system, most advanced planning and scheduling software have an ability to generate reschedules without much hassle. The new solution was more “flexible” than the “rigid” MRP II solutions. The planning and execution is “combined” as the uncertainties experienced in execution can be incorporated to create a fresh plan. Since the market for ERP is almost maturing and new license sales nearly stagnating, the new solution is being widely promoted by the IT and management consulting industry. However, due to the high cost of the solution, the adoption is not as widespread as was seen in the case of MRPII and ERP waves. However many companies, particularly the large ones are evaluating the options. It is important to evaluate if this is also a case of another set of “emperor's new clothes”.

Deciphering the latest emperor's clothes: The advanced planning and optimization solutions

- **Configuring the current mess:** Fire fighting is almost a norm for most shop floors. In an environment of frequent fire fighting, the constraints keep on shifting across work centres. The intuition of most managers about the “constraint” work centre is usually flawed as they end up assuming that they have an environment of multiple constraints. The same intuition is used for configuration of products and consultants involved proudly do so as the software claim to fame is handling multiple constraints. Once the software is trying to “optimize” multiple resource constraints, there is no way one can reduce inventory of the shop. On the contrary the inventory is bound to go up, if every reschedule focuses on optimizing multiple constraints.
- **Institutionalizing poor reliability?:** The claim to fame for most of these products is the ability to optimize multiple constraints and provide order due dates. At the same time, if there are uncertainties in execution, the products have an ability to reschedule the orders. If one tries to schedule to optimize multiple work centres in a shop, the chances of uncertainties disturbing schedules is very high. If with every uncertainty, one has to reschedule the orders, then how is it possible to get high on-time delivery as per the original commitments. The only way out is to remove all uncertainties of the shop floor – which is only a theoretical possibility!
- **How optimal is the solution?:** To counter the problem of frequent reschedules, many of these products allow buffers to be defined in the schedules. If buffers are defined, it is no longer an optimal schedule. Without a proper feedback process in execution, it is likely that the buffers are either too much or even too less. In either case, the claim of an “optimal” solution is jeopardized.

- **Poor priorities for made to stock environments:** The execution urgencies are based on schedules given to resources which is time based. But for environments which are essentially made to stock, the time based priorities can be grossly inaccurate. The shop floor can end up expediting orders which are “late” but the stock at the warehouse may be more than adequate. At the same time, there can be orders running on or before schedule but the corresponding stock at warehouse is near to stock out. The signals of relative urgencies of orders can be grossly wrong unless one has perfectly forecasted the demand which again is nearly impossible – we do expect some SKUs to get consumed at much faster rate than forecast while others may have a slower rate of consumption.
- **The Black box effect:** The schedules from these products are generated using complex mathematical algorithms which not many people understand. As a result, to expect the shop floor to follow them blindly is a tall order. The shop floor people will always check if the schedules make any intuitive sense to them. It is not surprising that in most cases where the software is claimed to have been implemented, people at shop do not follow the schedules – they apply their own mind. It is presented as a “discipline” problem by the consultants. Managers will always manage and take decisions if they are held accountable for overall performance. They will use their intuition for decision making. The only way managers will accept the new schedules is when they change their intuition to match the complex algorithm of the software. This is humanly impossible! So managers will never accept the schedules derived from complex solutions, unless we replace them with robots!
- **Data Integrity:** One of the prime reasons of companies buying MRPII systems but never really implementing it is the lack of data integrity. Errors in BOM and routing file, inventory file not updated is a chronic problem for most organizations. If most organizations failed to ensure data integrity for implementing a MRPII or production planning module of ERP, how do we expect the advanced schedulers to ever be implemented, particularly when they require even more data discipline?

The core issue: the management paradigm

MRP II analyzed the issue of effective management of shop floor as a “visibility” issue while the advanced schedulers analyzed it as a problem in mathematics.

Is this the real problem behind the effective management of shop floor?

The core issue which bothers the shop floor managers is the conflict between utilizing the work centres and ensuring timely order completion. Every shop manager understands the conflict. They know that if they focus too much on utilizing work centres, the order completion gets jeopardized and then one is forced (due to month end dispatch targets or customer follow up or pressure to reduce receivables) to move to the other extreme of rushing orders out of the shop even at the cost of poor utilization.

MRP II implementations never tried to deal with the conflict. On the contrary they tried to institutionalize it by integration of manufacturing resource planning with product costing. For minimal product costing, the work centres have to be utilized to the maximum to spread the overheads over more units. This in turn required batching across many orders to minimize setups which in turn increased the production lead time.

Most MRP II implementations incorporated the “experienced” fixed lead times into the software. These lead times were because of practices of maximizing work centre efficiencies which in turn increased the waiting time and the queuing time. When work centres are given local due date targets after an MRP II schedule, the dates become self fulfilling prophecy for most initial work centres. The given lead times become a “legitimate” performance measure of a department, and hence gains are rarely passed on. The delays due to uncertainties are however passed on. Instead of trying to recover the delays, the later work centres try to manufacture to “their” target lead time. As a result, the expediting signals come in very late which in turn disrupt the work centres leading to loss of capacity. The conflict between managing order flow and utilizing capacity remained. This is one of the prime reasons for MRP II implementations failing to give results even when there is an “intelligent” planner who is able to arrive at a realistic master schedule. In many other cases, the plan itself tends to be unrealistic as the planner is not “intelligent” enough to juggle between maintaining due dates and levelling the loads on the resources to arrive at a realistic master schedule.

Advanced production planning and optimizer software not only takes away the dependence on an “intelligent” planner but at the same time, instead of depending on suboptimal heuristics of an individual planner, it arrives at a mathematically optimal solution given the problem of multiple limiting factors. However with the feature of re-scheduling and user defined objective function, the tool allows the plant managers to decide what they want at any point of time – mess up order commitment or mess up capacity. The choice was with the plant managers and software allows for everything!!

Both the solutions and the way they were implemented inherently failed to address the real problem – how to break the very essence of the conflict.

The management paradigm which is widely held by most manufacturing managers for ages is; “if one tries to focus on fast flow of orders in the shop, it is impossible to get best efficiencies as it will lead to many undesired setups and corresponding “loss of capacity”. So the default rule is to focus on efficiencies until one is forced to focus on flow. This switch in work culture is prevalent in almost all manufacturing plants and comes in the way of effective management of a production shop.

If we are able to establish that focusing on maximizing speed of order flow in the shop actually does not cause capacity losses and on the contrary it helps in better utilization, then we can make a significant change in the management of shop floors. Instead of constantly switching between “culture of utilization” and “culture of order flow” - if we help managers to stay on one without jeopardizing the other – we will have a solution which will be implementable. At the same time, the solution should be simple to understand, easier and faster to implement.

Is it time to provide some real clothes?

Since the fundamental problem is that of a management paradigm we need a solution which provides the new paradigm to the plant managers. Or in other words, what is required is not necessarily the hardware or the software, but an alternative “mindware” to manage the plant.

Theory of constraints has made us aware that the output of plant is controlled by the constraint machine. If material is released more than the pace of constraint machine, there will be excess WIP in the shop floor, which will lead to incorrect prioritization, elongation of lead time and shifting

bottlenecks and month end spikes. While most plant managers agree to the theory, they tend to believe that their shop floor complexity is inherent to their plant. However the observed complexity is because of the outcome of their decisions. The multiple constraints in most cases is because of the practice of releasing too much material into the shop so unless the WIP is reduced, one cannot understand the true characteristics of the shop.

In most environments, the touch time is less than 10% of the overall lead time. So if we choke the release of material to half of the observed lead time, the excess WIP will come down and the real constraint will then be visible to everyone. The new orders can then be finitely loaded on the single observed constraint to provide due dates. Now we do not need accurate data everywhere but only in one place – the constraint. Planning now looks much simpler – no mathematical modelling is required. But how do we deal with uncertainties? If we want to have due date performance, we should not keep on rescheduling orders with every observed uncertainty.

Since the material release is controlled, less time is wasted in the shop and now even half the previous lead time has enough buffers to adjust for usual uncertainties (remember touch time is still a small percentage of lead time). So instead of rescheduling the due dates with every uncertainty, we can provide the work centres with execution signals based on elapsed time since material release. So instead of imposing schedules on them, we can allow them to take decisions which are in the best interest of flow. The execution signals can be used to check the adequacy of time buffers and also plan improvement projects to further reduce the lead time.

The above approach is the Theory of Constraints paradigm for managing the shop floor. Implemented world over in a wide variety of manufacturing environments, the typical results include 50% reduction in lead time, dramatic improvement in due-date performance and around 40% increase in plant output.³

We have a rather perplexing question before us. If the solution is so simple and results so significant, why is it not as popular? Is it that our admiration for sophistication and complexity blinds us from deciphering the inherent simplicity of a manufacturing environment?

¹ Manufacturing resource planning (MRP II) is defined by APICS as a method for the effective planning of all resources of a manufacturing company.

² Scholars have noted that the phrase 'Emperor's new clothes' has become a standard metaphor for anything that indicates a state of widespread collective denial.

³ Mabin, Victoria J. and Balderstone, Steven J., The World of the Theory of Constraints, CRC Press LLC, 2000. A review of the international literature on TOC analyzed the average results achieved: 70% reduction in lead time, 44% improvement in due-date performance and a 76% increase in revenue/ throughput/profit.

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