Demand Driven MRP

Standing on the Shoulders of a Giant

To See the Future of Formal Planning

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Carol Ptak and Chad Smith

"If I have seen a little further it is by standing on the shoulders of Giants."

Sir Isaac Newton, 1676.

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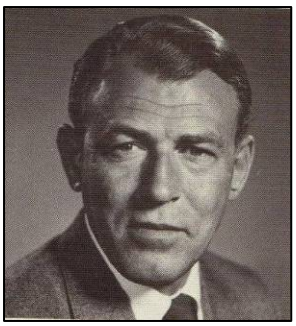
The Giant

Joe Orlicky was truly a giant. When he wrote the first book on Material Requirements Planning (MRP) in 1975 only 700 companies had implemented the concept.

"As this book goes into print, there are some 700 manufacturing companies or plants that have implemented, or are committed to implementing, MRP systems. Material requirements planning has become a new way of life in production and inventory management, displacing older methods in general and statistical inventory control in particular. I, for one, have no doubt whatever that it will be the way of life in the future."

MRP did become the way of life in manufacturing. The codification and subsequent commercialization of MRP fundamentally changed the industrial world. Orlicky recognized the opportunity presented by changing manufacturing circumstances and the invention of the computer that enabled a planning approach never before possible.



Joe Orlicky

"Traditional inventory management approaches, in pre-computer days, could obviously not go beyond the limits imposed by the information processing tools available at the time. Because of this almost all of those approaches and techniques suffered from imperfection. They simply represented the best that could be done under the circumstances. They acted as a crutch and incorporated summary, shortcut and approximation methods, often based on tenuous or quite unrealistic assumptions, sometimes force-fitting concepts to reality so as to permit the use of a technique.

The breakthrough, in this area, lies in the simple fact that once a computer becomes available, the use of such methods and systems is no longer obligatory. It becomes feasible to sort out, revise, or discard previously used techniques and to institute new ones that heretofore it would have been impractical or impossible to implement. It is now a matter of record that among manufacturing companies that pioneered inventory management computer applications in the 1960s, the most significant results were achieved not by those who chose to improve, refine, and speed up existing procedures, but by those who undertook a fundamental overhaul of their systems."

In the first edition of Orlicky's MRP, Orlicky made the case for a fundamental reexamination of how companies planned and managed inventory and resources. This case was so compelling that the concepts that he brought to the table proliferated throughout the industrial world within two decades.

Industry now faces another time of transition and re-examination. The circumstances under which Orlicky and his cadre developed the rules behind MRP and Distribution Requirements Planning (DRP) have dramatically changed. Customer Tolerance Times are much shorter. Product variety has risen dramatically. Supply Chains have extended around the world. Product complexity has risen. Outsourcing is more prevalent. Product life cycles have reduced. Reductions in working capital are mandated.

In a nutshell, there are more complex planning and supply scenarios than ever before in history. The complexity comes from multiple directions; ownership, the market, engineering and sales and the supply base. While this complexity has risen, the potential of technology has progressed and accelerated. The lack of significant financial return on technology investments would strongly suggest that this potential has been squandered.

Software is a tool that translates and reinforces rules into a routine. If the rules behind the software are inappropriate and outdated then we must change the rules before we change the tools. In recent

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years, however, industry and software providers have attempted to combat increasing complexity with better software applications; applications with the old rules embedded at their core. The net effect is that we have improved the efficiency of doing the wrong or inappropriate things. Money and energy spent to optimize antiquated rules with increasingly sophisticated tools is wasteful, distractive and counterproductive. Given the current world of increased variability and volatility; conventional MRP and DRP logic now requires a fundamental overhaul. We think Orlicky would agree.

Seeing the Future

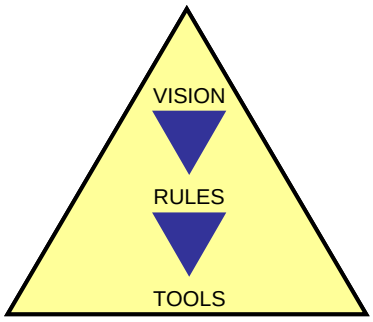
Our self imposed mission was to stand on the shoulders of Joe Orlicky's incredible vision in order to see further. This white paper and the latest edition of Orlicky's MRP proposes elegant and intuitive MRP and DRP rule sets to address the volatile 21st Century landscape. Complexity cannot be combated with more complexity. Effective rules and subsequent tools are necessary for the demand driven world to enable companies' resources and assets to move closer to actual demand. There can be no more lip service to small incremental changes that may or may not improve the company's performance; concrete and proven tactics are required that drive sustainable bottom line results. Furthermore, the tension between the formal planning and the Lean communities must be eliminated; they need each other desperately.

To better understand the context of the required change, the following five questions need to be asked:

1. Is the vision behind MRP still relevant in this more complex world?
2. What Rules Need to change with MRP?
3. Why do Lean and other pull-based techniques often come into conflict with MRP?
4. Why has MRP not significantly evolved to meet dramatically different circumstances?
5. How must MRP change to become Demand Driven?

Question 1: Is the vision behind MRP still relevant in this more complex world?

Successful businesses follow a very simple formula. A clear vision must lead to the appropriate rules which then lead to the appropriate tools. Simply put companies get into trouble when this sequential progression is broken.



MRP enables organizations to quickly calculate and synchronize total requirements given the rate of demand. This is of particular importance when the company has a deep bill of material or many shared components. Is this vision still valid? Absolutely! Due to the increased variability and volatility in manufacturing today the vision of MRP is more relevant today than ever.

At the heart of every supply chain is manufacturing. At the heart of manufacturing is MRP. Supply chains are not the simple linear structures normally represented as a straight line from the supplier's supplier to the customer's customer. Supply chains are three dimensional web-like entities that are difficult to graphically represent. Each node in the web is a different MRP system.

Therefore a primary limitation of any supply chain will be how well MRP systems perform not just individually on each node but also collectively throughout the web. Simply put, if we want more agile manufacturing and supply chains then we will need a more agile form of MRP. MRP can be more impactful and relevant to today's supply chain effectiveness than ever before but it will require wholesale change to get there.

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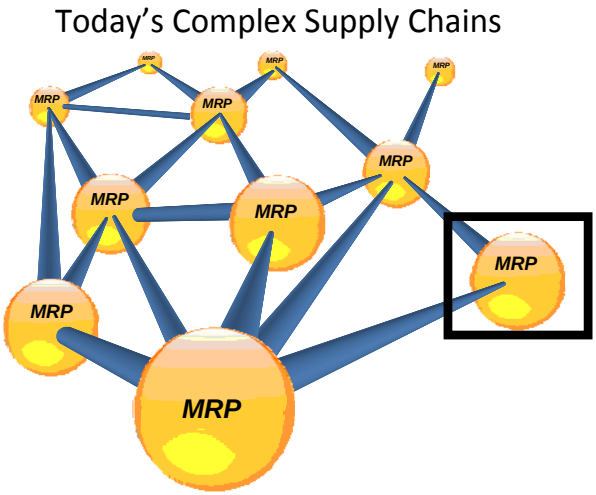

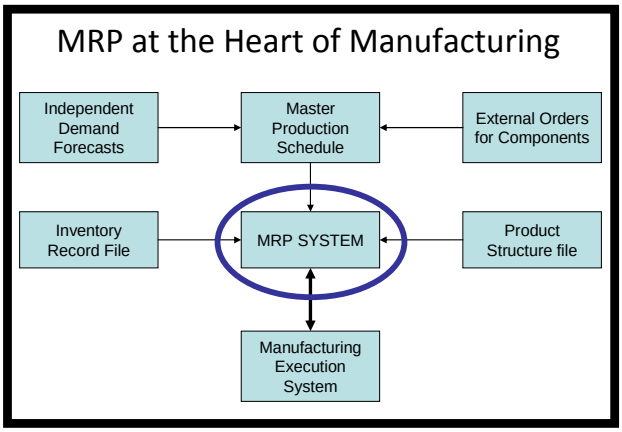

Question 2: What Rules Need to Change with MRP?

If the vision of MRP is still relevant, why is MRP failing and perceived as outdated? MRP has many well known shortcomings. The result of MRP's shortcomings is that companies have chronic and frequent shortages at various stages of the production, procurement and fulfillment cycles. These chronic and frequent shortages tend to lead to three main effects. Companies frequently can identify many of these problems at the same time.

1. **Unacceptable inventory performance** This is identified as having too much of the wrong material, too little of the right material, high obsolescence and/or low inventory turns.
2. **Unacceptable service level performance** Customers continue to put pressure on the company which quickly exposes poor on-time delivery, low fill rates and poor customer satisfaction. In addition, customers consistently attempt to drive prices down.
3. **High expedite related expenses and waste** In an attempt to fix the previous two unacceptable business results, managers will commit to pay premiums and additional freight charges or increase overtime in order to fulfill promises. Typically this effect is under measured and underappreciated in most companies.

Experienced planning personnel are not blind to the shortcomings of MRP. These have been discussed for years around the world at APICS meetings. However, these shortcomings have been further exacerbated by the variability and volatility in today's hypercompetitive environment. Materials and Production Control personnel often find themselves in a dilemma regarding their MRP system. There are powerful aspects of MRP that are still relevant and necessary. For example, given the need to be able to plan complex product structures across a complex supply chain well in advance of customer demand means that some aspects of MRP are even more relevant today than 40 years ago. Companies desperately need visibility within today's more complex planning scenarios.

So, what are some of the rules that need to Change? Below is a short list of some of the bigger issues. A more complete list of shortcomings and their corresponding effects to organizations can be found on a table on the next page.

1. **The definition of "demand"**: Most MRP systems are driven by a master schedule driven by a forecast. A forecast is a best guess at end item requirements. Using the forecast to drive requirements creates by definition a push based system. In a more volatile environment, the chance that the push will be wrong is much higher. The answer will not be found in a better forecast. Despite the proliferation of very advanced forecasting algorithms planning accuracy is not gaining ground. There needs to be a fundamental change to the nature of the demand signal that feeds MRP. This demand signal must mirror actual consumption and/or sales orders.

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2. **Unrealistic lead time calculations.** For manufactured items, MRP only recognizes two types of lead times. In most cases both of these lead times are unrealistic. Manufacturing Lead Time assumes the availability of all components. How often is that the case? Cumulative Lead Time assumes that ALL components are not available. How often is that the case? In reality, a different type of lead time is required that more accurately reflects the fact that some of the components will be in stock. This new type of lead time, known as ASR Lead Time, is explored in depth in the book.
3. **No relative priority management.** Priority in MRP is driven by dates and quantities pegged to "demand." If the demand is invalid and the lead times are unrealistic then how good is the planning signal for a single item? Furthermore, what if limitations like capacity, cash and space exist? Accurate relative priority in the planning process (which item is needed more than others) is mission impossible using today's MRP.
4. **Antiquated stock management techniques.** The purpose of stock is to decouple or dampen variability between the company and its suppliers or the company and its customers. Traditional MRP systems call this supplementary inventory position safety stock. Safety stock is like a fire extinguisher when industry really needs a firewall. Safety stock does not compress lead times and can actually result in more variability being passed to the supplier. Finally, safety stock levels tend to be static that are rarely adjusted. MRP must have strategically positioned and dynamically adjusted buffers that dampen variability, compress lead times, reduce working capital requirements and protect both suppliers and customers.
5. **No execution tools.** By definition MRP is a planning tool. Its purpose is to generate supply requirements directly related to demand and bill of material structure. Problems tend to be identified only after they have become a reality. There is little to no visibility as to what might become a problem and what the actual execution priority really is. This lack of visibility creates a critical gap in today's more complex supply chain scenarios. MRP must have an integrated set of execution rules and priority management for open supply orders.

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	Typical MRP Attributes	Effects to the Organization
Planning Attributes	MRP uses a forecast or master production schedule as an input to calculate parent and component level part net requirements.	Part planning becomes based on a "push" created by these forecasted demand requirements. Forecast accuracy at the individual sku and part levels is highly inaccurate. Build Plans and PO's that are calculated from this forecast often are misaligned with actual market demand. This leads to excessive expediting, overtime, premium freight, increased inventory of the wrong items and missed shipments.
	MRP pegs down the ENTIRE Bill of Material to the lowest component part level whenever available stock is less than exploded demand.	Creates an overly complicated materials and scheduling picture that can totally change with one small change at a parent item. When capacity is scheduled infinitely there are massive priority conflicts and material diversions. When capacity is scheduled finitely across all resources there is massive schedule instability due to cascading slides from material shortages.
	Manufacturing Orders are frequently released to the shop floor without consideration of component part availability.	Manufacturing Orders are released to the floor but cannot be started due to shortages. This leads to increased WIP, constantly changing priorities and schedules, delays, lots of expediting and possibly overtime.
	Limited future demand qualification. Limited early warning indicators of potential stock outs or demand spikes.	Planners either have to bring in all future demand which inflates inventories and wastes capacity and materials or bring in no future demand which makes the environment extremely vulnerable to spikes or must pour through large amounts of data in order to qualify spikes for each part.
	Lead time for parent part is either the manufacturing lead time (MLT) or the cumulative lead time (CLT) for the parent item.	MLT typically represents a gross underestimation of realistic lead time. When MLT is used, Manufacturing Orders are often released with dates that are impossible to achieve and/or without all component parts available. CLT typically represents a gross overestimation of lead time. When CLT is used Manufacturing Orders are typically released to far in advance, raising WIP levels and making the environment more susceptible to disruption when order changes occur.
Stock Management Attributes	Fixed reorder quantity, order points, and safety stock that typically do not adjust to actual market demand or seasonality.	Additional exposure to forecast inaccuracies resulting in increased expediting.
	Past due requirements and orders to replenish safety stock are often treated as "Due Now."	There is no way to judge relative priority between stock orders. Every safety stock order looks the same, which means there is no REAL priority. To determine real priorities requires massive attention, analysis and priority changes.
	Priority of orders is managed by due date (if not Due Now).	There is no way to judge relative priority between stock orders. Due dates will not reflect actual priorities. To determine real priorities requires massive attention, analysis and priority changes.
	Once orders are launched, visibility to those orders is essentially lost until the due date of the order when it is either present or late.	There is no advanced warning or visibility to potential problems with a critical order. Critical parts are often late and disrupt parent item schedule.

Question 3: Why do Lean and other pull-based techniques often come into conflict with MRP?

In addition to the rise of volatility and complexity referred to earlier, the proliferation of Lean and other pull-based philosophies has put additional pressure on planning personnel and MRP systems. The fundamentally different view of inventory puts Lean advocates and planning personnel at odds. Many Lean implementations attempt to abandon MRP completely. This causes tremendous friction between them and the planning personnel responsible for ensuring a reliable source of supply.

Lean advocates often see MRP as an overly complex and wasteful dinosaur that simply doesn't work in this demand driven world. However, planning personnel see it a completely different way. They understand that without the ability to see the total material requirements picture, critical blind spots

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then exist in the planning process leading to shortages or excessive inventory positions or both. They see the Lean approach as a gross oversimplification for the complex scenarios that are now the new normal. The irony is that both sides are absolutely correct. They are blind to the real issues. There is an elegant solution to this conflict. Both sides need each other to stay competitive in this hypersensitive environment. Read this white paper **http://www.demanddrivenmrp.com/leandl.php** for an in-depth exploration of this conflict and its resolution.

Question 4: MRP progress in the last 30 years?

Software providers, consultants and the academic community have had ample opportunity to fix MRP's shortcomings. Why has MRP not progressed?

Software not necessary or sufficient: There are many knowledgeable experts in demand driven techniques like Lean and the Theory of Constraints (TOC). Unfortunately many of these experts do not understand the role planning technology must play to bring those techniques to full realization across a complex enterprise and supply chain. Many of them advocate the elimination of technology as the true measure of success and they do so under the "simplicity" banner. As referred to above oversimplification is a real danger in this more complex world.

Process capability focus: Experts in variability and volatility utilizing the DMAIC Six Sigma process tend to be less focused on the whole enterprise and supply chain. Instead they tend to focuson more specific data and event focused. Variability must be considered in relation to its impact across the entire system. All variation does not have the same impact. Reducing variability in many individual areas does not directly translate to improvement in the overall process. There are critical places where variability must be protected against or improved in order to keep the system stable and effective. In other areas, improvement activity can actually create waste instead.

MRP Lost Generation: The generation that developed MRP (the giants) is all but lost. Today, the majority of people that still have an in-depth knowledge of how MRP really works are not in software companies or academia – they are seasoned planners working in private industry. These people are busy propping up the current systems and processes. They have limited ability and inclination to reach out and force wide scale change. They know there is a problem but in many regards their hands are tied. It is nearly impossible for these people to affect change across the industry.

Software Community Inertia: Even some of the largest ERP software companies have only a small number of people (sometimes only 2 or 3) who truly understand what MRP is and how it works. Rarely does even the largest provider have software developers with any real world experience utilizing the tools they are building. The big ERP software companies cannot and will not solve a problem they cannot see. This is evidenced by the fact that none have addressed the core issues identified in this section. The proliferation of planning work-arounds proves this. More importantly the software community will not change what is perceived to be working as specified and to replace it with functionality that will not sell more licenses.

Question 5: How Must MRP Change to Become Demand Driven?

In the new edition of *Orlicky's Material Requirements Planning*, MRP for the 21st Century; Demand Driven MRP (DDMRP) is introduced. Demand Driven MRP represents a fusion of the still relevant vision of MRP but applies new rules and corresponding tools in order to marry that vision with competing in the demand driven world. DDMRP moves formal planning logic from the world of "Push and Promote" to "Position and Pull."

Demand Driven MRP has five components that are detailed through eight chapters, over 100 graphical depictions and over 50 new terms.

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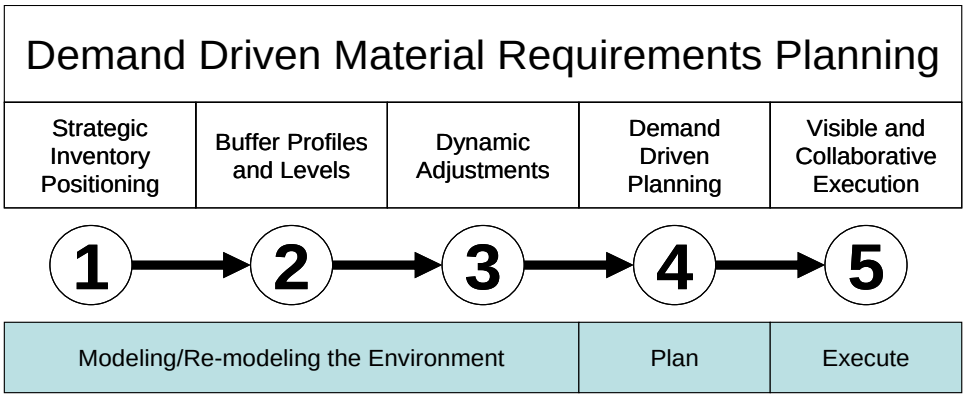
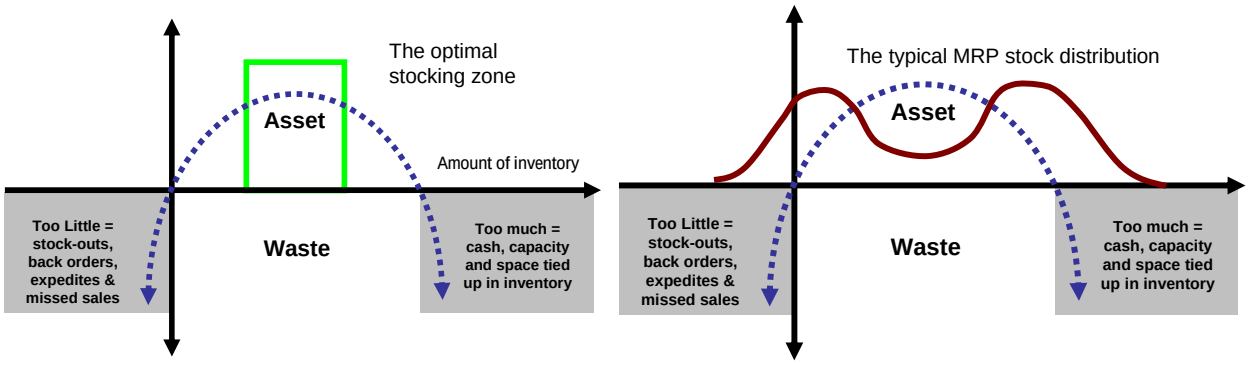


At its core, DDMRP uses a new type of strategically positioned and dynamically managed stock position to dampen variability, compress lead times and reduce working capital requirements while ensuring unprecedented levels of service. The positions dramatically alter the planning and execution rules of conventional MRP.

In most manufacturing environments, inventory stock in some form is a requirement. As mentioned previously, a primary reason to hold inventory is that customer tolerance times are shrinking. Customers will no longer tolerate long lead times. However, most manufacturing companies and certainly every supply chain cannot be a pure make to order system. Would you wait at the grocery store for a quart of milk if you knew the cow had not even been milked? What about at the gas station if the oil had not yet been drilled? Holding inventory is a reality in the modern world. In most cases, companies cannot position and manage stock positions effectively because they have only antiquated stock practices and tools.

There are many who believe that carrying inventory is a waste. Inventory is waste only if it is located in the wrong places and in the wrong quantities. The key is to determine first **where** the right places are to stock and only then determine the amounts to be stocked. Next the process must allow those places and amounts to change as the environment and conditions change. The effective management of inventory is a dynamic closed loop process. This is necessary to effectively leverage the working capital and capacity commitment inherent in inventory to maximize the company's overall financial performance.



At the same time it is also extremely wasteful to not carry inventory. When companies lean out too much inventory, then frequent shortages can result. When companies experience shortages they are forced to spend additional time, effort, money and capital in order to resolve the problem and significant market opportunities can be missed.

Agility is not synonymous with zero inventories. The key to effectively leveraging the working capital and capacity commitment inherent in inventory is to find the places where that inventory can make the biggest impact and therefore provide the greatest return. Inventory can decouple otherwise

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dependent events so that the cumulative effects of variation are not passed and/or amplified between the dependencies. Inventory can be a breakwall against the variability experienced from either supply (externally and internally) or demand variability. But, like any breakwall they are only effective if placed and sized properly. Thus, the first question to ask is "where?" and then the second question of "how much?" can be answered.

Today companies must think systemically across the supply chain and not just within their own four walls. Putting inventory everywhere is an enormous waste of company resources. Eliminating inventory everywhere puts the company and supply chain at significant risk. Strategically positioning inventory ensures the company's ability to absorb expected variability with the smallest possible investment. Unfortunately, today most tools, training and educational material is oriented towards determining the answer to the questions, "how much?" and, "when?" with little to no attention to answering, "where?" Properly determining where to place inventory is a strategic question that should involve key personnel representing a relevant cross section of the company. There are six critical positioning factors in determining where to properly place inventory.

The Critical Positioning Factors

1) **Customer Tolerance Time** – the time the typical customer is willing to wait.

2) **Market Potential Lead Time** – the lead time that will allow an increase of price or the capture of additional business either through existing or new customer channels.

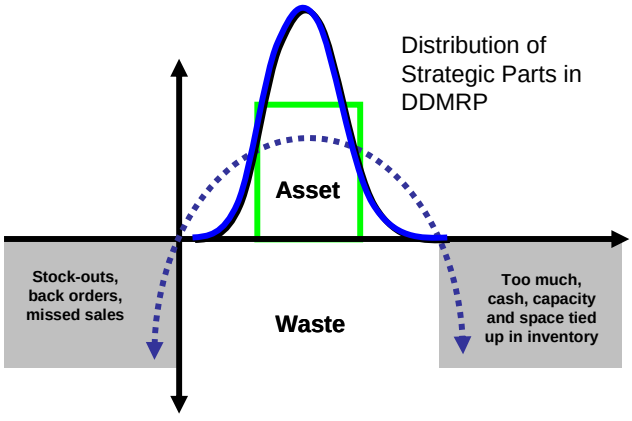
3) **Variable Rate of Demand** – the potential for swings and spikes in demand that could overwhelm resources (capacity, stock, cash, etc.).

4) **Variable Rate of Supply** – the potential for and severity of disruptions in sources of supply and/or specific suppliers.

5) **Inventory Leverage and Flexibility** – the places in the integrated BOM structure (the Matrix BOM) or the distribution network that leave a company with the most available options as well as the best lead time compression to meet the business needs.

6) **The Protection of Key Operational Areas –** It is particularly important to protect critical operational areas from disruption.

These above six factors must be applied systematically across the entire bill of material, routing structure, manufacturing facilities and supply chain to determine the best positions for purchased, manufactured and finished items (including service parts). The bigger the system these factors are applied to, the more significant the results can be.



After the initial positions are determined, new innovations with regard to sizing stock levels, replenishing them based on actual demand and judging execution priority take over. All of this is detailed in depth in the newest version of *Orlicky's Material Requirements Planning*.

The third edition of *Orlicky's Material Requirements Planning* tells the story of MRP; its past, its present and the blueprint for its future. The future, something called Demand Driven MRP (DDMRP), is a true multi-echelon supply chain solution that represents a fusion of the still relevant aspects of

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MRP and DRP combined with the pull-based methods of Lean and the Theory of Constraints and incorporates revolutionary innovations. The future is now.

Official book page at:
www.orlickysmrp.com

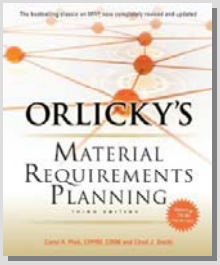
About the authors

To learn more about Demand Driven Material Requirements Planning go to www.demanddrivenmrp.com and explore whitepapers, downloads, podcasts and special book offers.

Carol Ptak is currently a partner with the Demand Driven Institute, and was most recently at Pacific Lutheran University as Visiting Professor and Distinguished Executive in Residence. Previously, she was vice president and global industry executive for manufacturing and distribution industries at PeopleSoft where she developed the concept of demand driven manufacturing (DDM). Ms. Ptak is also a past president of APICS and has authored several books on MRP, ERP, Lean and Theory of Constraints (TOC).

Praise for the new Orlicky's Material Requirements Planning (Ptak and Smith, McGraw-Hill, 2011)

"**It is in short the best book in this subject area that I have ever seen.**" John G. Schleier Jr.



"This is a very useful and brilliant book. Ptak and Smith have resolved the core problems of MRP systems." Eli Berniker PhD

"This comprehensive text will, in my opinion, become THE new standard for anyone who wants to get ahead in manufacturing." William M Hewitt

"Carol and Chad: as one of the original MRPers, I applaud you and thank you for your work, and for advancing, with this book, our science more than any other has done in many years." Bob Reary

Chad Smith is currently a partner with the Demand Driven Institute as well as cofounder and managing partner of Constraints Management Group, a services and technology company specializing in pull-based manufacturing, materials, and project management systems for mid-range and large manufacturers. He has been at the forefront of developing and articulating Demand Driven MRP (DDMRP) and is also an internationally recognized expert on the Theory of Constraints (TOC).

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Transform Push and Promote to Position and Pull

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