

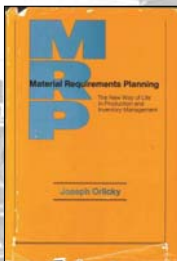
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THE MRP CHALLENGE IN THE 21ST CENTURY



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Joe Orlicky

The MRP Revolution

*"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." Orlicky 1975*

Features:

- Time Phased Planning
- Level by level BOM explosion
- Dependent demand planning

Benefits:

- Component synchronization
- Reduction in inventory
- Improved priorities

- MRP did become THE way of life for planning.
- It was conceived in the 1950s with the prevalence of computers.
- It was codified in the 1960s by a small group of practitioners.
- It was commercialized in the 1970s
- By 1990 most manufacturers of even modest scale had an MRP system

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What is Material Requirements Planning?

A set of techniques that uses bill of material data, inventory data, and the master production schedule to calculate requirements for materials. It makes recommendations to release replenishment orders for material. Further, because it is time-phased, it makes recommendations to reschedule open orders when due dates and need dates are not in phase. Time-phased MRP begins with the items listed on the MPS and determines (1) the quantity of all components and materials required to fabricate those items and (2) the date that the components and material are required. Time-phased MRP is accomplished by exploding the bill of material, adjusting for inventory quantities on hand or on order, and offsetting the net requirements by the appropriate lead times. (APICS Dictionary 14th edition, Page 103)



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How Does MRP Work?

- MRP is simply a calculator that obeys specific rules
- The fundamental objective of MRP is to create a synchronized plan (quantity and timing) across all dependencies
- These dependencies will be defined by MRP's three primary inputs:
 - Product Structure
 - Demand
 - Inventory Records

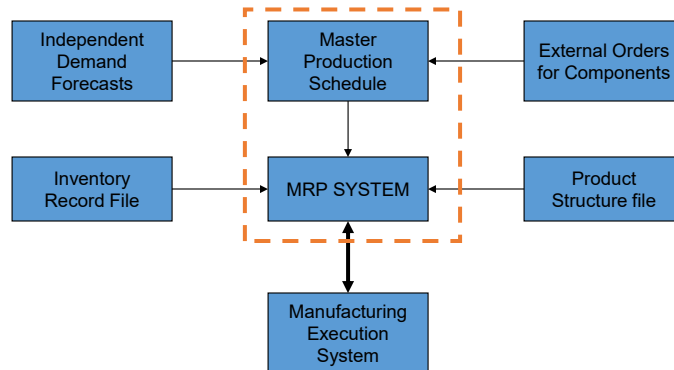


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MPS – MRP Conventional Planning Schema

“The master production schedule...is 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.” (APICS, Page 101)



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THE BULLWHIP EFFECT

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Complex and Volatile is the “New Normal”

Supply Chain Characteristics	1965	Today
Supply Chain Complexity	Low	High
Product Life Cycles	Long	Short
Customer Tolerance Times	Long	Short
Product Complexity	Low	High
Product Customization	Low	High
Product Variety	Low	High
Long Lead Time Parts	Few	Many
Forecast Accuracy	High	Low
Pressure for Leaner Inventories	Low	High
Transactional Friction	High	Low

Today's supply chains look VERY different from 1960's supply chains when conventional planning rules were formulated but...

Conventional planning rules have not appreciably changed since the 1960s. MRP still plans today the way it did 50 years ago!

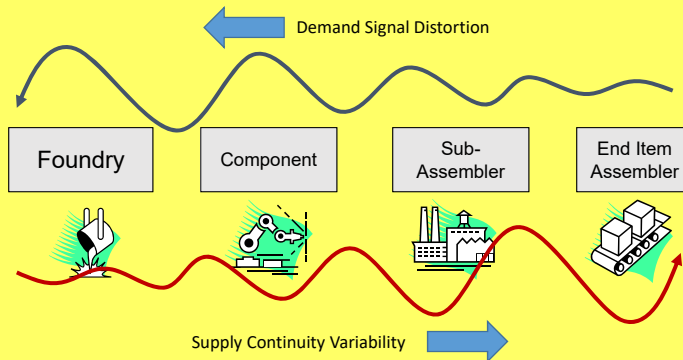
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The Collective SCM Problem

Bull-Whip Effect: “An extreme change in the supply position upstream in a supply chain generated by a small change in demand downstream in the supply chain. Inventory can quickly move from being backordered to being excess. This is caused by the serial nature of communicating orders up the chain with the inherent transportation delays of moving product down the chain.” (APICS Dictionary, 14th Edition)



Transference AND amplification of variability in BOTH directions.

The more parts to the supply chain – the worse the effect!

A true solution must deal with demand AND supply distortion together.

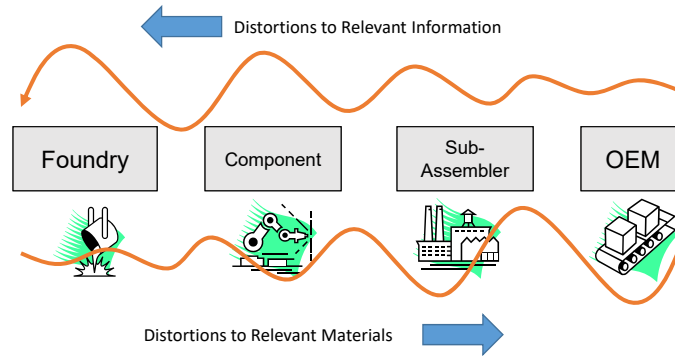
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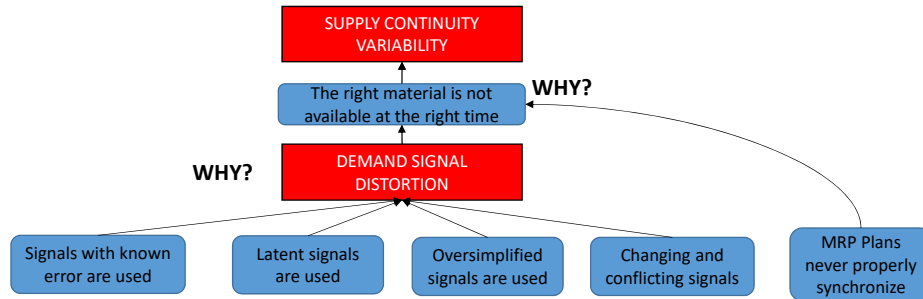
Why Does the Bullwhip Effect Exist?

- If MRP is so powerfully precise across all dependencies why does the bullwhip effect exist?
- How does MRP distort relevant information and materials?



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So, if we fix the demand signal distortion the bullwhip is solved?

NO!

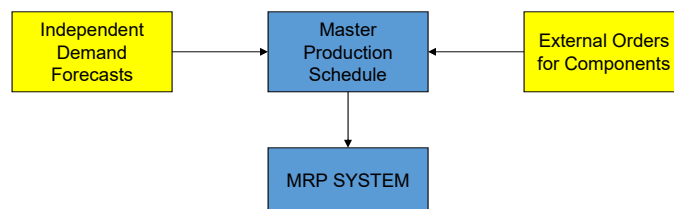
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Demand Signal Input

- Conventional planning requires a demand signal
- **“demand** - A need for a particular product or component. The demand could come from any number of sources (e.g., a customer order or forecast, an interplant requirement, a branch warehouse request for a service part or the manufacturing of another product”. (Page 44)
- We essentially have two choices of demand inputs (forecasted and actual).

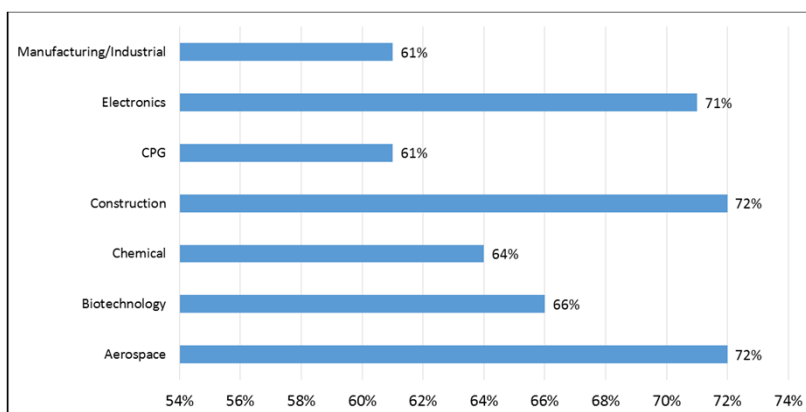


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Forecast Accuracy Across Industries



The three rules of forecasts:

1. They start out wrong
2. The longer the range, the more wrong they are
3. The more detailed, the more wrong they are

Rohan Asardohkar, August 22, 2012, <http://www.forecastingblog.com/?p=423>

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MRP Uses Both Forms of Demand

- MRP is loaded with forecasted demand in the form of planned orders.
- These planned orders represent real commitments in capacity, cash, space, etc.
- As the demand picture changes with actual demand incorporation massive plan changes occur as MRP attempts to fully net across all dependencies.
- These changes result in overages, shortages and lots of expediting activity.



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Why is MRP Used in this fashion?

- This combination of forecasted and actual demand guarantees error.
- Starting a serial, complex and interdependent process with an error prone input, has to result in an output integrity that is suspect.
- The use of forecasted demand IS A CHOICE
- Why would we intentionally do this?

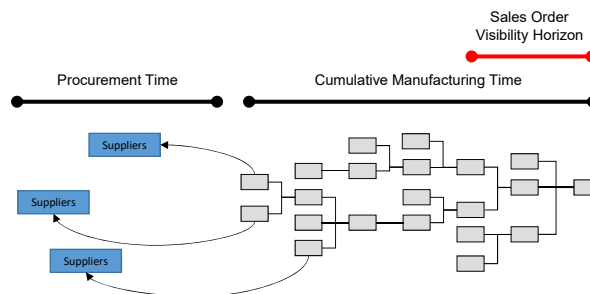


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What Forces us Into Using Forecasting for Supply Order Generation?

- It could be argued that MRP is the perfect JIT System but that assumes one thing...
- That you have enough time across all dependencies!!
- Procurement Time plus Cumulative Manufacturing Time > Sales Order Visibility Horizon



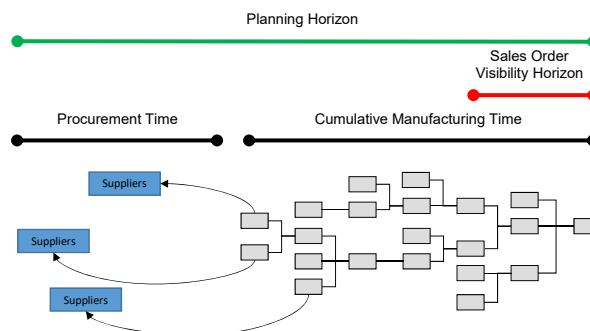
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What Forces us Into Using Forecasting for Supply Order Generation?

- To Compensate we must forecast out in time in order to attempt to have the right things at the right time
- The farther out in time we project the less accurate the projection becomes
- The less accurate the projection becomes the less synchronized the assets are



As actual demand becomes known the demand input must incorporate those changes.

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The Problem with Changes

- MRP's power was its ability to calculate all of the requirements through and across all BOMs given a demand input.
- This creates a huge problem when that demand input is constantly changing.
- Every input change ripples through any involved BOM.
- This is called nervousness.

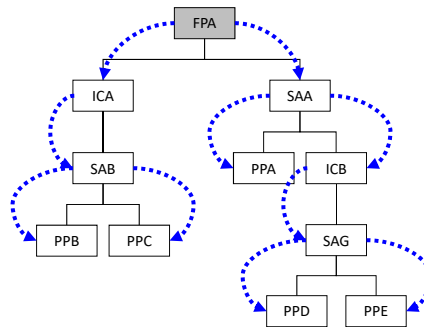
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Nervousness

Nervousness: "The characteristic in an MRP system when minor changes in higher level (e.g. level 0 or 1) records or the master production schedule cause significant timing or quantity changes in lower level (e.g. 5 or 6) schedules or orders." (APICS, Page 86)



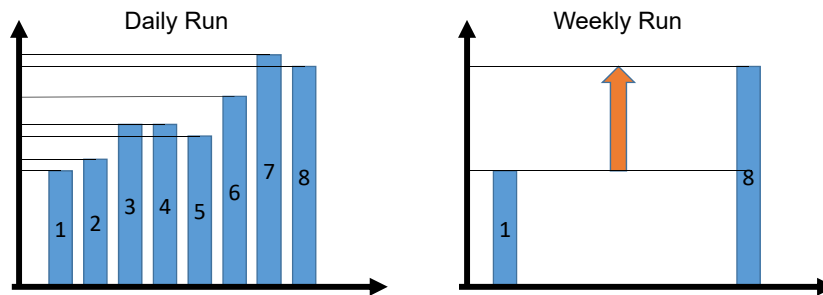
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The Weekly Bucket

- The more frequently MRP is run the more nervous it is.
- In order to dampen the effects of nervousness MRP is typically run less frequently.
- Typically, the frequency is once a week.
- Instead of many little frequent changes you can get large infrequent change.



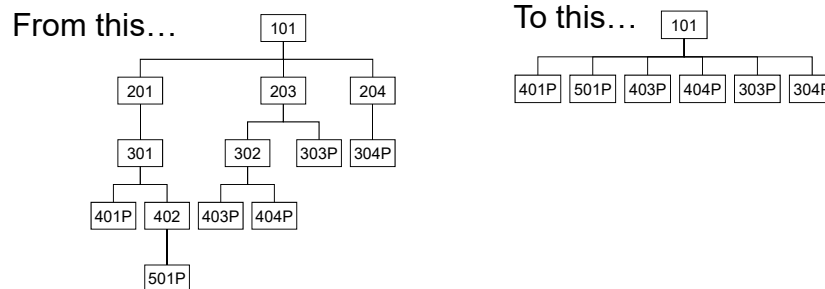
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Flattening the BOM

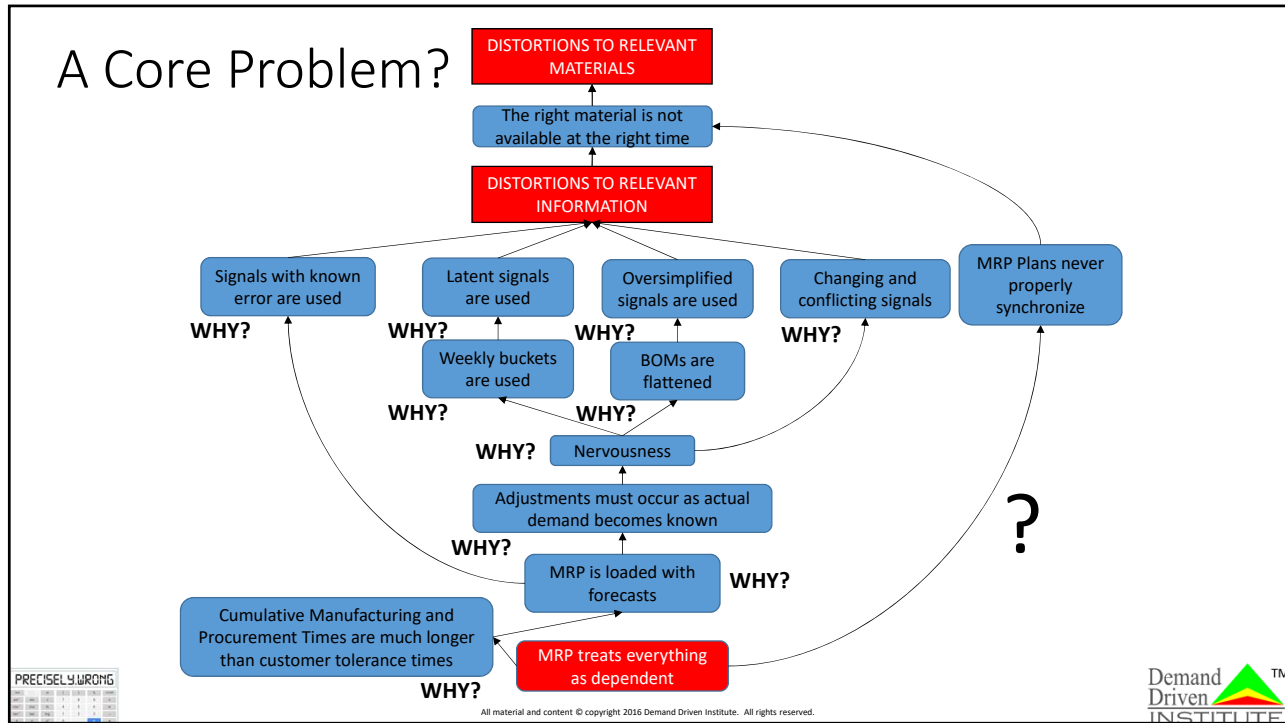
- Another tactic to dampen nervousness is to limit the number of connections in the BOM.
- This is called flattening



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Operational Variability

- **FACT:** Normal and random variation exists in any process
- **FACT:** A process is still deemed in **STEADY STATE** as long as the variation is within the calculated control limits
- **FACT:** Steady State **DOES NOT** mean without variation

Upper Control Limit

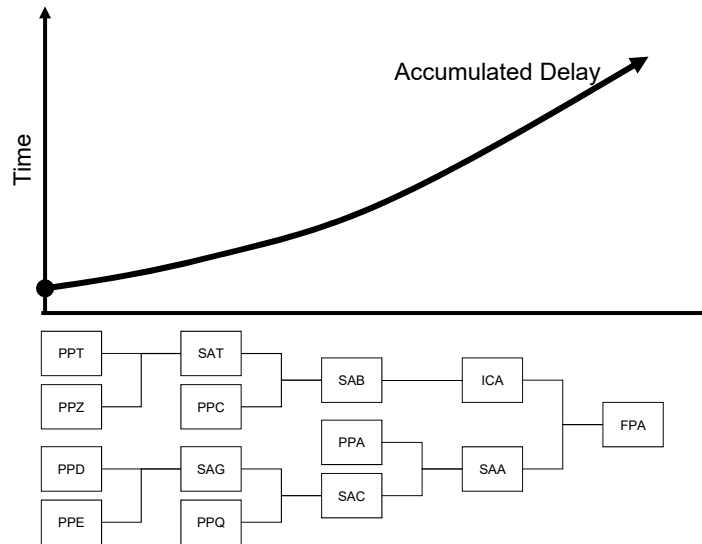
Lower Control Limit

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Accumulated Delay



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Delays Accumulate – Gains do not

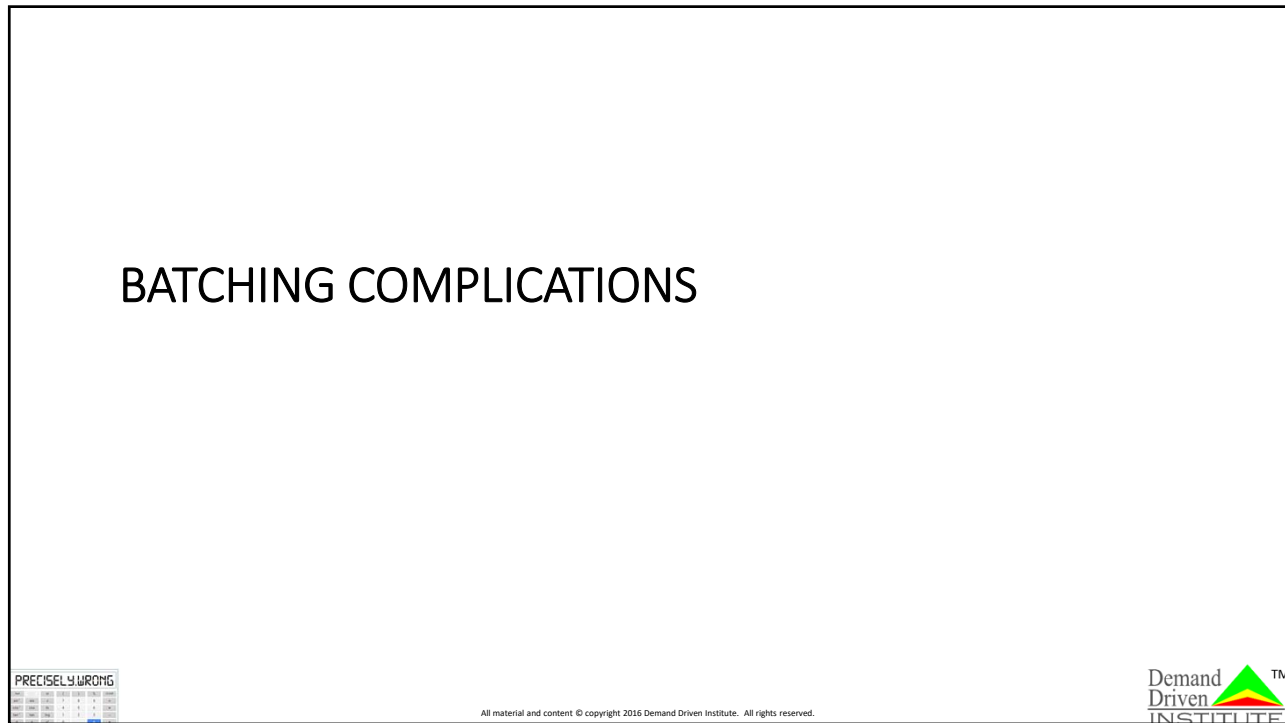
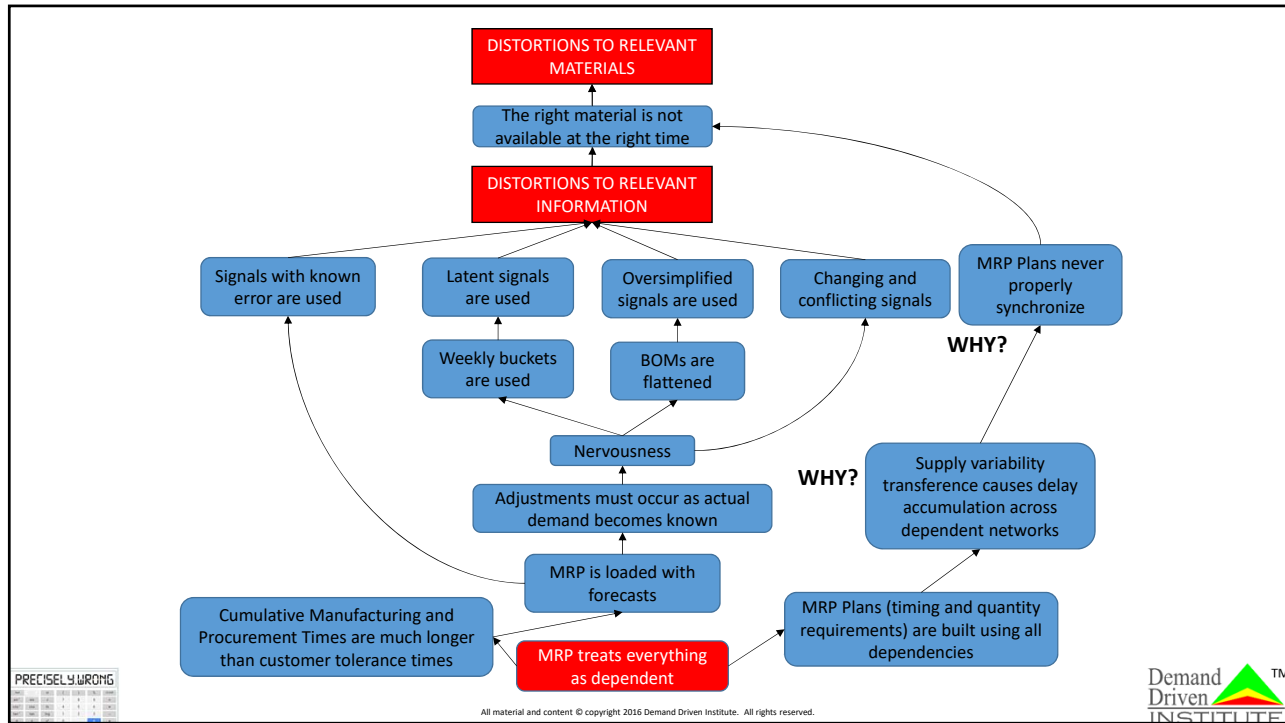
Many components can have very good availability but it only takes one to have serious implications for the parent item.

Component Number	Availability Level	Probability of Simultaneous Availability
1	95.0%	95.0%
2	72.0%	68.4%
3	98.0%	67.0%
4	97.0%	65.0%
5	99.0%	64.4%

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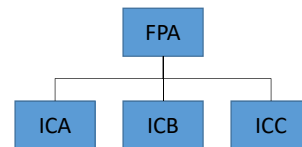


Batching Policies

Demand Signal Distortion

- MRP has to obey the defined order policies (min, max and multiple)
- When order policies differ between parent item and components distortion occurs.

FPA Demand = 115
 ICA Min = 100, Multiple = 50
 ICB Min = 250, Multiple = 50
 ICC Min = 100, Multiple = 100



How much will be ordered of each component?

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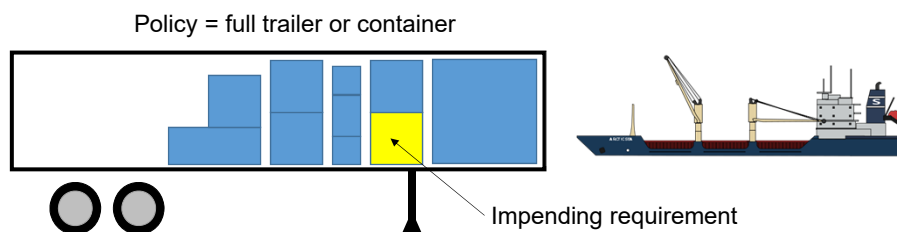
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Batching Policies

Delay Accumulation

- The way things move in a supply chain is often subject to batching restrictions
- This can create inherent delays that contributes to delay accumulation



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APS COMPLICATIONS

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Scheduling Nervousness – The APS Problem

- Every schedule and the assumptions it is based on is subject variations and unforeseen issues that break down at least one of those assumptions
- These deviations begin almost immediately after the release of a schedule
- They tend to accumulate and/or amplify each other to create major synchronization issues throughout the entire resource base for released work orders
- By constant rescheduling priorities and schedules are in a constant state of flux
- The quest for constant precision in scheduling is fool's gold – it actually contributes to the bullwhip!

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A DIRECTION FOR A SOLUTION

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Mitigating The Bullwhip Effect

- The only way to stop the Bullwhip Effect is to stop distortion from being passed between the parts of the system **IN BOTH DIRECTIONS**
- This is accomplished by “decoupling” and then “buffering” the “decoupling point”

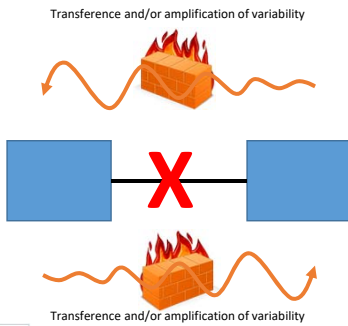
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Decoupling & Decoupling Point

decoupling - creating independence between supply and use of material. Commonly denotes providing inventory between operations so that fluctuations in the production rate of the supplying operation do not constrain production or use rates of the next operation. (APICS, Page 43)



decoupling point - the locations in the product structure or distribution network where inventory is placed to create independence between processes or entities. Selection of decoupling points is a strategic decision that determines customer lead times and inventory investment. (APICS, Page 43)

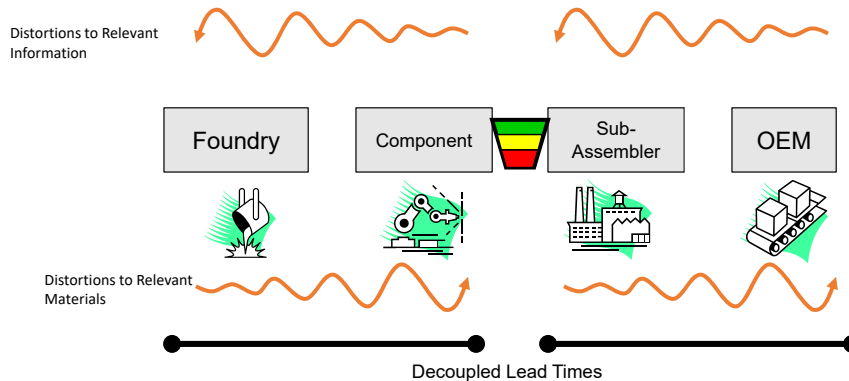


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Decoupling Inventory – the “Buffer”

“An amount of inventory kept between entities in a manufacturing or distribution network to create independence between processes or entities. The objective of decoupling inventory is to disconnect the rate of use from the rate of supply of the item.” (Page 43)

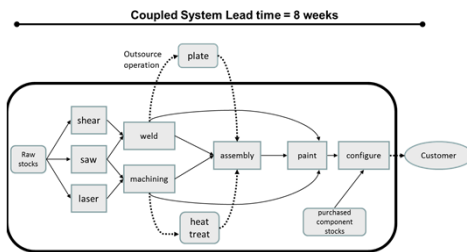


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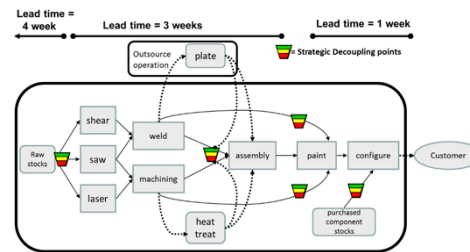


MRP (Everything Dependent) versus Strategically Decoupled

MRP Everything Dependent



Strategically Decoupled



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Six Tests for Decoupling Point Success

- Decoupling Test
- Bi-Directional Benefit Test
- Order Independence Test
- Primary Planning Mechanism Test
- Relative Priority Test
- Dynamic Adjustment Test



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Summary



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