Material Positioning Analysis for Infor Visual Enterprise 9.0.3 and higher

A new CONCEPT, METHOD & PROGRAM how to deal with Material Shortages in a Manufacturing Environment
designed by

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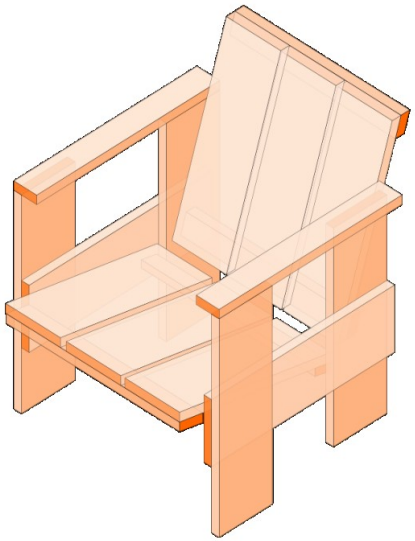
One cannot sit on the concept of a chair, but……

(Kees van Kooten & Wim de Bie



MPA is not only a concept

……MPA is not only a concept & method but in the meantime it is also a program "on top of" the ERP system Infor Visual Enterprise:

"You cannot build without a CONCEPT but the builder of the system is the designer of the concept of the route called "materializing" (Jacques Selders ©2000)"

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What's in a name : MPA

……next to positioning each and every material in a manufacturing environment you can do every kind of analysis of a single Part but also of whatever group or set of Parts, Orders, etc. you can imagine.

Therefore the concept is named not only "Material Positioning" but also "Analysis".

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What is Material Positioning Analysis (MPA)?

In an ERP system MPA is a method that positions every available On Hand of a part, and when no On Hand is left anymore every available (subassembly) Work Order, and when no (subassembly) Work Order is left anymore every available Purchase Order, against a Demanding Part from a Customer Order Line and/or (assembly) Work Order Material and/or Inter Branch Transfer (IBT) Material to "handshake" and fulfill it's requirement right now. When there are Forecast and/or Master Production Schedules involved in the demand, demanding Customer Orders and/or Work Orders can be virtual.

Positioning takes place in the sequence order of the Customer Order Line's Desired Delivery Date and/or the Desired Want Date of the Work Order Material, which is a result from a Site related scheduler, but could be any other sequence mechanism as long as priority is clear.

In this sequence the Required Qty will be crossed out or ticked off from the existing Stock On Hand, and when no On Hand is left from the (already running) Subassembly Work Order's Qty and, when no WO Qty is left from the (already running) Purchase Order Lines.

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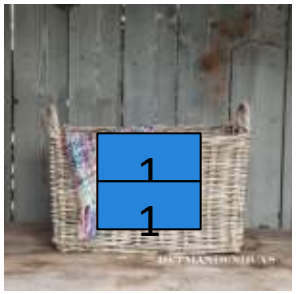
On Hand, WO's and PO's are put in Baskets first

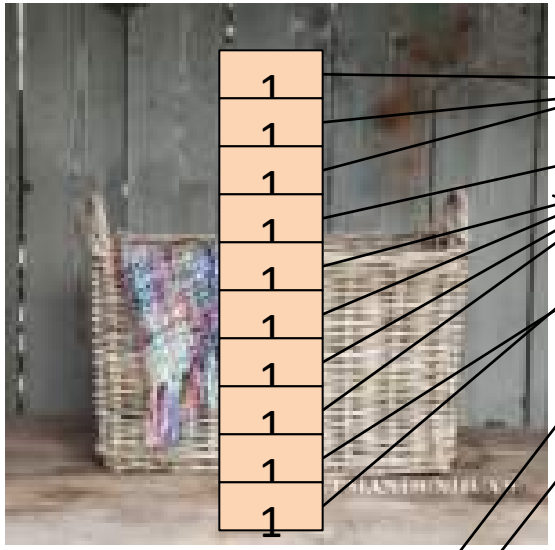
Qty 10 On Hand Part ABC in the ABC"Basket"

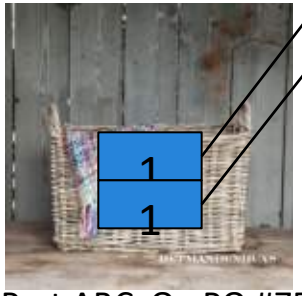


Qty 2 Part ABC On PO #75 Line #1 in the ABC"Basket"

The MPA "Handshake" proces

Qty 10 On Hand Part ABC in the "Basket"





Qty 2 Part ABC On PO #75 Line #1 in the "Basket"

What the MPA Engine does visualized for Part ABC

Work Order #1 Material Card #10 Part ABC Required 3 "Handshaked" 3 Left On Hand 7

Work Order #3 Material Card #30 Part ABC Required 1 "Handshaked" 1 Left On Hand 6

Work Order #11 Material Card #50 Part ABC Required 4 "Hansdhaked" 4 Left On Hand 2

Work Order #27 Material Card #20 Part ABC Required 2 "Handshaked" 2 Left On Hand 0

Work Order #35 Material Card #90 Part ABC Required 5 "Handshaked" 2 Open 3

Work Order #49 Material Card #10 Part ABC Required 3 "Handshaked" 0 Open 3

That's it guys. That is all there is to it.

In this example there are 6 Dependent Demand Work Orders in sequence demanding Part ABC in a total of 18 but there are only 12 available; 10 On Hand and 2 on a running PO; that means that a total of 6 remain open which could help generate a planned order

What does MPA try to achieve

The aim is to cover as many requirements as possible through available On Hand Stock, and/or available, but still running, Subassy Work Orders, and/or available, but still to be delivered, Purchase Order Lines containing the requirements PartID in the required quantities.

MPA is cyclical and runs preferably every day/night one time.
Between 2 cycles of MPA you need to improve the Material Requirements Covering, because the MPA results of the first cycle tells you exactly what to do in terms of material shortages and replenishing them.

Why "improve"? Because the result will be that you could not cover all your requirements at that point in time for the full 100%. Nobody can.
That's because you got new orders in and changes and cancellations of running, but not yet, delivered orders. Everything can and will change permanently.
"Improve" in this context means : get On Hand in by generating Subassy Work Orders and Purchase Orders and perform them.

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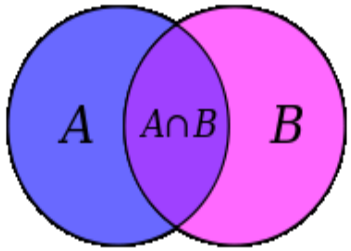
Is there a theoretical scientific support for MPA?

Yes there is; it is the Set Theory (Wikipedia):

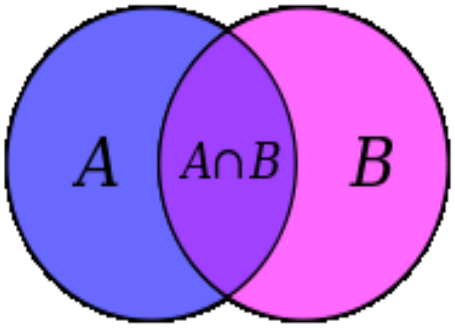
https://en.wikipedia.org/wiki/Set_theory

Set theory is a branch of **mathematical logic** that studies **sets**, which informally are collections of objects. Although any type of object can be collected into a set, set theory is applied most often to objects that are relevant to mathematics. The language of set theory can be used in the definitions of nearly all **mathematical objects**.



A **Venn diagram** illustrating the **intersection** of two **sets**.

MPA sets are we starting with?



•A is the set with all Material Requirements from all Real & Virtual Customer Order Lines, Real & Virtual Work Orders and IBT's with Status Firmed or Released
•B is the set with all Available On Hand for all Parts.
•A ∩ B (A Cross-section or Intersection B) is the set with "Handshaked" Available On Hand in (a limited) number of Material Requirements.

All sets reside in the ERP database.
What happens here is that the A ∩ B set has got other (extra) properties per set element in comparison with or only set A or only set B.
The MPA analysis generated those properties.
Each element of the A ∩ B set got both all properties from A and from B

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MPA works with a Pre Engine an Engine and a Post Engine(1)

What does the Pre Engine:
"The Pre Engine prepares the "Basket" tables with On Hand, Work Orders and Purchase Order Lines both in Quantities and Inventory Value.
And sees to it that eventual Forecast and Master Production Schedules are converted into Virtual Customer Order and Virtual Work Orders to have the set with Demand Requirements complete for the Engine to do its work.
Virtual Customer Orders and Virtual Work Orders are created in non-standard Types to make or to have a distinction between Real and Virtual."

What does the MPA Engine:
"The MPA program deals with every requirement stepwise in "require_date or desired delivery date or want_date"-order and creates a "hand shake" between the requirement and the available On Hand Stock of a component and/or a running (sub) Work Order and/or a running Purchase Order."

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MPA works with a Pre Engine an Engine and a Post Engine(2)

What does the Post Engine:

"The Post Engine populates the Statistic Results Tables for Customer Order Lines covering and Work Order Requirements covering.
The Post Engine also builds up statistics on already running too many sub(Work Orders) and/or too many Purchase Order Lines."

The Post Engine is also able to :
Create planned orders based upon WBS_CODE "MPA",
Create planned orders based upon WBS_CODE "MPA_SAFETY_STOCK",
Create planned orders based upon WBS_CODE "MPA_COL_SHORTAGE"
Create planned orders based upon WBS_CODE "MPA_KANBAN"

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Crossing out existing On Hand Stock first, then (SubAssy) Work Orders, then PO's

The Engine of the MPA program deals with every requirement stepwise in "require_date or desired delivery date or want_date"-order and creates a "hand shake" between the requirement and the available On Hand Stock of a component.

If the On Hand Stock has been crossed out or ticked off completely, the program will do the same for (SubAssy) work orders first and when these are crossed out completely, the program is doing the same for purchase orders (order line level)

So, every requirement will be "told" whether or not On Hand Stock could be crossed out for that requirement, or whether or not a subassy Work Order's qty could be crossed out for that requirement, or whether or not a Purchase Order (Line) could be crossed out or ticked off for that requirement; in all cases to the maximum of that specific requirement's required Qty.

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What requirements are we talking about?

There are 3 kinds of so called Independent Demand Requirements we are talking about here:

1. Requirements of Parts on Customer Order Lines (CO's)
   - Customer's demand for products at a specific moment in time from both real and virtual Customer Orders eventually.
2. Requirements of Parts on Material Cards from Operations on real and virtual Work Orders (WO's)
   - Work Orders "supply" their products to Customer Order Lines where customer's demand for products at a specific moment in time.
3. Requirements of Parts of Inter Branch Transfers (IBTs)
   - IBTs take care of the transfer of stock between warehouses.
   - That means that all stock "claimed" by IBTs is to be considered as "Floating Warehouse Stock" , but……
   - They "consume" stock that cannot be spend on demand of CO's and WO's at the moment in time the IBT is required.

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Is that the complete set of requirements in an ERP system like Infor Visual Enterprise?

There are such things as FORECAST and MASTER PRODUCTION SCHEDULE (mPs) items which could have a Forecast and/or MPS schema demanding final assembly parts, subassembly parts and purchased parts in future.

The MPA Pre Engine converts eventual FORECAST and MPS schema's into Virtual Orders (can be Virtual Customer Orders and/or Virtual Work Orders claiming Required Material at the highest level of a (Multi Level) Bill of Material but also one level lower at component level.)

Work Orders Type W = Real Work Orders
Work Orders Type M = Engineering Masters
Work Orders Type Q = Quote Masters
Work Orders Type F = Virtual Forecast Work Orders
Work Orders Type P = Virtual mPs Work Orders
Work Orders Type C = Customer Forecast derived Virtual Work Orders
Work Orders Type S = Virtual sub Work orders derived from Real Work Orders
Work Orders Type R = Virtual Work Orders derived from Customer Order Line without Linked Work Order where one should have been.
Work Orders Type I = IBT Virtual Work Order

What about FORECAST items?

In Infor Visual Enterprise you can have FORECAST at a general level but also specificly and also connected to a specific Customer:

- FORECAST named just FORECAST.
- But also FORECAST named specificly like M81123 or MONOSTOCK or whatever name you make up when assigning FORECAST.
- Customer FORECAST named after the customer

FORECAST can be on Fabricated Parts but also on Puchased Parts.

When FORECAST is on Fabricated Parts the MPA Pre-Engine could make virtual Work Orders Type F out of each Active FORECAST line based upon the leading Engineering Master (a copy of) of that Part, if there is a Master.
When there is NO Master, MPA creates a virtual Customer Order (Line) out of the Fabricated Part.
When FORECAST is on Purchased Parts the MPA-Pre-Engine could make virtual Customer Orders (Lines) Status On Hold out of each Active FORECAST line.

For Customer Forecast the same can happen but then with Work Order Type C

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What about MASTER PRODUCTION SCHEDULE items?

In Infor Visual Enterprise you can have MPS items when having Order Policy "Master schedule".
Master schedule can be on Fabricated Parts but also on Puchased Parts.

When "Master schedule" is on Fabricated Parts the MPA Pre-Engine could make virtual Work Orders Type P (Virtual Production) out of each Firmed MasterSchedule line based upon the leading Engineering Master (a copy of) of that Part.
When "Master schedule" is on Purchased Parts the MPA-Pre-Engine could make virtual Customer Orders Status On Hold out of each Firmed "Master schedule" line.
But the MPA user can also decide to create Real Work Orders Type W out of the Firmed Master Schedule Line and can clear up Firmed MPS Lines which are in the past.

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What about Multi Level BOM items?

When you have a Bill of Material (BOM) attached to your Work Order each item in this BOM could have it's own Bill of Material one level lower.
In Infor Visual Enterprise this is expressed in an Engineering Master having items which "carry" an Engineering Master one level lower.

And this Engineering Master could "carry" in itself items which could have an Engineering Master again one level lower etc.

MPA can handle this BOM leveling up to 9 levels deep by the maximum.

Based upon the "leading" Engineering Master attached to the Required Part in the BOM the Pre Engine can create Virtual Work Order based upon the BOM structure of the Engineering Master.

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MPA is cyclical and runs per Site.

The basic principles of the MPA Analysis Program(1);

What happens in 1 cycle?

1. Running the Pre-Engine: creating (Sub)Assembly Virtual or Real Work Orders and Virtual Customer Orders out of Active (Customer) FORECAST and Firmed Master Production Schedule (MPS) Requirements to have a complete set of requirements from Customer Order Lines, Work Orders and IBT's demanding material at a specific moment in time.
2. Resetting all previous MPA results.
3. Deleting all remaining non-KanBan Planned Orders.
4. Analyze Real Customer Orders/Customer Order Lines, Real Work Orders and Real IBT's in one set together, because of delivery date priorities for it's Material Requirements (Material Cards)
5. Analyze Virtual Customer Orders/Customer Order Lines and Virtual Work Orders in one set together, because of delivery date priorities for it's Material Requirements (Material Cards); or a priority Mixed Mode of point 4 and 5 based upon Required Date Sequence.

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The basic principles of the MPA Analysis Program(2);

What happens in 1 cycle optional?

Maintain statistics of fulfilled and non-fulfilled Customer Order Lines and/or Work Order Material Cards (Read "Handshake" for fulfill)

6. Maintain statistics of fulfilled Material Cards and non-fulfilled Material Cards
7. Analyzing and creating Replenishment Advices and Planned Orders. MPA can create Planned Orders by Type; MPA can create eventually Real Orders immediately.
8. Analyzing and creating Planned Orders for Safety Stock Items under Safety Level to support Demand Driven MRP Rules
9. Analyzing and creating KanBan Planned Orders for KanBan items under KanBan level with MPA specific very simple Kan Ban rules.

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The starting point is Resetting the previous MPA result and creating (Sub)Assy Wo's and CO's from (Customer)FORECAST and Firmed Master Production Schedule (MPS) Requirements

MPA is cyclical; this means that at any point in time you can start a (re)run of MPA in the ERP system.

All results of the analysis from the previous run are deleted and the analysis (including the Pre-Engine, Engine and Post-Engine) will run all over again.

Also all eventual Planned Orders which has not yet been converted into real orders are deleted as well.

(Customer)FORECAST and MPS are taken into account for all FORECAST and MPS Requirement Qty's with a future date/period. Through this Virtual (Sub)Assy WO's and CO's can be created which, after that, can consume On Hand Stock and already running Real (Sub)Assy WO's and Real PO's.

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Sequence and priority of Demand Requirements.

Customer Orders and highest level Work Orders together with IBT's are sequenced and analyzed in one go or one set based upon in Desired Ship Date and/or Want_date order.

The system will check whether or not there will be available On Hand Stock for each Line with a Part Requirement but NOT a hard link to a replenishing Work Order. If so, the "handshake" is stopped for that Requirement Line.
With a hard-linked replenishing Work Order this WO is then taken as the "handshake" for that Line.
With no hard-link replenishing Work Order MPA tries to do the "handshake" against running Real (sub)assy WO's and PO's.
This "handshake" will be done for all released (real) orders in the sequence order of Desired Ship Date / Want_date.

The "handshake"is maintained both in special fields (Customizable User Def. Fields) in the Customer Order Line and a "Cross Out" basket Table of the PartID , where the basket holds eventual Available On Hand qty's or subassy Work Order qty's or PO Line qty's.

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MPA maintains statistics of material fulfillment(Handshakes)

MPA maintains completely automatic statistics of the fulfillment of all required material for both Customer Order Lines and Material Cards from Work Orders and IBT's

The number of Customer Order Lines which reached fulfillment is expressed in a percentage of the total number of Customer Order Lines involved in one cycle of the MPA run.

The number of Material Cards from Work Orders which reached fulfillment is expressed in a percentage of the total number of Material Cards involved in one cycle of the MPA run.

The number of IBT Lines from IBT's which reached fulfillment is expressed in a percentage of the total number of IBT Lines involved in one cycle of the MPA run.

Through this, Key Performance Indicators (KPI) can be created and expressed, which indicate the degree of Material Fulfillment of the whole of the manufacturing organisation at that point in time.
When these KPI's are put into a historical timeframe the organisation can control it's own growing level of Material Fulfillment in time (of which 100% is the ideal world).
In itself this is one of the major underlying supporting ellements of real controllable Delivery Reliability toward the organisation's customers.

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MPA and Goldratt's Theory of Constraints

MPA maintains completely automatic statistics of the value of the On Hand Inventory, the Purchase Order Line Inventory and the Work Order Inventory.

Purchase Order Line Inventory is the summary of the still to be delivered PO Line quantities expressed in value.

Work Order Inventory is the summary of the still to be finished WO production quantities expressed in value.

The Sum of On Hand Inventory plus PO Line Inventory plus WO inventory = Total Inventory Value (I) as part of the Goldratt's Return On Investment formula:

$$\frac{T - OE}{I} = ROI$$

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Goldratt's Theory of Constraints converted into Management Question

What should be managed	What should be measured	What should be Improved
agreements	Delivery reliability	committing
capacities & priorities	Throughput (T)	communicating
division of tasks	Operational Expenses (OE)	cooperating
delivery times	Inventories (I)	confiding

$$\frac{T - OE}{I} = ROI$$

Planned Orders can follow the MPA Analysis step

Planned orders can be created immediately after one MPA cycle but this can also be done in a separate steps after first evaluating the MPA analysis results.

Planned orders can be created in specific types ofwhich type MPA is the most important one.

Types of Planned Orders:
•MPA; a common Planned Order but then generated by MPA
•MPA_FORECAST; a Planned Order based upon a demand coming from Forecast
•MPA_MPS; a Planned Order based upon demand coming from Master Production Schedule
•MPA_SAFETY_STOCK; a Planned Order based upon Safety Stock Demand only without any other highest level independend demand.
•MPA_KANBAN; a Planned Order based upon a demand coming from a KanBan controlled item

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MPA works with Parameters(1)

Safety Stock can be taken into account.

Flags for involving in MPA the On Hand that really can be used in practice or not; also for protecting Safety Stock or not.

Nettable = "Y"
Flag for marking the selection of parts with QTY_AVAILABLE_ISSUE (Nettable = "Y") or QTY_ON_HAND (Nettable = "N");
Available Quantity is the total of the NOT On Hold Warehouse Locations
Quantity On Hand is the total of the On Hold Locations and the Available Locations
Unavailable Locations are NOT involved in MPA at all!!!!!!!!!!!!!!!!!

DoNotConsumeSafetyStock = "Y"
Flag for marking the selection of parts where SAFETY_STOCK should be preserved when enough On Hand Stock is available ; Safety Stock should be taken into account then.
This means that SAFETY_STOCK_QTY should be deducted from the QTY_ON_HAND when the On Hand Qty is larger than the SAFETY_STOCK_QTY
When the flag " Nettable = "Y" " is on, not the QTY_ON_HAND should be used in the MPA Analysis but the QTY_AVAILABLE_ISSUE instead.

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MPA works with Parameters(2)

The sequencing of the "Handshakes" determines what Material Cards can be fulfilled in what order.

Flags for running MPA in a particular required date sequence and give priority to the one Material Card within one Work Order over the other and to give priority to the one Work Order within the whole set of Work Orders over the other.

WOWantDateSequence = "N"
WOWantDateSequence = "Y" means that the Work Order's Desired Want Date will be the basic prioritizer.

WOSchedDateSequence = "Y"
WOSchedDateSequence = "Y" means that the Work Order Schedule Finish Date (ScheduleID STANDARD) will be the basic prioritizer. This only makes sence when the ERP using organisation runs a Scheduler program for it's shop floor planning of Work Orders and Work Order operations.

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MPA works with Parameters(3)

Forecast and Master Production Schedule Integrated

InvolveFORECASTMPS = "Y" or "N“

PastFORECASTMPS = "Y" or "N“

FirmedFORECASTMPS = "Y" or "N“

MPAExplodeMultiLevelBOM = "Y" or "N“

VirtualForecastCustomerID = "[SiteID]FORECAST“

VirtualMPSCustomerID = "[SiteID]MPS“

PlannedMPSOrdersForPurchased = "Y" or "N“

RealMPSPOsForPurchased = “N” or "N“

ResetMPSForPurchased = “Y” or "N“

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MPA works with Parameters(4)

Safety Stock and KANBAN also parameterized

VirtualForecastMPSWOsForFabricated = "Y“

RealMPSWOsForFabricated = "Y" or "N“

ResetForecastMPSForFabricated = "Y" or "N“

DeletePastForecastMPSAnyway = “Y” or "N“

DeletePlannedOrders = "Y" or "N“

MPAplannedOrders = "Y" or "N“

MPAplannedOrdSafetyStock = "Y" or "N“

MPAplannedOrdCOLShortage = "Y" or "N“

MPAplannedOrdKANBAN = "Y" or "N"

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What can MPA do what MRP cannot(1)?

Because all analysed sets, not only the A's and the B's sets
but also the A ∩ B are maintained in the ERP database,
It is possible to work with exception reporting for actually all kind's of
A ∩ B sets.

Example1: a list with all subassembly Work Orders and/or all already running Purchase Orders which are NOT claimed to fulfill whatever material requirement is a very easy and simple exception report.

Example2: a list per Customer Order (Line) whether or not all the underlying Work Orders can start yes or no because of material fulfillment is a very easy and simple exception report.

Example3: a list for all Customer Order Lines and all Work Orders where no or limited fulfillment took place and where a Planned Order is necessary is a very easy and simple exception report.

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What can MPA do what MRP cannot(2)?

Maintaining history and statistics of the MPA runs and it's (intermediate) results is very easy because it is all kept in the form of A ∩ B sets in the database.

Not only the detailed level of the MPA analysis can be very easy and simple made visible through exception reporting but also the high level meta data can be made visible in simple to read exception reports.

The MRP's Material Planning Window gives you a view per Part what the demanding Customer Orders and Work Orders are and what the Replenishment (Planned or WO or PO) Orders. That forces you go through this screen Part by Part to find your own exceptions manually.

MPA makes it possible to make ANY cross reference exception report you like; by Customer, by Part, by Work Order, by Resource, by Vendor, by Outside Service activity, by Warehouse, etc, etc. Not manually but automatic if you want.

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What can MPA do what MRP cannot(3)?

When MPA generates Planned Orders and/or real Work Orders and/or real Purchase Orders the Order Date WILL AND CAN NEVER BE IN THE PAST like MRP does when required date minus leadtime end up in the past during the MRP calculation.

One cannot plan any work or any order in the past; that is far from realistic and very confusing for MRP users.

MPA can warn the user for wrong or incomplete use of specific Order Policies.
For Example: MPS items with a remaining open MPA requirement after the MPA-MPS run means an incomplete MPS Schedule.
For Example: Not-Planned items with remaining open MPA requirements could mean a wrong Order Policy.
MRP WILL NEVER BE ABLE TO TELL YOU THIS!!!!!!!!

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What can MPA do what MRP cannot(4)?

MPA works with types of Planned Orders.
(In a Planned Order the field WBS_CODE is taken as such).

Types are possible for Forecast Parts, MPS Parts, Purchased Parts, Fabricated Parts, Order Policies, KanBan, etc.
MRP has only one (or actually no) type, namely Planned Order.

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MRP was a good solution, but…….

MRP is/was a good solution to the wrong problem, namely being able to explode a multi-level BOM and signify the lowest level as to be purchased with as result: only planned orders for now

MPA, although maybe not perfect yet, is the (maybe to be further improved) solution to the right problem namely to use exeption reporting to control and manage material replenishment in a dynamic permanently changing environment both in quantity and in value.

It is always better to have a bad or not yet so good solution to the right problem than a good one to the wrong problem, because one can always grow into a good solution with the right problem and not with a wrong one.

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MPA is demand driven

MPA is in first instance demand driven and not so much Stock On Hand driven.
That means that Safety Stock and Forecast/MPS and various kinds of Order Policies can be taken into account but play a minor role or going to play a minor role when MPA is used instead of MRP.

MPA drives out MRP when used

It is not possible to stay and use both MPA and MRP at the same time.

MPA will be able to generate Planned Orders in a much broader perspective than MRP.
But when MPA and MRP are run at the same time this will in most cases lead to double Planned Orders.

An organisation will have to make a fundamental choice for or going on working with MRP (with all it's limits) or MPA (and try and improve both the tools and the way of working for proper replenishment).

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.....Is MPA a concept that could bury Joseph Orlicky's MPR1 Concept and put it in it's grave?

Orlicky's Material Requirements Planning MRP Review
Orlicky's Material Requirements Planning – 3rd Edition by Chad Smith and Carol Ptak – Reviewed

Joseph Orlicky is a legend in the field of manufacturing systems, and **Orlicky's Material Requirements Planning**, aka Orlicky's MRP, first written in 1975, is a classic. It is quite simply the Bible of books on MRP, and the sales history – 175,000 copies sold – proves the claim.

Another legend was invited to write the 2nd Edition in 1994 – George Plossl, Orlicky's friend, and contemporary of other Giants such as Oliver Wight.

And now Chad Smith and Carol Ptak have written the 3rd Edition of Orlickys Material Requirements Planning at the invitation of publisher McGraw-Hill.

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MRP1 is 46 years old now!!!

MRP1 was designed in 1975 by Joseph Orlicky to help Material Planners and Software Designers in those days to better understand both the requirement side and the replenishment side of material and components for Customer Orders and/or Work Orders in a Manufacturing Environment.

The concept has remained the same ever since.

All ERP software vendors have built it in into their ERP systems.

But after 44 years of working with this concept it's limits and limitations are unfit for the 21st century; MPA will make it quite obsolete.

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MPA Room for Improvement

IBT's are yet recently integrated as part of the Independent Demand Set.

Forecast has been integrated recently and considered in MPA much the same as MPS has been considered till now.

There is more possible in terms of additional reporting and graphical presentation of the analysis results.