Demand Driven World™

Demand Driven From Quote To Cash In ETO Supply Chains 2024 Update

Debra A. Smith, Managing Partner, Constraints Management Group

Demand Driven World Conference 2024

Demand Driven Institute™ The Global Authority on Demand Driven

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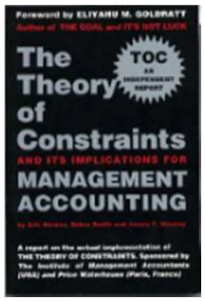
DEMAND DRIVEN TECHNOLOGIES

AGENDA

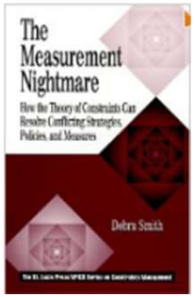
CMG's Demand Driven Journey Overview

- Demand Driven Operating Model (DDOM) Role, Rules and Tools review
- Thoughtware always comes before Software
- DD Rules & Tools applied to ETO DDOM Design
- Update on ETO DDOM lessons From KES
- ETO Rules and Tools innovation with NOV

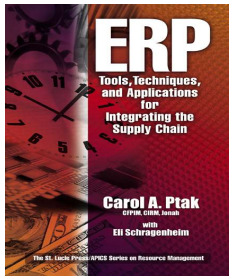
The CMG Demand Driven Journey of Exploration



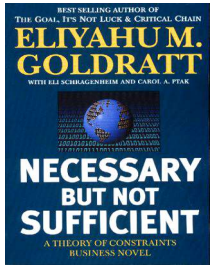
1995



1997



1999



2000

DitchWitch

1998

The Power of Decoupling:

- $35M inventory decrease
- Lead time 90 to 14 days

Roseburg

2001 -2003

The Power of Vertical Integration:

- $30M inventory decrease
- ROI from 4 to 18%
- Lead time 3 weeks to 3 days

2005 -2006

The Power of the Right Rules/Tools DBR+™/R+®:

- Sales up 12%,
- Inventory down 24%,
- Income up 21%,
- Cash flow doubled,
- Foundry lead times 2 weeks to 2 days,

2004 we began coding - 2005 DBR+™ & 2006 R+®

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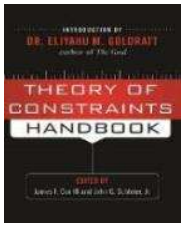
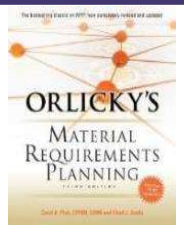
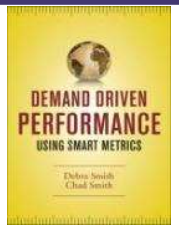


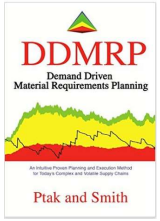
2010



2011



2013



2016….

2019

LeTourneau TECHNOLOGIES
Built On Experience. Driven By Vision.

2004-2009

Analyze Deep and Broad Product, Project, Structures DBR+™/R+® and Concerto/CCPM:

- OTD 60% to +95%
- ROI from 5 to 22%
- Lead time 24 to 10 weeks Equipment
- Lead time 27 mos. to 12 mos. Drilling Rigs
- 6 X revenue with .8 inventory increase

Unilever

2011 -2014

The Prioritized Share Equation & Hybrid Distribution:

- 45% decrease finished goods
- 18% decrease raw and pack
- 99.7% service levels

corona
STEMCELL™ TECHNOLOGIES
NOV
WÄRTSILÄ
Honeyville
Server Technology
Quality Rack Power Solutions
MICHELIN
GENESIS ROBOTICS AND MOTION TECHNOLOGIES
primex
Norsat International Inc.
JOHN ZINK HAMWORTHY COMBUSTION
KOCH
Server Technology

2015-2023

Demand Driven Adaptive System

- Demand Driven Operating Model
- Demand Driven S&OP
- Prioritized Share Equation for critical capacity scheduling & execution

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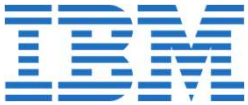
CMG Customers



The Role of A DDOM In A Demand Driven Adaptive Enterprise

Demand Driven Institutes' Demand Driven Adaptive Enterprise Model		
DDAE III	Sensing, Adapting and Innovating across the supply chain (customers and suppliers) for continual ROI improvement. Mature DDAE Model.	**Market Strategy, Tactics and Execution Aligned Around "System Flow" to Market Demand:** Increase market innovation rate. Velocity ↑, Working Capital ↓, Productivity ↑, ROI ↑
DDAE II	Leverage the Demand Driven Operating Model capability across the enterprise and into the mar… in place.	**End the Cost/Flow Conflict Across the Enterprise:** Investment Focus …ment Tactics are aligned around removing obstacles to …". Velocity ↑, Working Capital ↓, ROI ↑
DDAE I	Synchronizing and leveraging operational capability for better flow performance. Expand the implementation of a Demand Driven Operating Model.	**End the Cost/Flow Conflict in Operations:** Planning, Scheduling and Execution Aligned Around "System Flow" to Market Demand. Velocity ↑, WIP ↓, Productivity ↑, ROI ↑
Stage 2	Begin to emphasize flow-based operational efficiency with the preliminary implementation of DDMRP.	**End the MRP/Forecast Distortion:** Planning and Execution signals are synchronized to Market Demand. Expedite Costs ↓, OTD ↑, ROI ↑
Stage 1	Focused on cost-based operational efficiency (Cost reduction AND Responsiveness in conflict).	**Cost and Efficiency metrics and tactics are in conflict with Flow metrics and tactics. Supply & Demand Variability Transference ↑.** The result is high expedite costs and low OTD and suboptimal ROI.

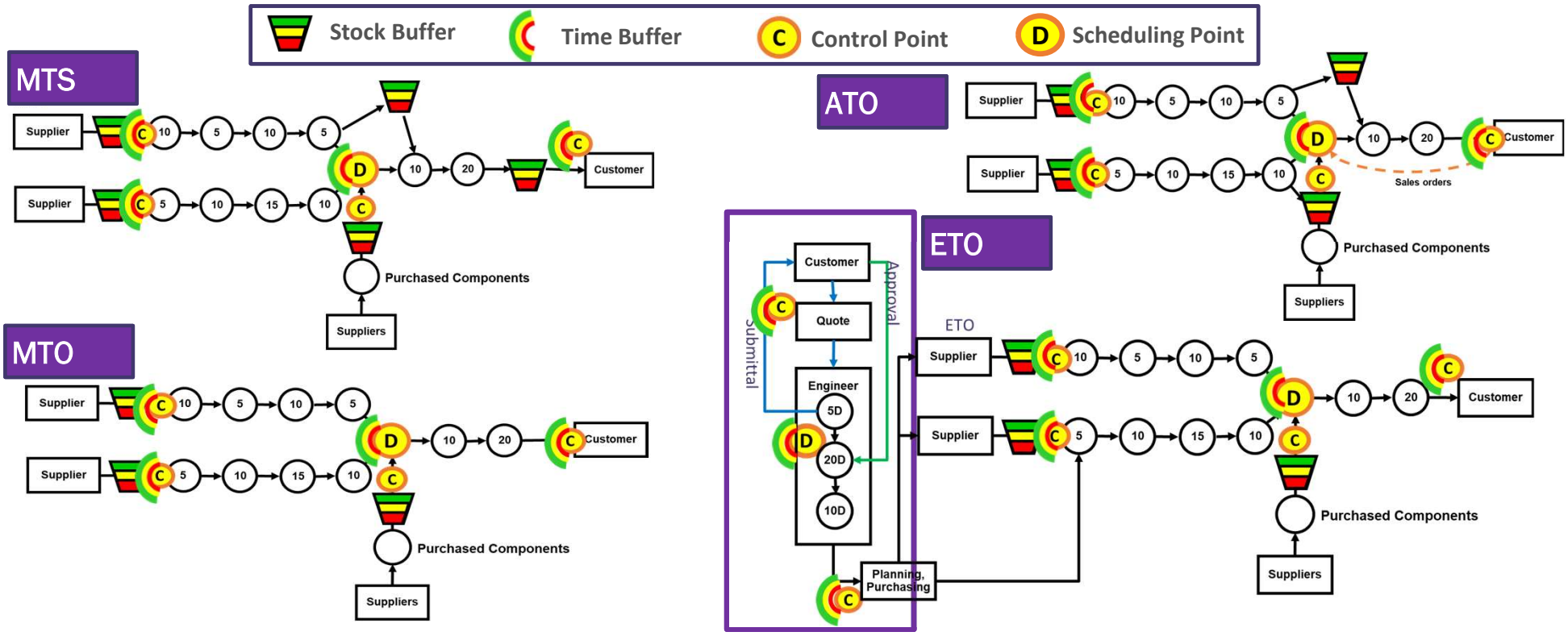
DEMAND DRIVEN OPERATING MODEL

DDOM is the Engine For Smart/Flow Metrics Execution & Trending

DDOM is the Foundation of DDS&OP and Adaptive S&OP

The Demand Driven Design and Thoughtware Determine DDOM Success

Four Different DDOM Designs to End Demand Supply Continuity Variation Transference



ETO adds another BoM level to each child component (Drawing pkg) and its own S&E

90% of our clients are a mix of MTS, MTO, ATO and 50% also have ETO

CMG Phases & the Koch DD Implementation

DD Implementation Phase Definitions:

PHASE 1:
Data Collection; Data Analysis; Build Flow Map; Workshop; Business Case; Project Map

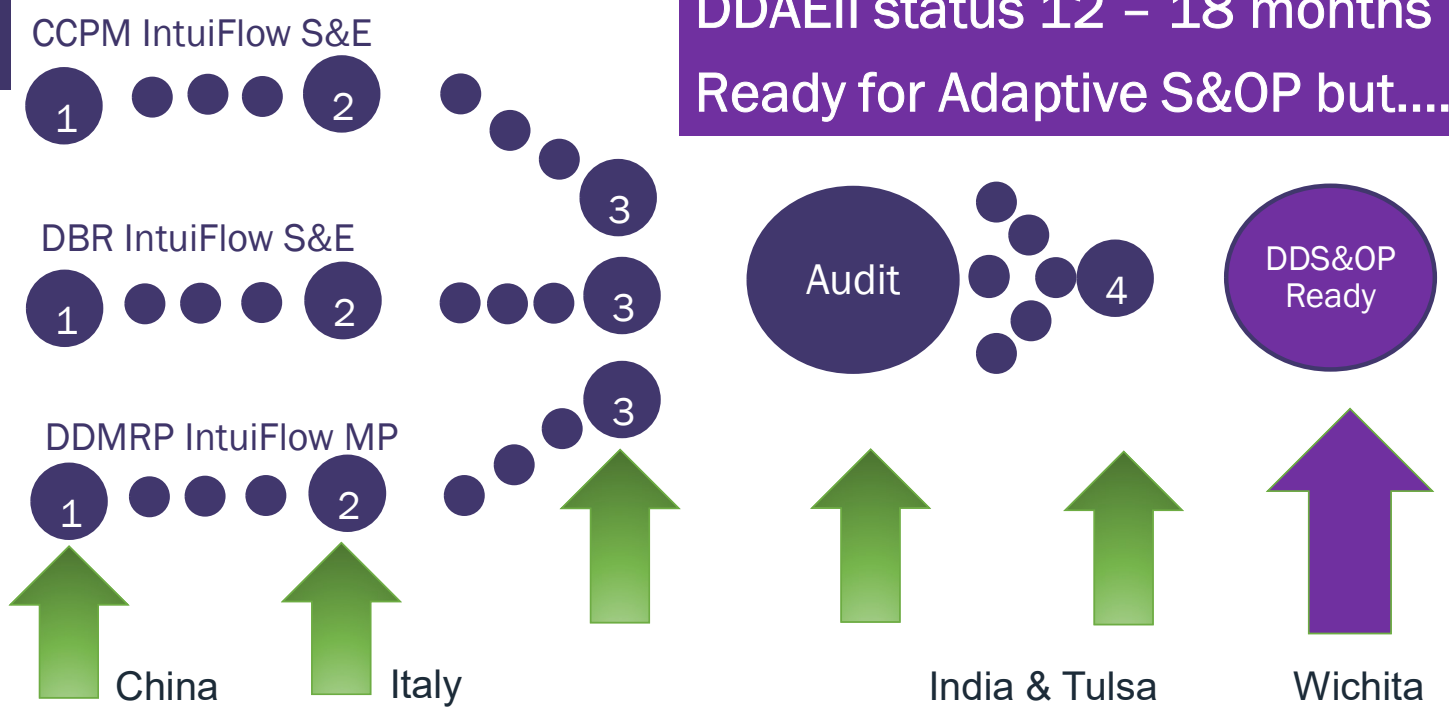
PHASE 2:
Implementation of the DDOM project Map Training & Modeling

PHASE 3:
Post Go Live Support – Learn to operate the DDOM

AUDIT:
Analyzing the state of our planning and scheduling Capability and create a project map for process improvement and remodeling.

PHASE 4:
Remodel and Implementation of the post go live project map.

Phase 5:
Routinized Tactical reconciliation, deriving DD improvement solution & implementation



DDAEII status 12 – 18 months Ready for Adaptive S&OP but....

Phase 1	Phase 2	Phase 3	Audit	Phase 4	Phase 5
• Data Collection • Data Analysis • Workshop	• Execute Implementation plan • Training • Modeling • **GO LIVE!**	• Normalize processes • Create feedback process • Adjust Model	• Data Collection • Data Analysis • Tactical Reconciliation	• Implement plan from Audit • Routinize tactical reconciliation and improvement process	• Routinize tactical reconciliation • The DDOM team is capable of leading conflict resolution and defining DD solution and recommendations

DDAEII status 12 - 18 months Ready for Adaptive S&OP but....

Only if your Demand Driven Operating Model is From Quote to Cash

Wichita April 2023 (PGL14 mos.)	Results
OTP Aftermarket no change	98% to 98%
OTP Projects	65% to 95%
Late Project Backlog in weeks	12.5 to 0
Sales Growth	+20% growth
Inventory turns	1.3 to 3.7
Stock outs	3%
Start on-time to schedule	95%
WIP Reduction (not inflation adjusted)	40%
Tulsa is ready for Adaptive S&OP	

Tulsa from 2023 to 2024	Results
OTP Aftermarket	26% to 50%
OTP Projects	26% to 74%
Late Project Backlog in weeks	Unavailable
Sales Growth	No change
Inventory turns	2.26 to 4.0
Stock outs	3%
Start on-time to schedule	95%
WIP Reduction(not inflation adjusted)	56%
Audit Improvement Project kicks off 10/21/24	

DDOM Rules, Tools and ETO, DDOM Design innovations

Current Reality Summary to build the business case. Why Change?

Understand the Importance of Flow and What blocks it

ETO lessons from our work with Koch and NOV

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Current Reality – Thoughtware to Build The DDOM Business Case

Current Reality Summary – Why Change

Not meeting your project budgets, OTP and ROI Targets

There is price and lead time competitive pressure.

Customers are unhappy with OTP and market share is at risk.

Quoted lead times and performance on current project deliveries determine future sales opportunity and 10+ years of Aftermarket cashflow.

Future revenue In ETO and ATO is leveraged by high margin aftermarket sales are 3, 4 & 5+X the original revenue over the product life.

Cash flow velocity - Past due AR - is high, due to poor OTP execution. Late documentation or lengthy negotiations on specification misses, cause payments to be held until resolved.

The Current Reality Supply Chain Summary

Supply Chain Current Reality Summary:

We have shared resources in engineering and operations, common vendors and some common materials that support Design, Fabrication & Assembly of all Projects/Products.

Project Managers, Engineering & Design, Purchasing and Manufacturing Managers are all measured on OTP, Earned Hours and Resource Utilization – All projects are started ASAP.

Project Managers, Fabrication & Assembly Managers constantly expedite, change priorities and schedules from engineering forward and variation cascades backwards and forwards through our supply chain.

There is no visibility to resource loads, drawing/design, work order and material status in functional areas or across the Supply Chain.

There is no process, agreement or visibility to the impact of changing a task(s), work order(s), project(s) or material usage priority, on the systems scarce resource(s) and the project(s) deliverables.

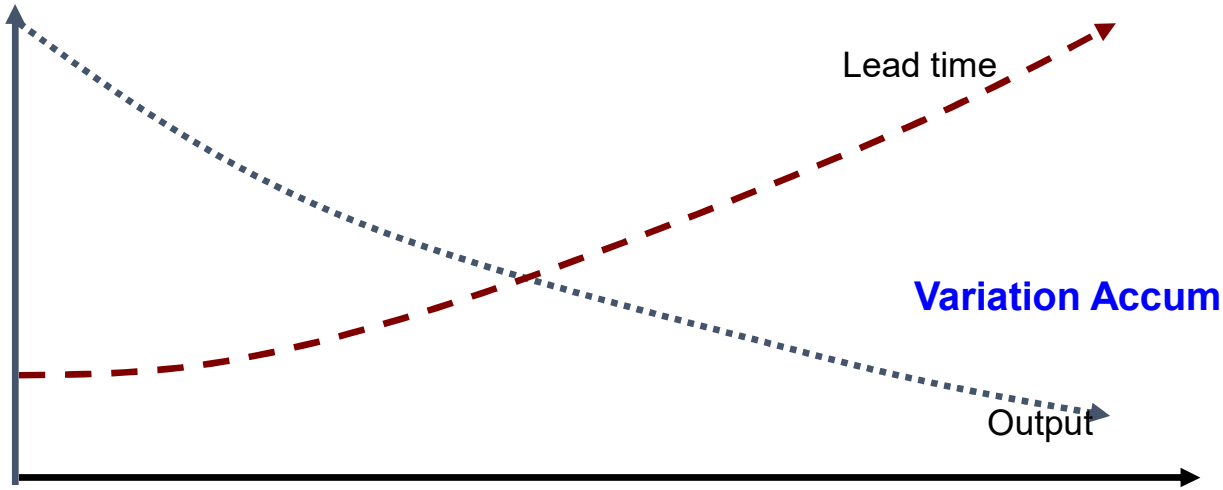
Identify & Agree on What Blocks Flow – The Major Sources of Variation

What short term firefighting action do you take to deal with your job's single biggest Challenge?

Koch - 60 leaders and managers from across the Supply Chain translated 13 answers:

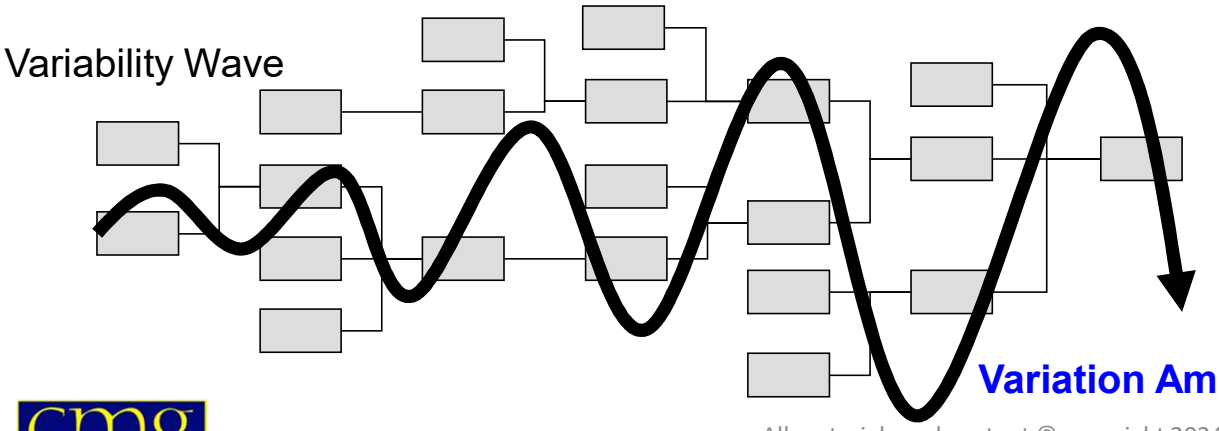
Supply variability transference causes delay accumulation across dependent networks – **Projects, BoMs, Routings**

Little's Law - System Dependencies, Interdependencies & Variation



Variation Accumulation

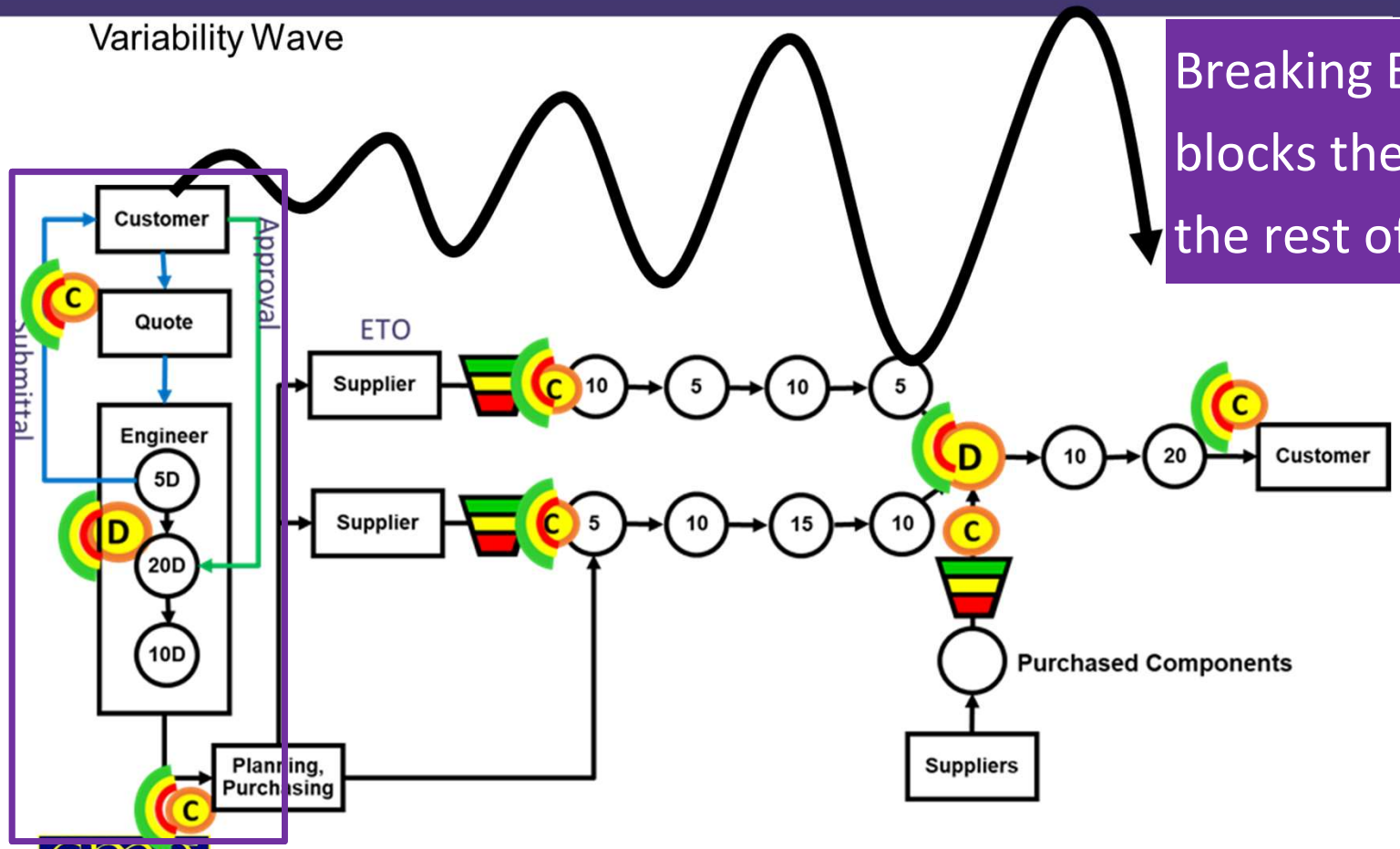
Supply variability transference causes delay accumulation across dependent networks – **Projects, BoMs, Routings**



Variation Amplification

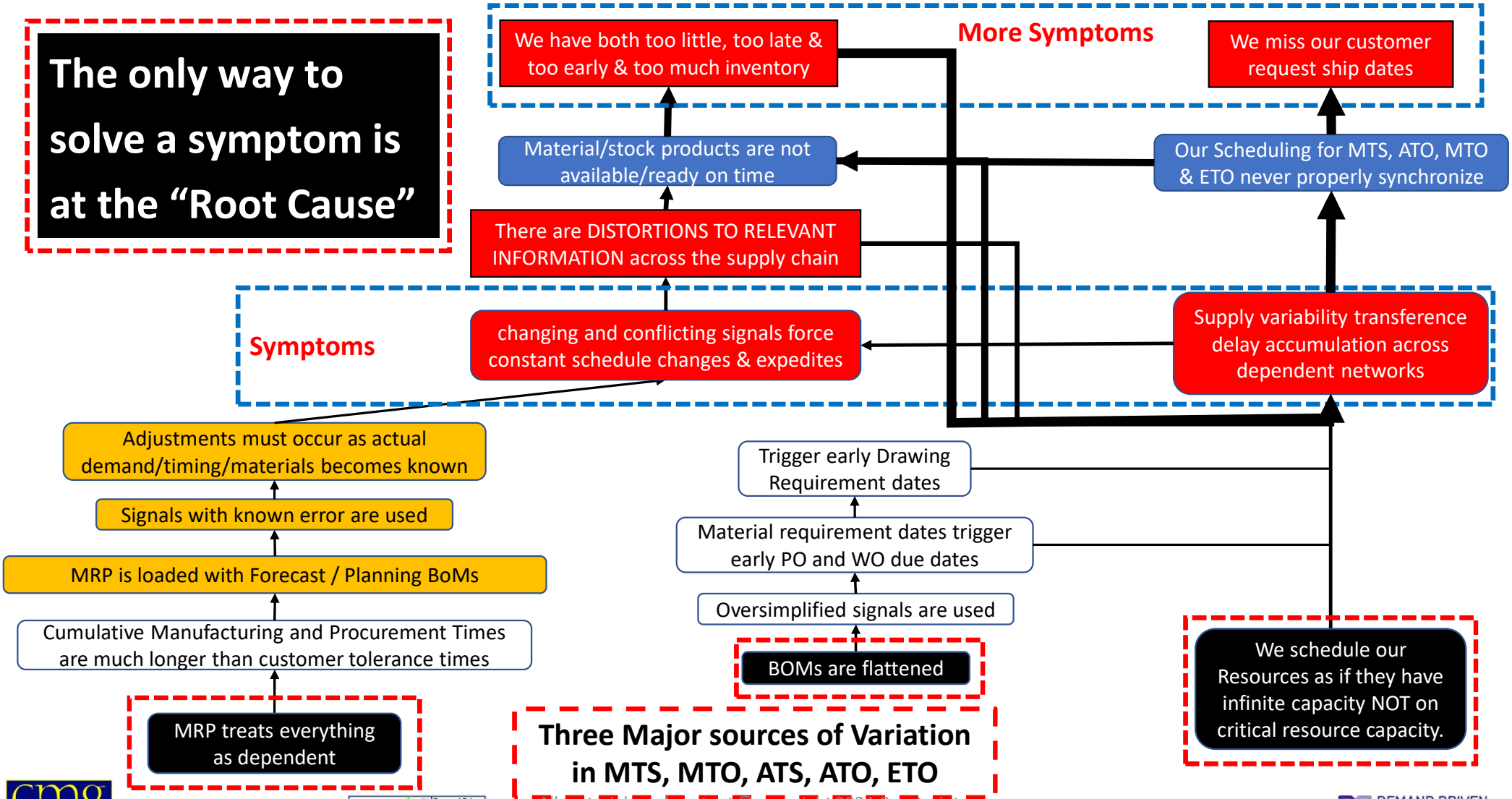
More Complexity = Variation Amplification
"The Bullwhip Effect"

The Bullwhip Effect in ETO Is Exponentially Larger than MTO & ATO

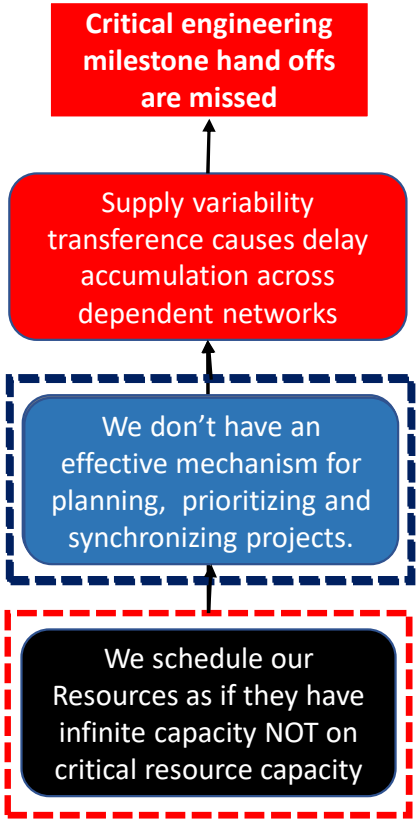


Breaking E&D variation blocks the cascade effect on the rest of the supply chain

DEMAND DRIVEN TECHNOLOGIES



Deep Dive Supply Variability and Engineering Symptoms



- **Critical path methods fails to account for the role of critical resource(s) capacity** to identify, protect and manage the longest leg of dependent events across the project – The Critical Chain *and…..*
- **Project Interdependencies are not recognized** or accounted for across the project;

then **… Missing task dependencies, concurrencies, misallocation of scarce skill sets** cause the critical path to "jump" and "jump" and "jump"…..

- **"Padded" task times at/by every resource** are used to account for Uncertainty and Variability;

then **… Safety is wasted on protecting every task and resource** - ignoring the physics *leverage point phenomena* and *statistical principle of aggregation/insurance protection* (not everyone will have a "wreck" today).

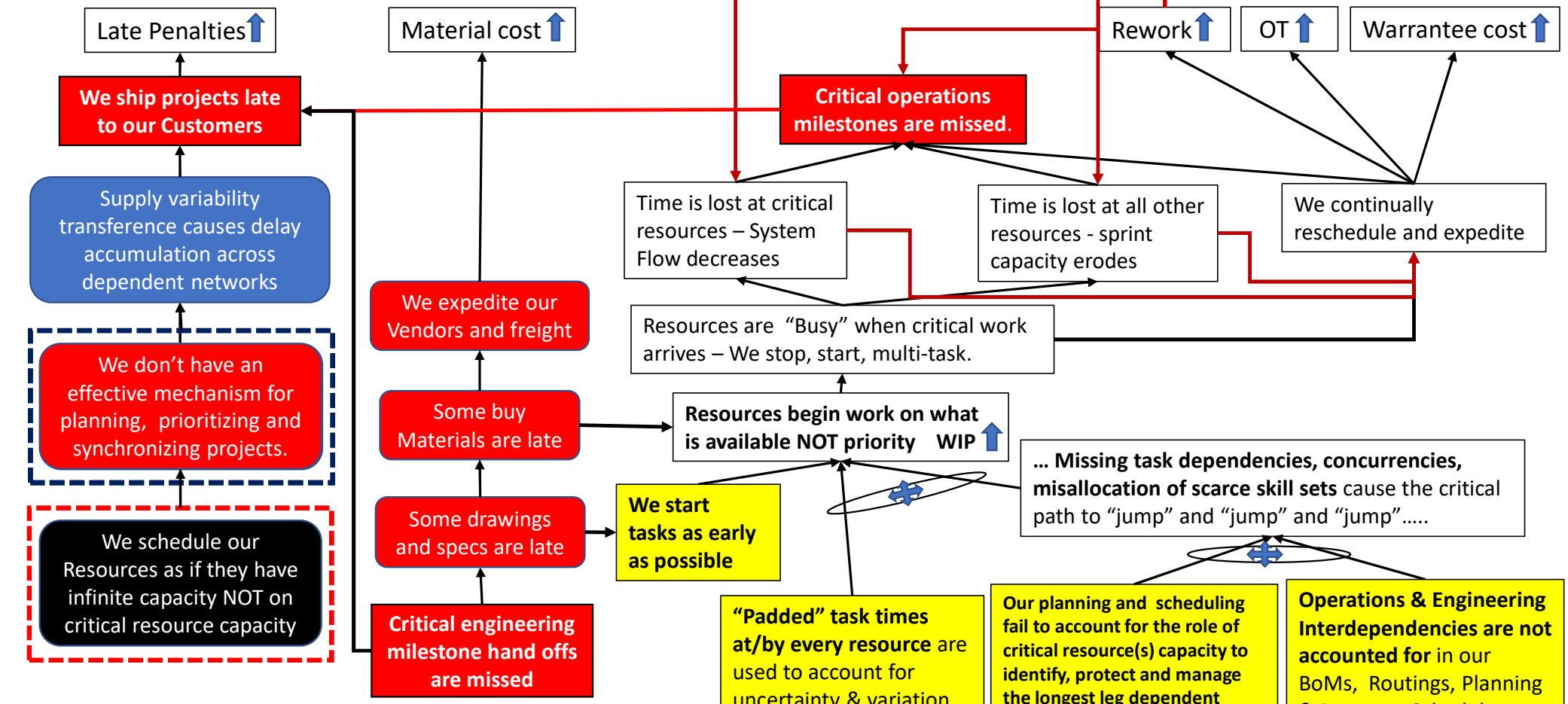
- **"Padding = delays are expected"** and work is released too early "to keep Resources "busy" **- WIP increases**;
- "**Busy" Resources are unavailable for critical work** when it does arrive;

then **… schedules and priorities shift to EXPEDITE critical work** and **Resources Start-Stop and Multi-Task;**

- **Time is lost at critical resources** *cannot be regained* **=** *System Flow capacity is lost forever;*
- **Time is lost at noncritical Resources** = **"sprint capacity" = the ability to recover from variation erodes;**
- *then….* **Most of the time a project is *waiting* for something** – *resources, specifications, approvals, materials, equipment, issue resolution, decisions, integration points, etc.*

Execution priorities become unclear and unsynchronized!

Deep Dive Purchasing, Planning & Manufacturing Variation ⬆



The Right Scheduling & Execution Rules - *"Starts As Early"* Or *"As Late As Possible"*

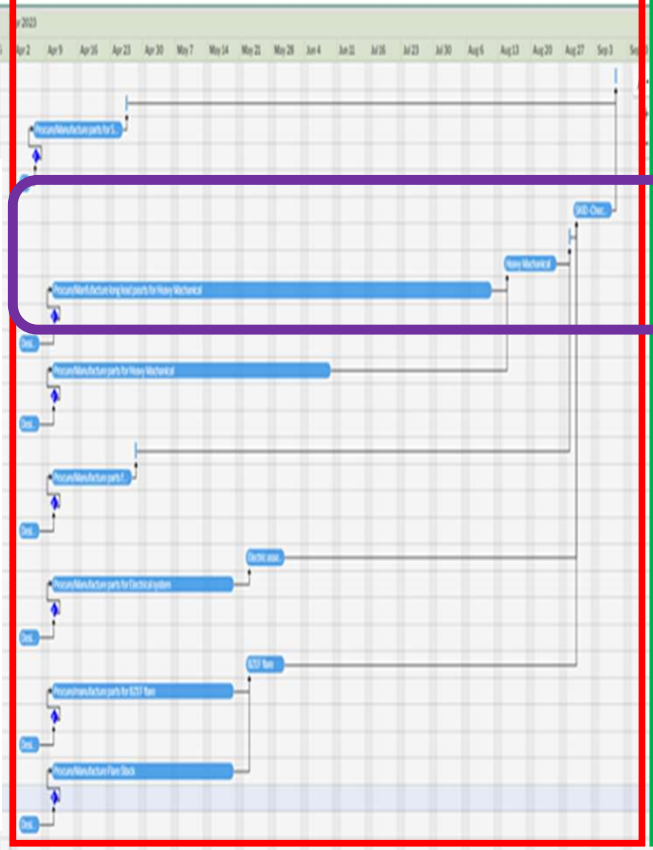
	PHASE	TASK TYPE	TASK NAME	REM DUR
1	Default Phase	Task	Bio Gas Sale Order	1 day
2	Default Phase	Task	Ship loose	1 day
3	Default Phase	Task	Procure/Manufacture parts fo...	14 days

This is the longest leg of dependent events for this project.

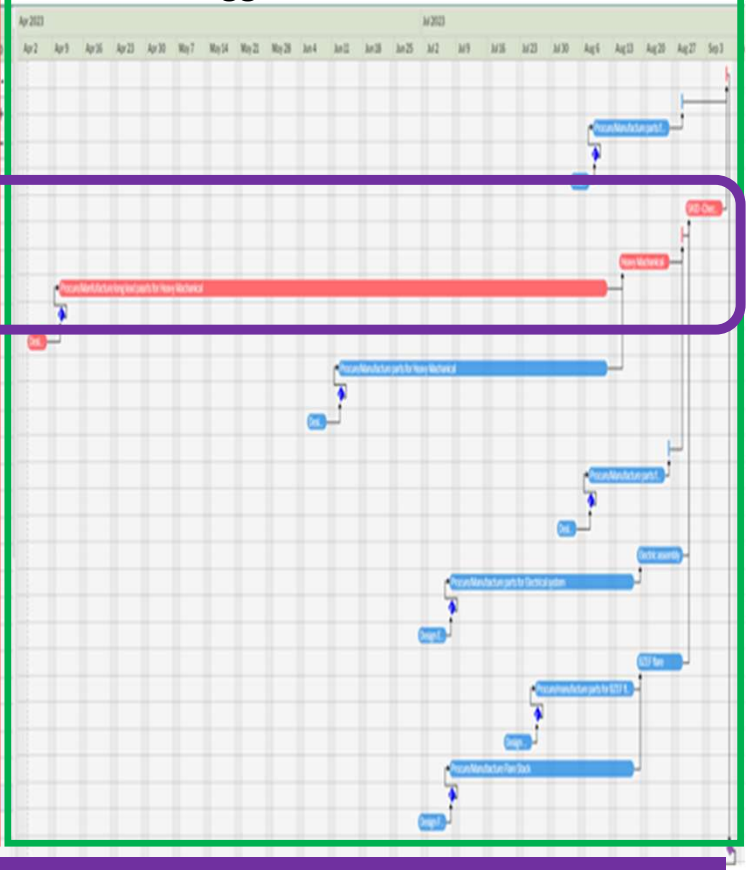
Which *Rule* provides the best project:

1. WIP Control?
2. Synchronize Drawing PKG handoff?
3. Synchronize material planning?
4. Synchronize MFG child/parent need date?
5. Prioritize scarce "Drum" resource capacity?
6. Prioritize/stagger all Resource tasks?
7. Prioritize common material?
8. Prioritize capacity and material decisions across project portfolio?
9. The ability for resources to Focus & Finish?

Schedule Start As Soon As Possible



Schedule Stagger To Start As Late As Possible



Scheduling backwards to start as late as possible staggers release to the "real due date", minimizes WIP and variation.

A Solution Must Address The Major Sources of Variation

Late Penalties ↑ | Material cost ↑ | Rework ↑ | OT ↑ | Warrantee cost ↑

ROI ↓

The Solution Direction

Implement a System with rules, tools, work practices and metrics that prioritize directs us to proactively manage "Projects / Products Flow" at a Company / System level.

ROI ↑

DD Operating Model Criteria Review

DDOM Provides The Missing Link In the Flow Equation

The Missing Link

ΔVisibility → ΔVariability →

Core conflict
Management Induced Variation

Plossl's First Law of Manufacturing and the Demand Driven Model

$$\Delta\text{Flow} \rightarrow \Delta\text{Cash Velocity} \rightarrow \Delta\left(\frac{\text{Net Profit}}{\text{Investment}}\right) \rightarrow \Delta\text{ROI}$$

Variability is defined as the summation of the differences between our plan and what happens.

Variability ↓ = Flow ↑

Variability ↑ = Flow ↓

Visibility is defined as **relevant information** for decision making.

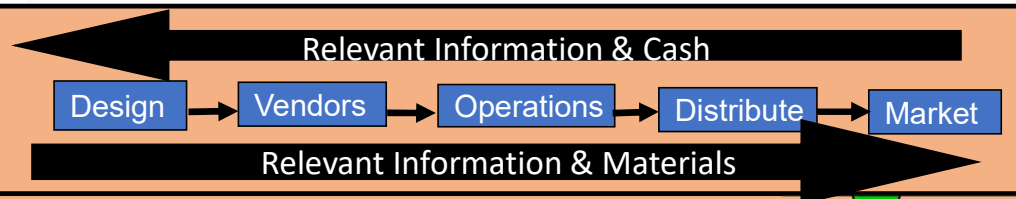
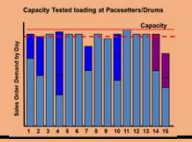
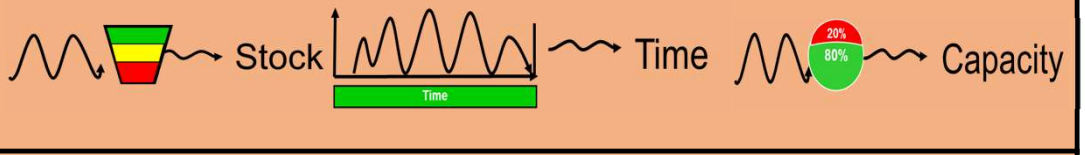
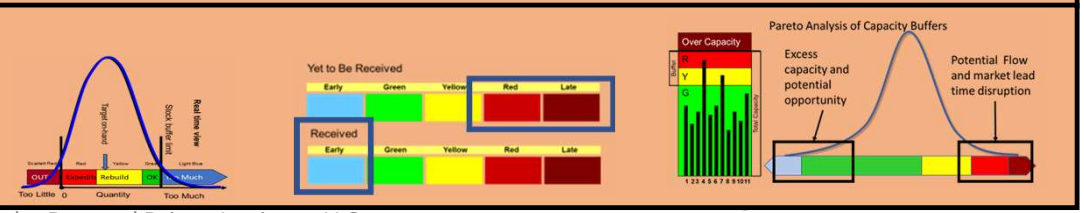
Visibility ↑ = Variability ↓

Visibility ↓ = Variability ↑

Demand Driven Is About Visibility For System Flow!

Relevant Information = Flow Based Metrics = "Smart Metrics"

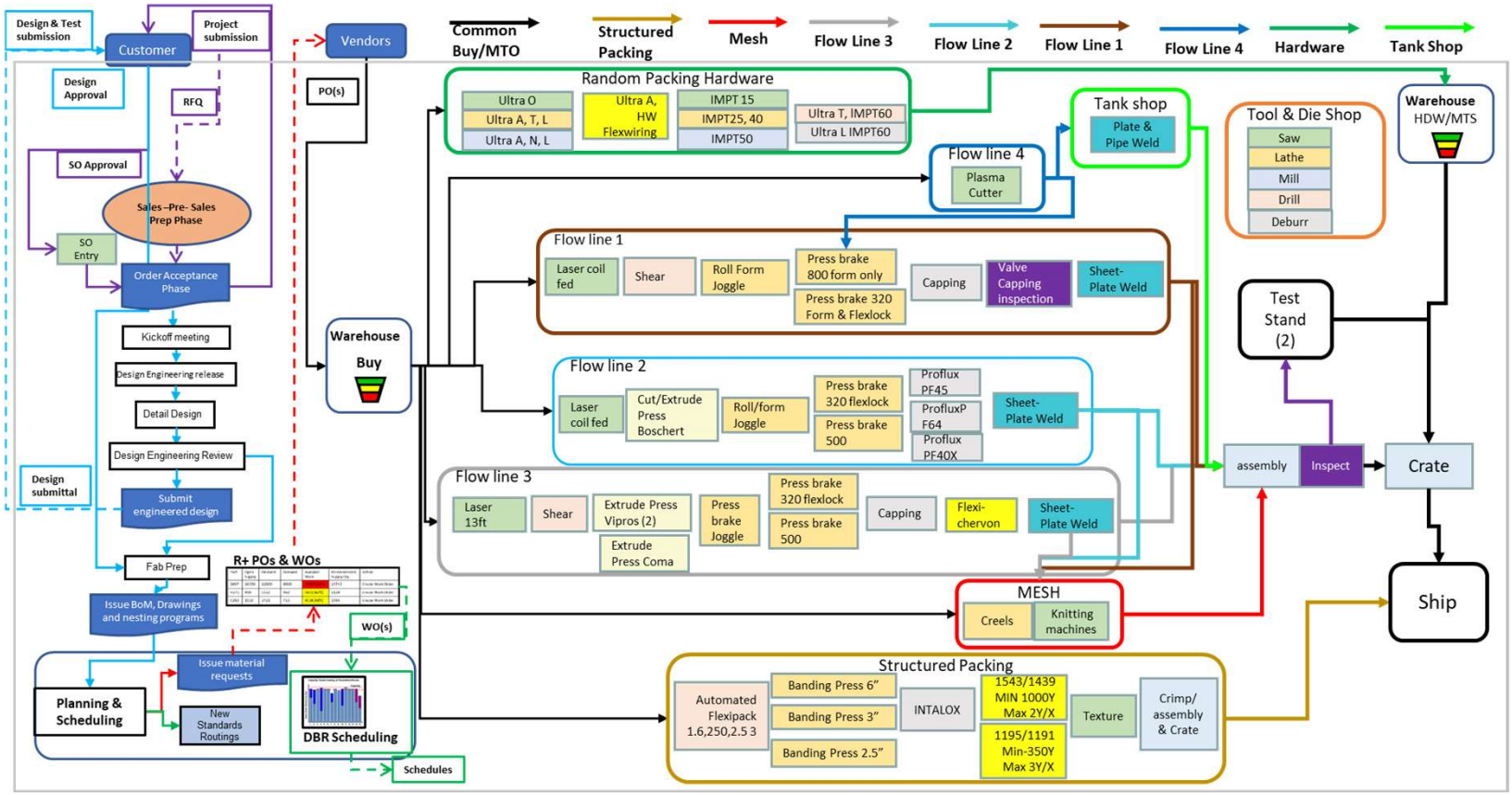
Agree On & Use The "Right Rules" To Speed Supply Chain Flow

Complex Adaptive System Rules	DD Model Attributes ΔVisibility → ΔVariability →	Operating the Demand Driven Model (Tactical Time Frame) ΔFlow → ΔCash Velocity → Δ $\left(\frac{\text{Net Profit}}{\text{Investment}}\right)$ → ΔROI
The method to understand a nonlinear system is to map the dependencies.	Create a Demand Driven Flow map of connections and interconnections of material, capacity and information.	
Nonlinear system "state" is dynamic, predictions change.	Create Short, independent planning horizons - **DDMRP**	Strategically place ***decoupling points*** for lead time compression and variability (bullwhip) mitigation. 
System output system is governed by a few critical points – "the levers"	Strategic control points govern and leverage the system output Buffering them protects FLOW.	 Strategically places ***control points*** for schedule synchronization to pacesetter/drums with finite capacity schedules 
Paretian statistical models – The tails of the distribution of the few critical points define relevant information to manage and adapt a nonlinear complex system.	All buffers use Paretian models to protect Control Points, with visible signals to prioritize when, who and where to act.	
A nonlinear system cannot be optimized but it can continually learn and improve. It can emerge to a higher order.	Visible buffer and control point status use a Paretian view to create a learning feedback loop to drive improvement. **"too much & too early" "too little and too late"**	

A DDOM Design Follows the Right Rules

Nonlinear systems can only be understood by mapping the dependencies and interconnections

Demand Driven Flow map of connections and interconnections

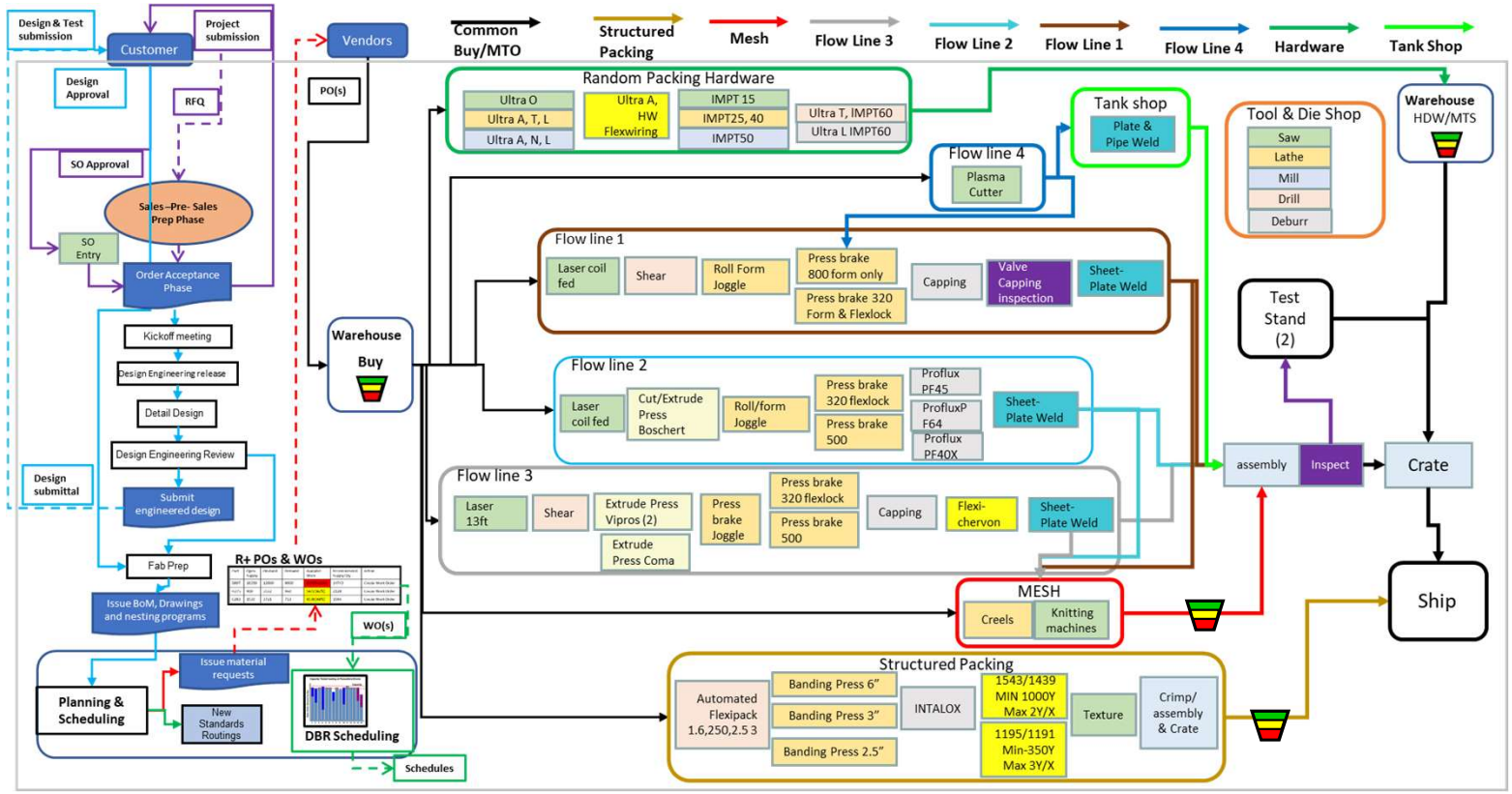


Create A Custom DDOM Design and Software Model

Nonlinear system "state" is dynamic, predictions change.

Create Short, independent planning horizons

Stock buffers are BoM child insertions that decouple lead times and create independent planning horizons



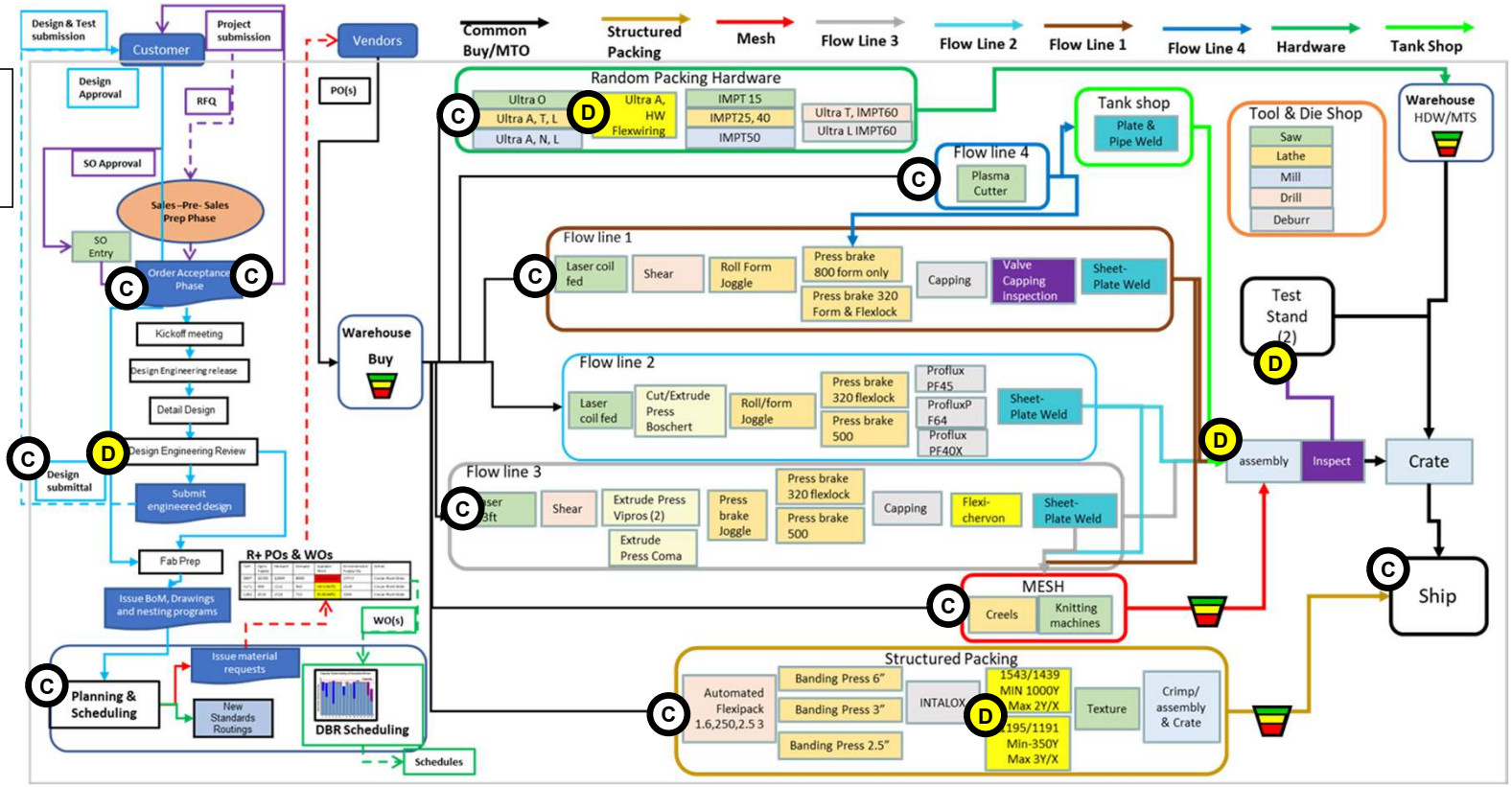
Create A Custom DDOM Design and Software Model

The output of nonlinear system is governed by a few critical points – the "leverage point phenomena"

Strategic control points govern and leverage the system output

D Drums/Pacesetters govern flow and create level loaded schedules for all resources.

C Control point create visibility to synchronize hand offs between



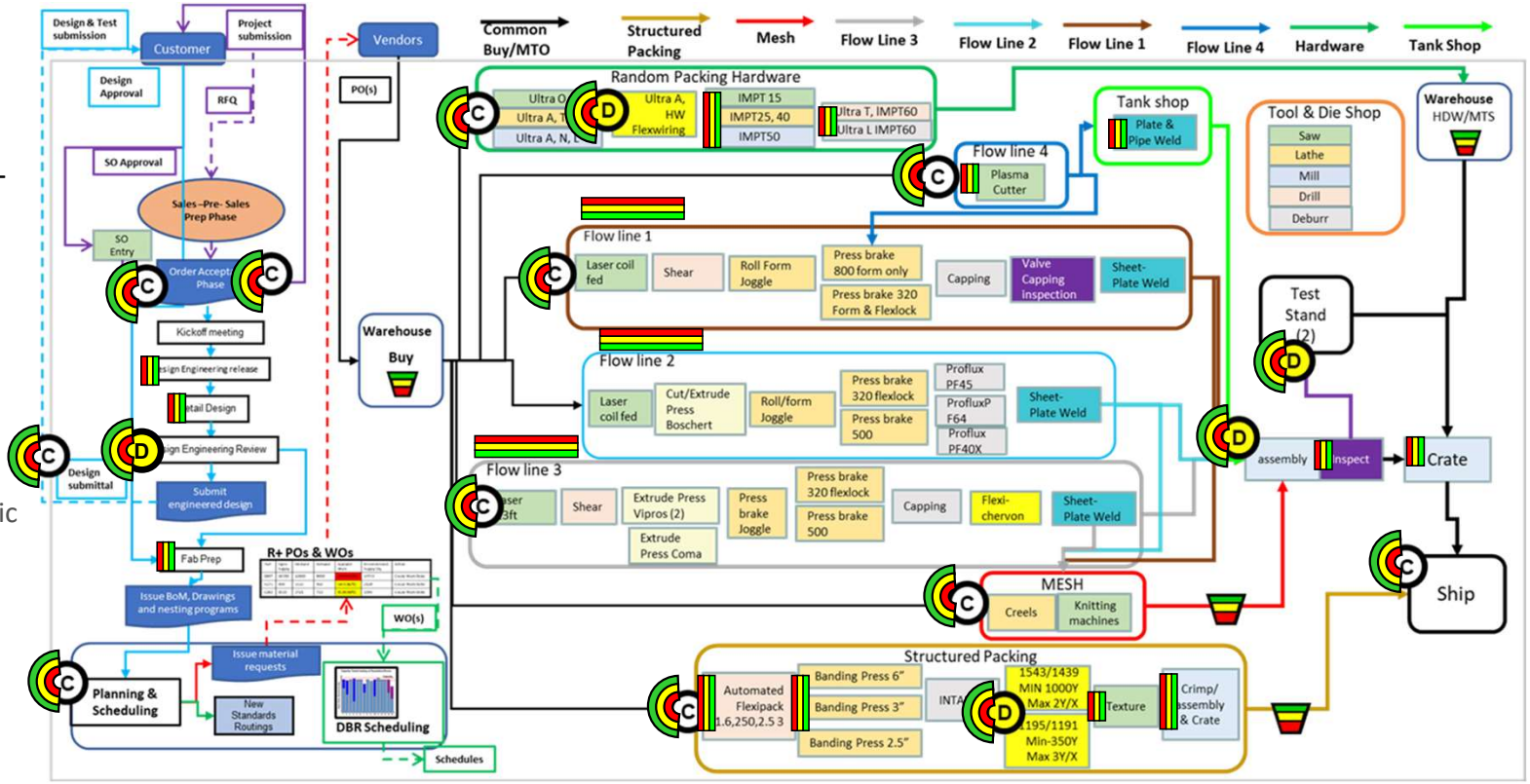
Create A Custom DDOM Design and Software Model

The output of nonlinear system is governed by a few critical points – the “leverage point phenomena”

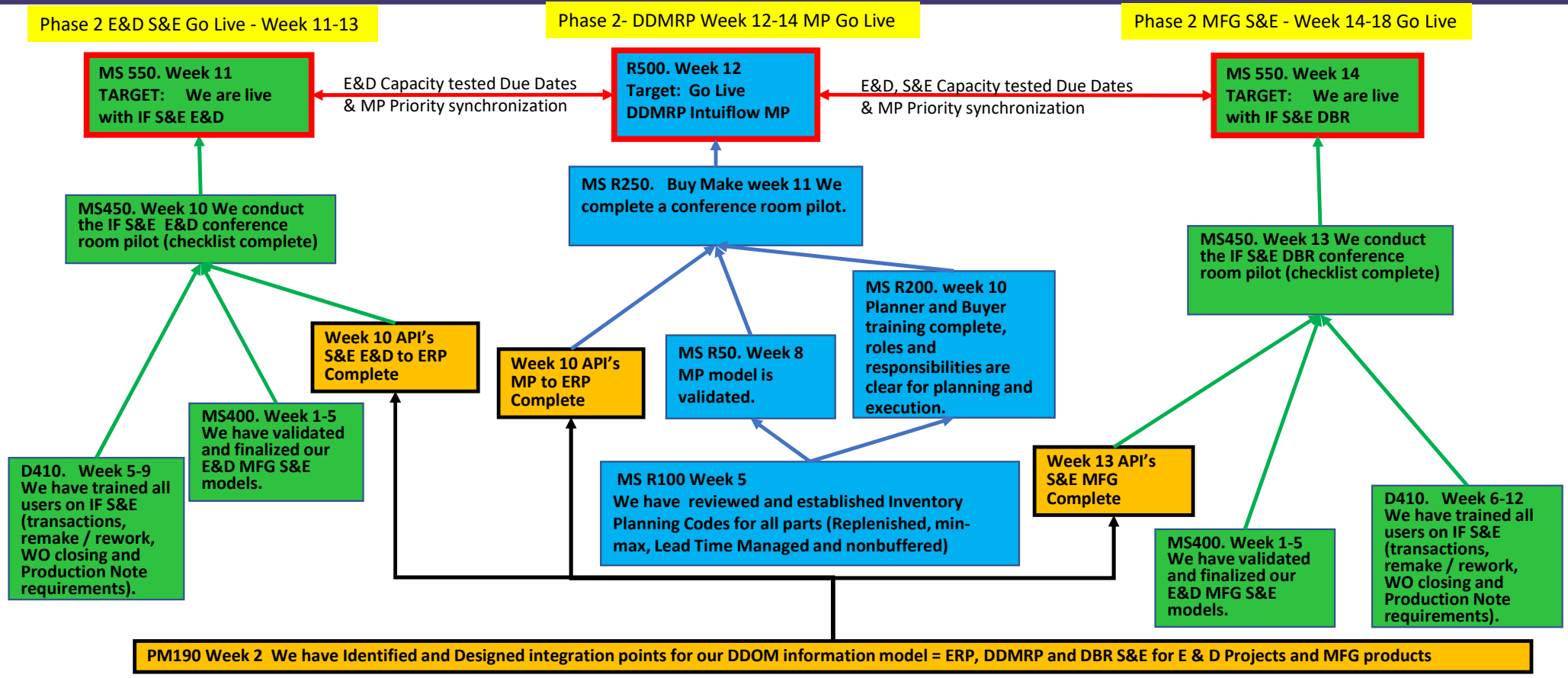
Protecting the critical points protects the System’s output

Time buffers protect Strategic control points, with visible signals to prioritize when, who and where to act

Capacity buffers provide “sprint capacity” to protect strategic control points



Create Implementation Maps From Quote To Cash



Lessons From KES Tulsa & Wichita = Breakthrough in ETO DDOM

Obstacles identified in the Audits to managing project flow and hand offs could not be solved with the current level of Rules & Tools.

- Hand offs to and from project management lack visibility alignment between the project management software, ERP and DBR+™ and R+® systems.
- There are fundamental Logic and Rule differences between traditional Theory of Constraints CCPM Scheduling & Execution for both project management and manufacturing, time buffer placement and DDMRP and Demand Driven Scheduling Rules.
- Until the integration of R+® and DBR+™ into Intuiflow™ no location aware Scheduling & Execution existed to connect S&E across the SC.
- CMG has been working on an integrated E&D DDOM that seamlessly integrates and maintains date alignment and status visibility S&E for Projects with Material Planning through the BoM levels in Materials Planning and S&E for Manufacturing priority and across a Supply Chain.
- The first implementation using the Intuiflow™ ETO DDOM that is fully Demand Driven compliant will “go live” in 3 weeks at Hydra Rig, a division of NOV.
- The next slides are a summary of the thinking, features and functions that enable A DDOM breakthrough for ETO.

The Design & Tool Functionality that Solved DD D&E S&E Obstacles

Packet Scheduling - Synchronizes all child start and end dates to the parent start date.

A BoM Builder Tool allows Engineering to easily and quickly populate new Engineering BoMs in their E&D Materials Planning and Routings in their E&D S&E data bases for both Quotes and Sold Projects.

Insertion of a child Drawing Part in the BoM for all first level component Parent Parts

Start date Priority alignment for Scheduling and Execution for E&D S&E through Materials Planning and Manufacturing S&E

"Real Time" E&D Capacity tested Promise Date updates a Materials Planning Workbench User Defined Drawing Status Field for all first level children with an open E&D Drawing WO:

- **Unreleased E&D Drawing WO(s)** *"DRAWING EXPECTED COMPLETION DATE"*
- **Drawing WO(s) received in their Completion Buffer** *"DRAWING COMPLETED XX/XX/XX"*

Right Tools - Intuiflow™ Packet Builder – Aligns MTO Child/Parent WO Due Dates

- The packet builder makes the BoM connections between parent and child work orders by stepping down the BoM and building a network of the dependent connections to synchronize child WO schedules to arrive together for the parent WO start date.
- Stocked parts are independently planned and excluded in a packet build.
- *The packet is scheduled to the request date of the top-level packet parent then the packet children are scheduled to meet the parent requirement dates.*
- The entire packet will move forward or backwards to the earliest available start date for the long lead time child WO in the Packet.
- The highest priority of any WO in the packet, sets the schedule priority for all the packet child WOs.

Order Number	Part	Part Description	Location
1001	18712476-001-demo-1	INJ HR6120 304050 REDHAWK UNIT	FTW1ENG

Routing & Operations | History | Routings | **Packet Relationships**

Packet Relationships

Advanced

Order Number	Part	Revision	Routing	Order Quantity	Earliest Start Date	Planned Release Date	End Request Date	Promise Date
1001	18712476-001-demo-1		Standard	1.00		09/05/2025	8/26/2025	10/24/2025
1024	18137713-001-demo-1		Standard	1.00		07/24/2025	7/8/2025	09/05/2025
1014	18198290-001-demo-1-ERN		Standard	1.00		07/15/2025	7/8/2025	09/05/2025
1033	18198049-001-demo-1		Standard	1.00		07/10/2025	6/6/2025	07/15/2025
1007	18124232-001-demo-1-ERN		Standard	1.00		10/09/2024	6/11/2025	07/10/2025
1018	18182699-001-demo-1-ERN		Standard	1.00		06/02/2025	7/8/2025	07/08/2025
1027	18743601-001-demo-1-ERN		Standard	1.00		06/11/2025	7/8/2025	07/08/2025

Packet aligns to Long Leg

WO 1007 to be released 10/9/24 with due date 7/10/25

Parent WO 1033 to be released 7/10/25 with due date 7/15/25

Parent WO 1014 to be released 7/15/25 with due date 9/5/25

Packet parent WO 1001 to be released 9/5/25 with due date 10/24/25

Right Tools - Intuiflow™ *Packet Builder* – Aligns MTO Child/Parent WO Due Dates

Order Number	Part	Part Description	Location
1001	18712476-001-demo-1	INJ HR6120 304050 REDHAWK UNIT	FTW1ENG

Routing & Operations | History | Routings | **Packet Relationships**

Packet Relationships

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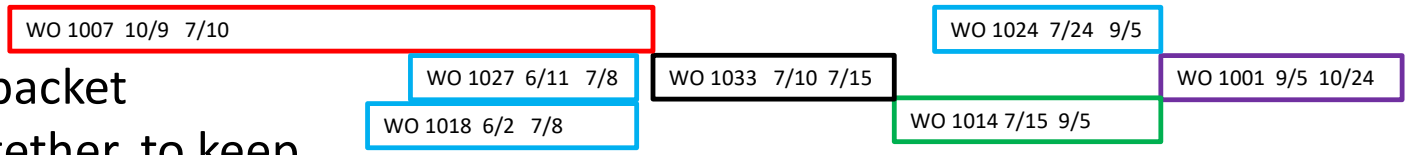
1014	18198290-001-demo-1-ERN		Standard	1.00		07/15/2025	7/8/2025	09/05/2025
1033	18198049-001-demo-1		Standard	1.00		07/10/2025	6/6/2025	07/15/2025
1007	18124232-001-demo-1-ERN		Standard	1.00		10/09/2024	6/11/2025	07/10/2025
1018	18182699-001-demo-1-ERN		Standard	1.00		06/02/2025	7/8/2025	07/08/2025
1027	18743601-001-demo-1-ERN		Standard	1.00		06/11/2025	7/8/2025	07/08/2025



IntuiFlow S&E moves the packet forward and backward together, to keep Capacity Tested schedule alignment for minimum WIP and maximum velocity.

BoM Packet Connections and Priority Status Scheduling Keep Dates Aligned

Engineering Drum Routing Step

Engineering Routing Step

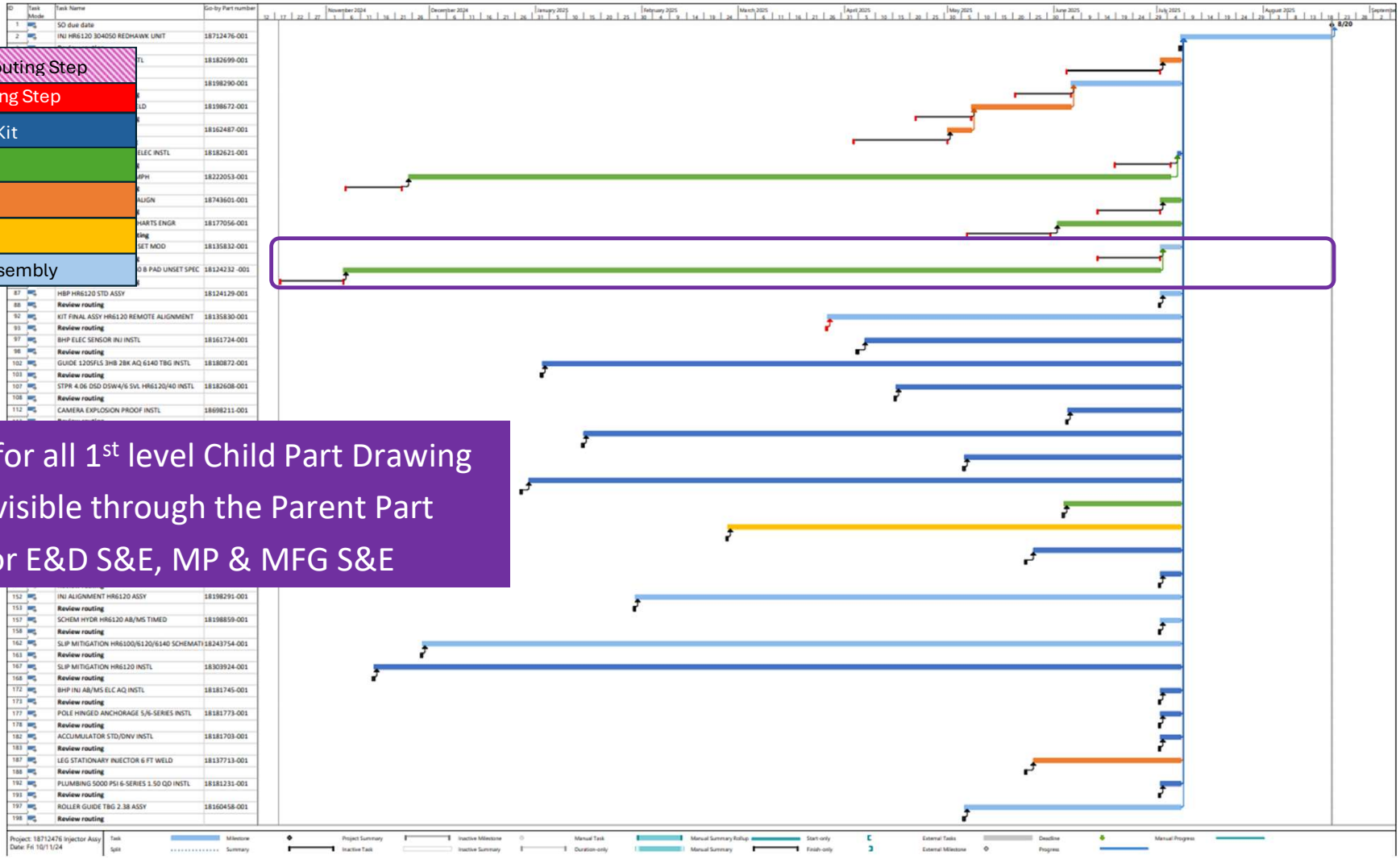
Installation Kit

Purchased

Purchased

Machining

Assembly/Subassembly



The Longest leg for all 1st level Child Part Drawing WO(s) is clearly visible through the Parent Part packet builder for E&D S&E, MP & MFG S&E

Engineering Drum Routing Step

Engineering Routing Step

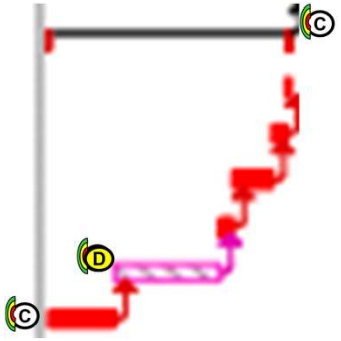
Installation Kit

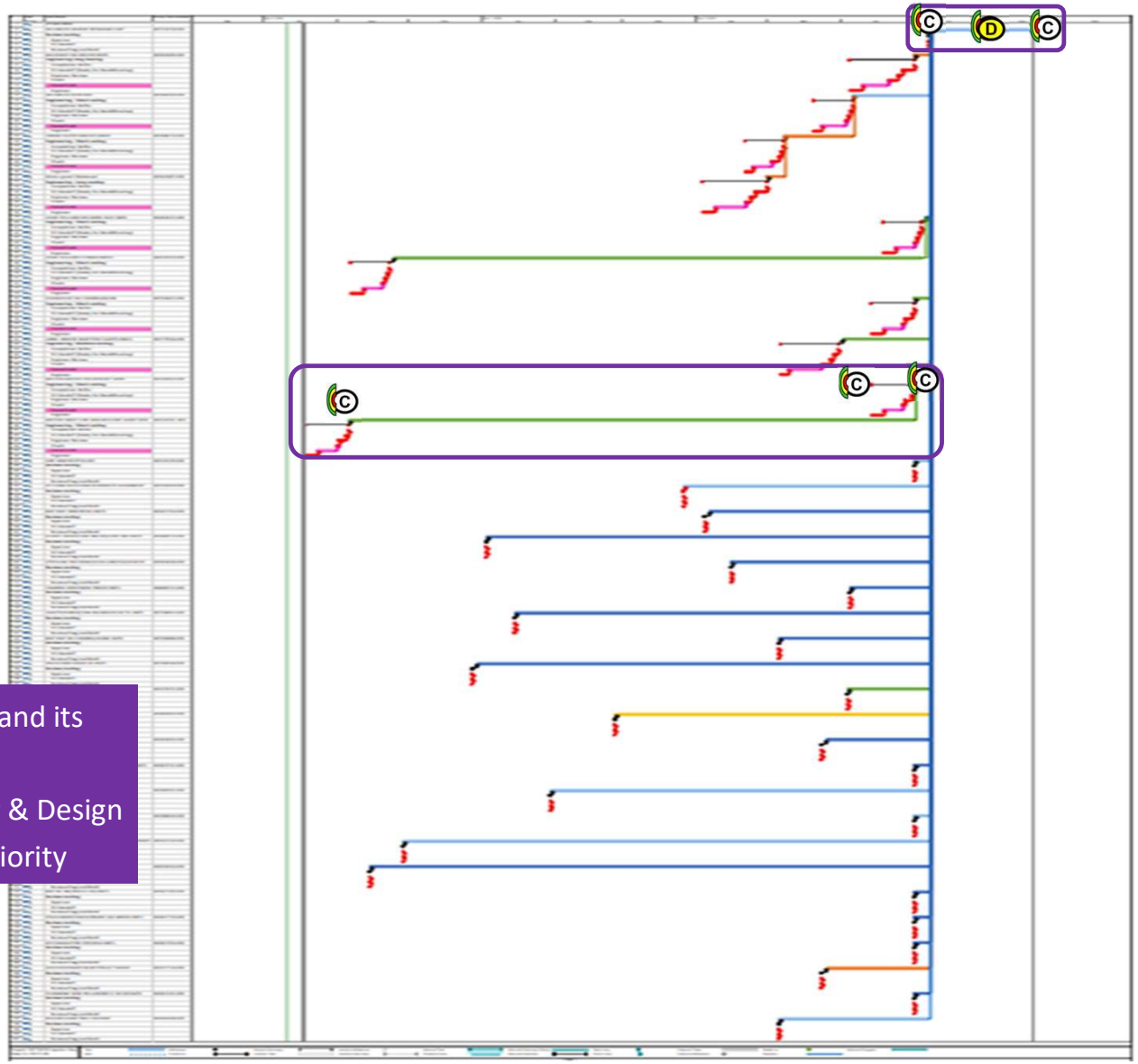
Purchased

Purchased

Machining

Assembly/Subassembly



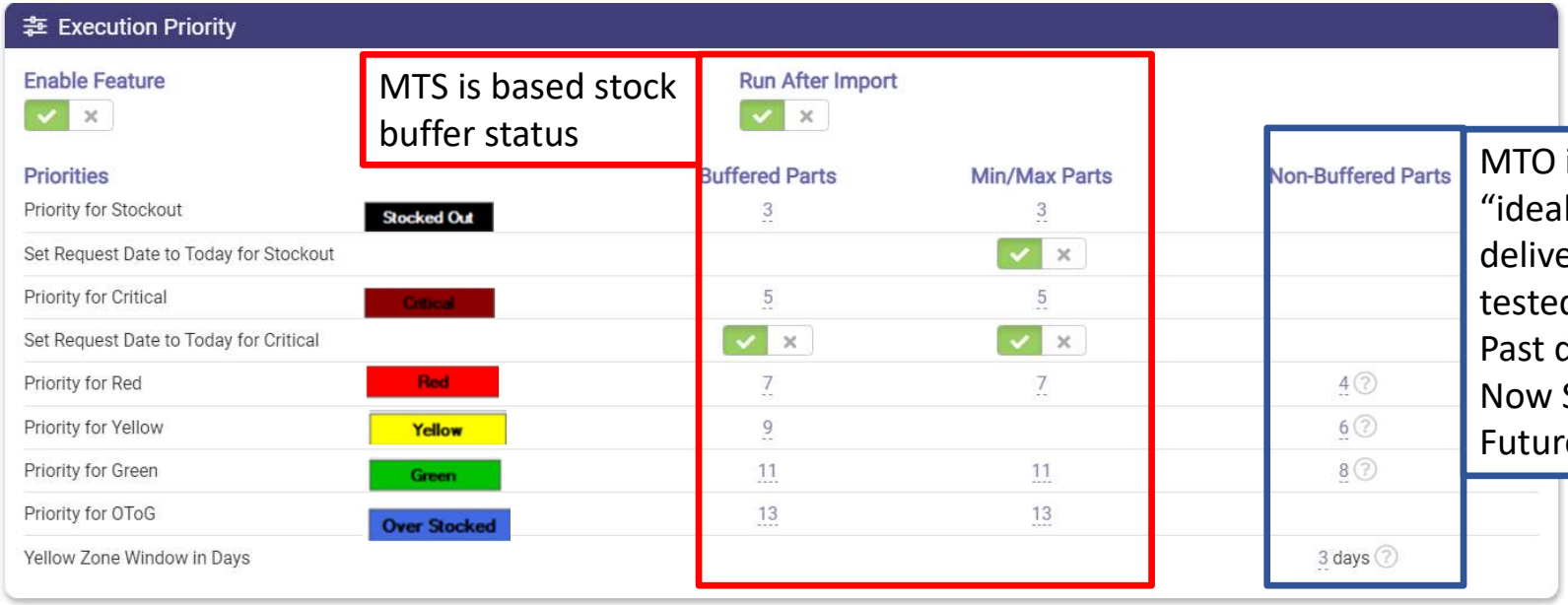


Blow down view to the Engineering Routing and its Drum for each Drawing WO of the Project.
Staggering by date needed from Engineering & Design Resources gives a true picture of load and priority

Right Tools - Intuiflow™ S&E Uses Material Planning MTO & MTS Priority Settings

Start Date priority is aligned to the due date handoff in the BoM relationship to end on time.

- **Replenished parts (MTS)** are assigned odd numbered priorities ranging from 3 to 13.
- **Non-buffered parts (MTO)** are assigned even numbered priorities ranging from 4 to 10.
- Priority levels of 2 (override high priority) reserved for assignment by Master Scheduler.
- Priority 1 is reserved for an executive decision.



MTS is based stock buffer status

MTO is based on an "ideal start date" to deliver to the capacity tested Promise Date – Past due Starts date 4 Now Start date 6 Future Start date 8

Right Tools - Intuiflow™ All WO(s) Scheduled by Priority (Buffer status/due date)

DBR+ Scheduler

Schedule View

Drum Schedules are loaded by IF MP due date for MTO and buffer penetration for MTS.

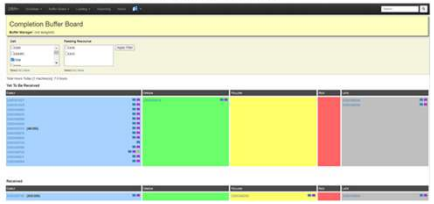
Work Order: Clear Constraint:

Work Order	Packet Parent	Packet	Sales Order	Order Date	Part Number	U/M	Description	Routing	Family	Customer	Work Order Quantity	Status	Expedite	Priority	Drum	Planned Release Date
8444613			9214738	3/2/2020 1...	1495512	EA	COOLSTAR-19-ARIA,BRN	1495512-8444613-00-...	MODEL	GREAT SO...	10	Unreleased	None	3	512-21	7/8/2020 1...
8444613-2			9214738	3/2/2020 1...	1495512	EA	COOLSTAR-19-ARIA,BRN	1495512-8444613-00-...	MODEL	GREAT SO...	10	Unreleased	None	3	512-21	7/10/2020 ...
8444613-3			9214738	3/2/2020 1...	1495512	EA	COOLSTAR-19-ARIA,BRN	1495512-8444613-00-...	MODEL	GREAT SO...	10	Unreleased	None	3	512-21	7/13/2020 ...
8444613-4			9214738	3/2/2020 1...	1495512	EA	COOLSTAR-19-ARIA,BRN	1495512-8444613-00-...	MODEL	GREAT SO...	10	Unreleased	None	3	512-21	7/14/2020 ...
8444613-5			9214738	3/2/2020 1...	1495512	EA	COOLSTAR-19-ARIA,BRN	1495512-8444613-00-...	MODEL	GREAT SO...	10	Unreleased	None	7	512-21	7/15/2020 ...
8444613-6			9214738	3/2/2020 1...	1495512	EA	COOLSTAR-19-ARIA,BRN	1495512-8444613-00-...	MODEL	GREAT SO...	10	Unreleased	None	11	512-21	7/20/2020 ...

Finite Drum Capacity Derives and Synchronizes All Resource Schedules

Real time System Wide Load & Status

Real Time Status Buffer Boards



We schedule our Resources as if they have infinite capacity NOT on critical resource capacity.

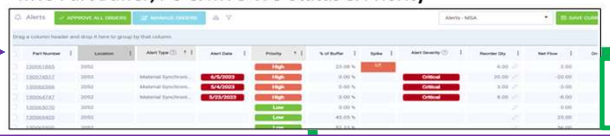
Schedule synchronization, finite capacity loading and protection of “System Critical Resources” deliver a reliable schedule.

Transparency to capacity and work order status, provide an early warning system to proactively make decision and act to speed System Flow.

IF “Ideal Start Dates” & Materials Are Synchronized To Project Due Dates Through The IF System Drums

Demand Driven MRP Materials Management Executive Dashboard

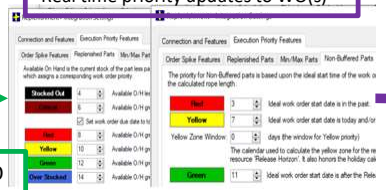
MTS Part Buffer, PO & MTO WO Status & Priority



Synchronized WO Priority & Status

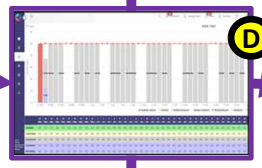
DRUM BUFFER ROPE - Synchronized Operations Scheduling and Execution

Real time priority updates to WO(s)



Real Time Drum WO Status Updates

Finite Drum Capacity Derives and Synchronizes All Resource Schedules to OTP



Real Time Capacity Buffer Status

Real time System Load & Status

Engineering Tasks to BoM hand off Promise Dates are Synchronized to Material & Make Part Need Dates

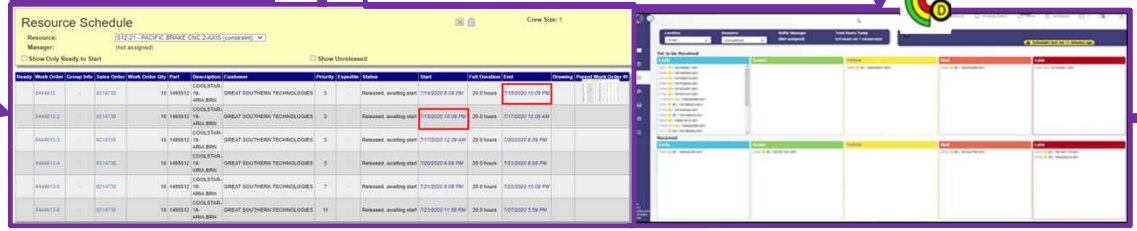
Finite Drum Capacity Derives and Synchronizes All Resource Schedules to Project Request Date

Real Time Task Status Updates for All Resources

Real Time Engineering Load & Status Updates

Execution Real Time WO Status

Real Time WO Execution Status at all Control Point Buffer Boards



All Resources WO Schedules are synchronized to arrive on time to their Parent Part “Start Date” at all Control Points (CPs)

Time Buffers Protect CP & Drums “Start Dates” With Early Warning Visibility to Work in Trouble in Engineering and Operations

Time Buffers Protect the Critical Resource “Start Dates” and Early Warning Visibility to Task in Trouble

Time Buffers Protect the “Start Dates” and Early Warning Visibility to WO(s) in Trouble

Executive Dashboard For All Project & WO/SO Control Point Buffer Status

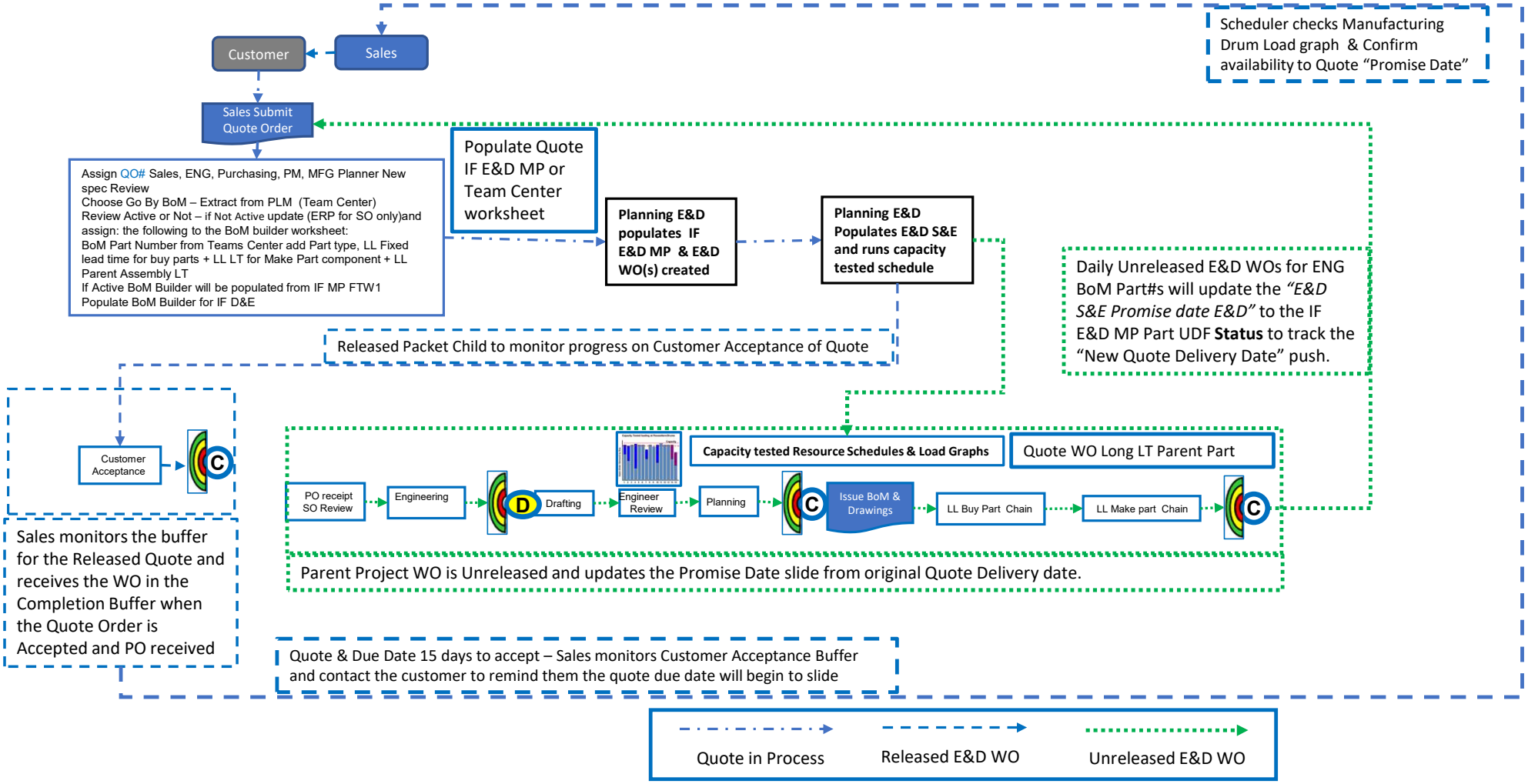
DDOM Solution Set

We have an effective mechanism for planning, to prioritize & synchronize all project tasks, PO(s) & WO(s)

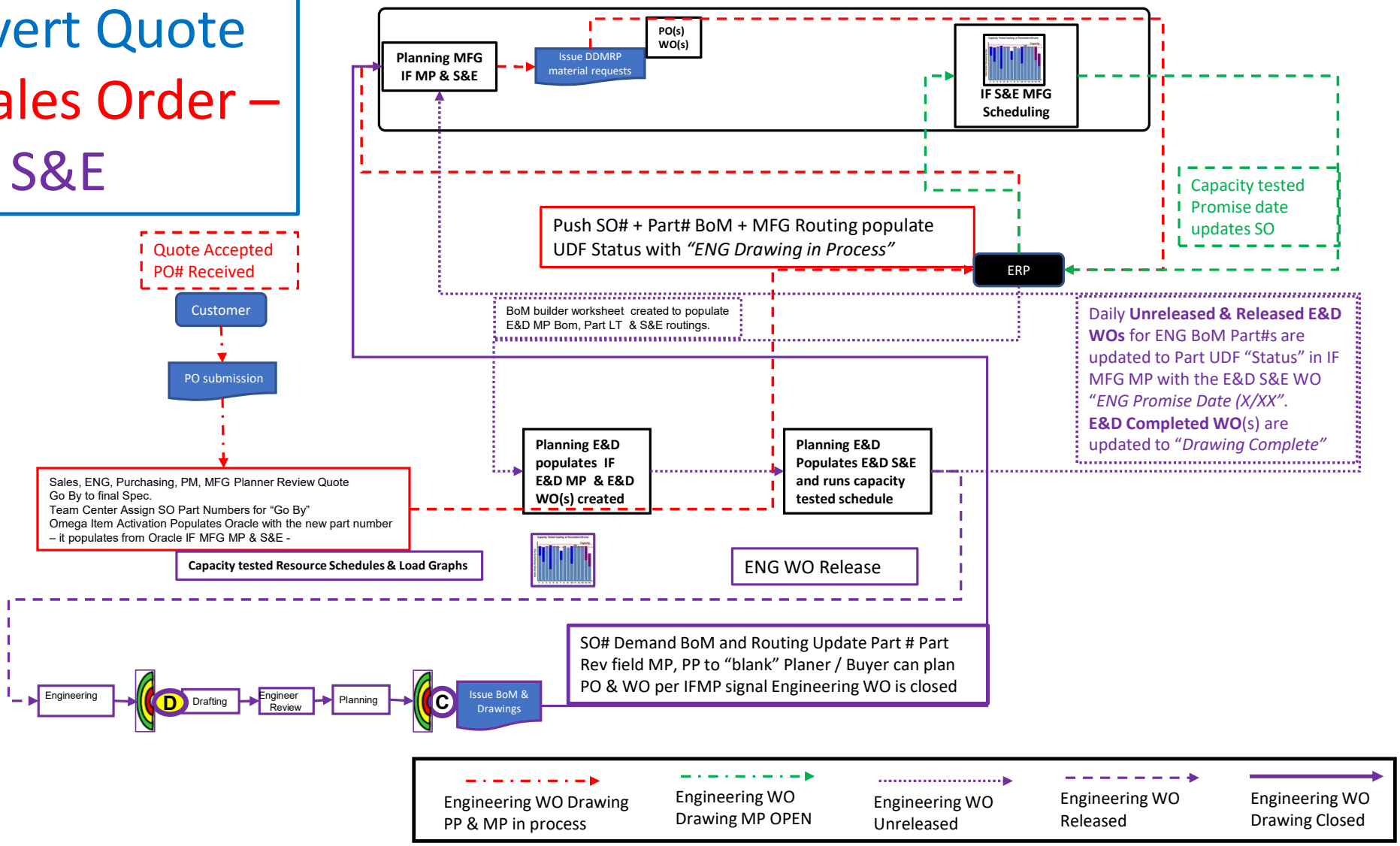
We schedule all our Resources on the finite capacity of our critical resources in Eng & Mfg to start as late as possible

We have real time visibility to the status of all Project tasks, PO(s) and WO(s).

Capacity Tested Due Dates For Quotes



Convert Quote To Sales Order – ENG S&E



Questions?

- Special Thank you to Koch KES and Hydra Rig Teams who made the Project Management breakthrough a reality.
- KES Tulsa hosted and shared results with NOV, 15 months ago.
- NOV launched 2 pilots Hydra Rig and Texas Oil Tool May 2024.
- Hydra Rig NOV has graciously agreed to host KES and demonstrate their ETO DDOM in Q1 2025.

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