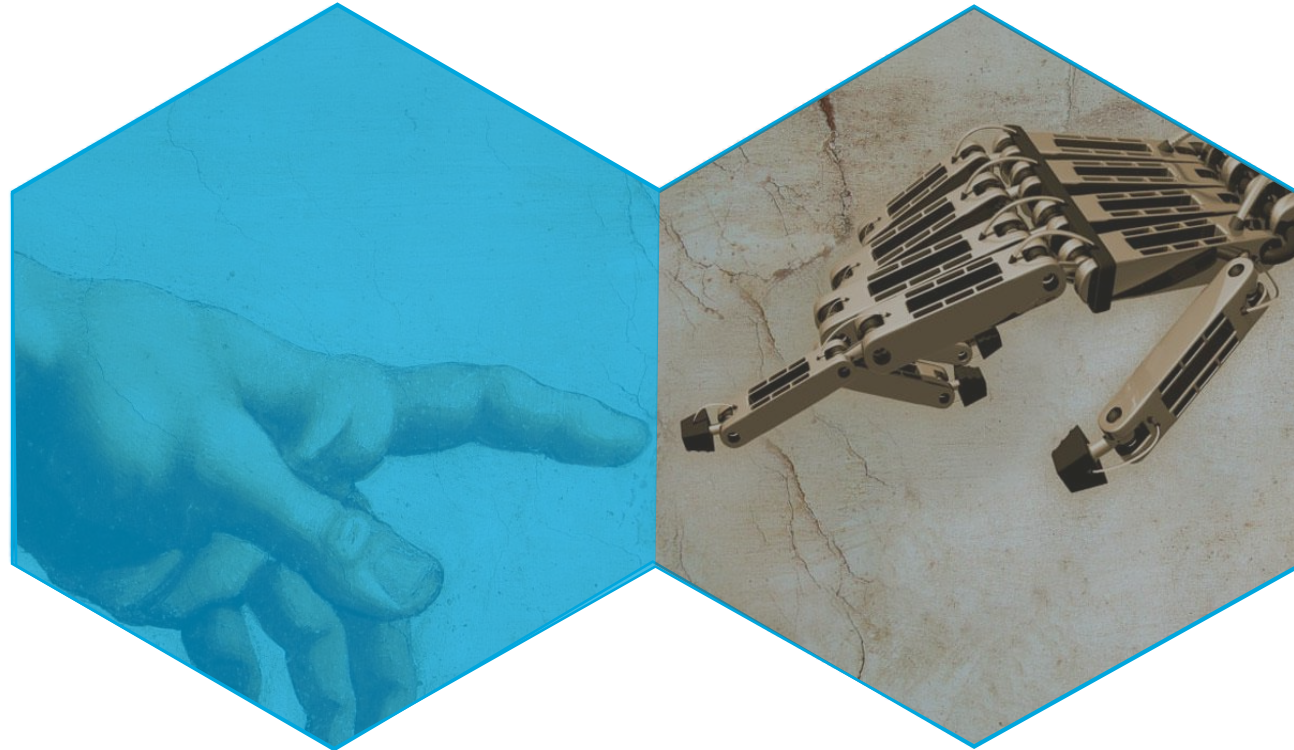


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YEARS AHEAD



IA > AI: How can we make No-Touch work?



Menno Bruggeling

What do you already know about AI & Machine Learning?

I've seen movies!



I am familiar with the concepts



I got this!

Data scientists are the new rock stars of IT



*"Of course, I don't
even get out of bed for
less than a petabyte"*

What AI techniques could help us out in Supply Chain Planning?

Examples within supply chain planning

Optimization
techniques

Clustering &
Classification

Cutting edge

Deep Learning
'AlphaGo'

Science fiction?

General Intelligence
'The singularity'

Discussion: is it likely that in the foreseeable future, these technologies will take over planning roles?

Production
scheduler

Demand planner

Supply planner

S&OP

Multi-echelon inventory optimization: Clustering and Genetic Algorithms



Optimize safety stock parameters to reach the best service level at customer against lowest network cost

PARAMETER CONFIGURATION

Safety stock parameters per:

- Stock point
- Group of products

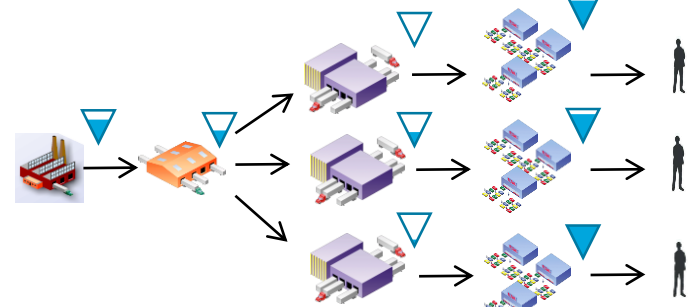


- Encode as genes
- Best features survive!
- Random mutations

TEST

LEARN

FITNESS EVALUATION: SUPPLY CHAIN SIMULATION



Suppliers Manufacturing DC / Distributor Retailers Consumers/Market

OBJECTIVE

- Service level target
- Lowest network stock costs



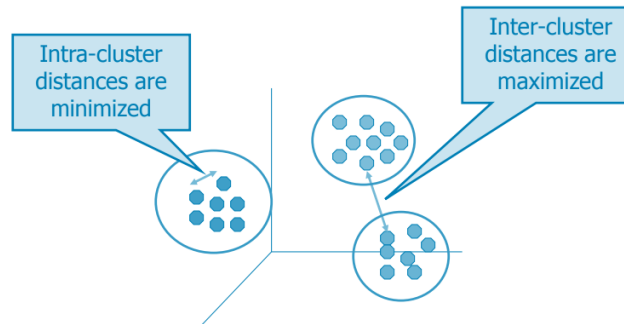
Clustering product groups

Setting safety stock per **individual** SKU is:

- Computationally not **feasible**
- Very difficult to **maintain**
- Need to cluster products into **groups**
- **Clustering** is used to decide which products get the same safety stock setting based on **similarity in features**:
 - Demand variability
 - Mean demand
 - Lead times
 - ...



Clustering: visualization



- Application in planning

- Reduce unneeded safety stock
- Figure out the right balance between local stock and central stock



Games are the cutting edge of AI innovation, and even there it is step by step!

Chess

1997



- Playing tactically, infeasible to compute all paths

Atari

2015



- Realtime
- Computer vision

Go

2016



- Computationally less feasible compared to chess
- 'Holy grail' of AI

Starcraft

2019



- Decision making
- Planning ahead
- Imperfect information
- Trade-offs

Hanabi

-



- Cooperation
- Imperfect information
- Interpretation of intentions

Disruption around the corner? Deep Learning is advancing step by step!

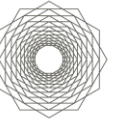
DeepMind advancements use reinforcement learning; the only predefined input is a *reward function*



"They would be lucky enough to click back on their base, but their next action would be: select all the workers and send them away somewhere."

"It's almost painful to see. From here they really need to start getting some signal, some reward. Hopefully they get lucky sometimes and they do something that is good, and - only then - they can start learning. StarCraft has such an exponential action space that it is quite hard to get off the ground, "

Lead Developer Starcraft II at DeepMind



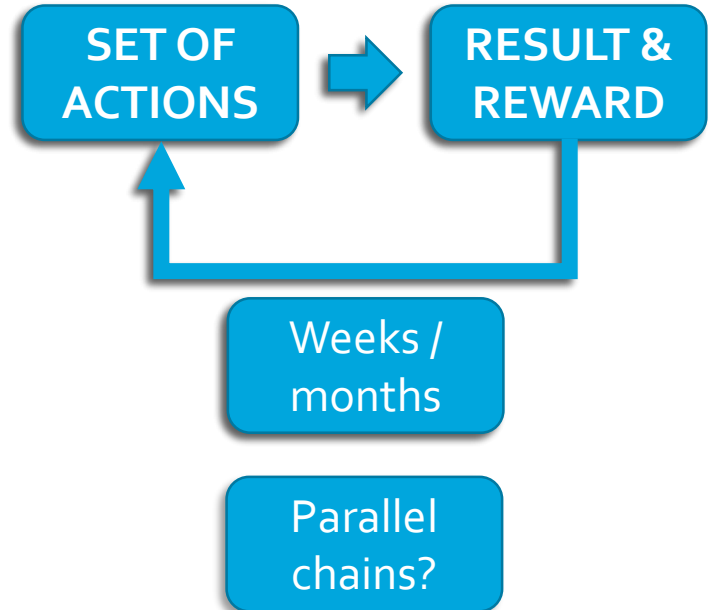
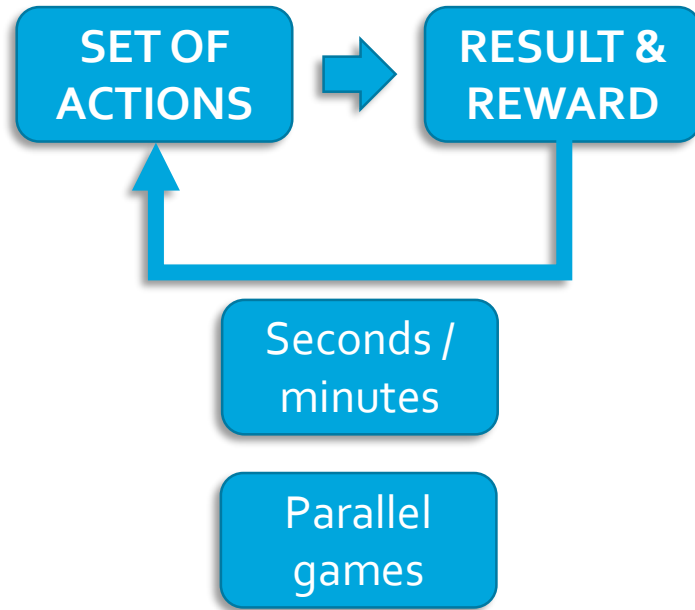
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DeepMind “AlphaStar” defeats Starcraft e-sports pro’s



"The AlphaStar league was run for 14 days, using 16 TPUs for each agent. During training, each agent experienced up to 200 years of real-time StarCraft play."

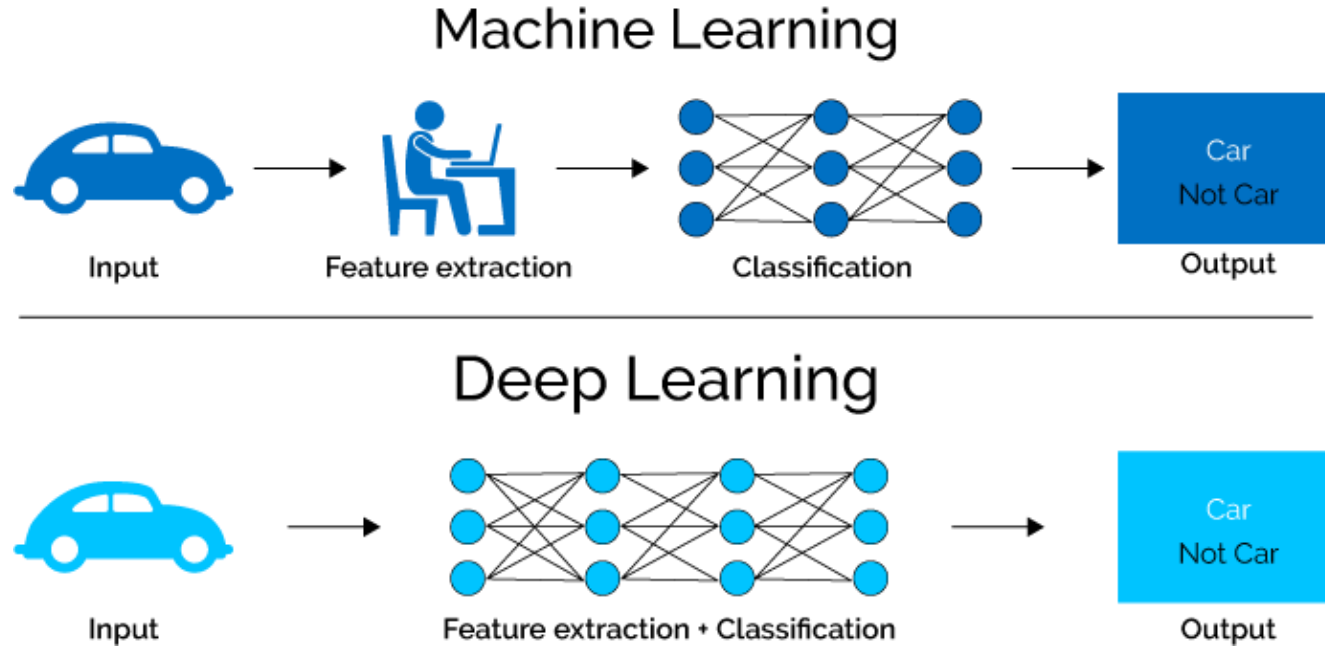
Learning rate in the real world planning domain is low for long chains!



Deep learning relies on an amount of repetitions that is hard to achieve for problems 'in the real world'

You think APS is a black box? Deep learning systems are even worse!

One does not simply *ask* a deep learning system to explain itself



Trust: issue in real-life application

- Already for current APS systems **trust** is an issue
- In deep learning the feature extraction step is an **unspecified** part of the neural net
- The outlook for **understandability** is not great when applied to **real-world problems**

Is an arm a feature of a dumbbell?



How can AI help us achieve no-touch supply chains?

So can advancements in these techniques....

Optimization
techniques

Neural nets

Deep Learning

General
Intelligence

...wholly or partly replace various roles in the field of supply chain planning?

Production
scheduler

Demand planner

Supply planner

S&OP

Learning 1: so far, we can apply AI only to specifically defined problems, with specific data and learning opportunities, designed by human experts

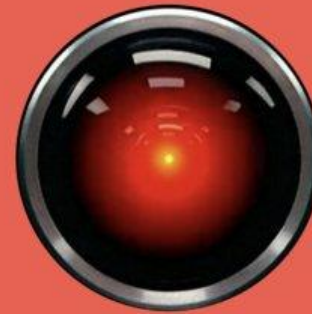
Narrow AI

PERFORMS TASKS THAT NORMALLY REQUIRE HUMAN INTELLIGENCE, BUT CAN ONLY PERFORM TASKS IN A VERY SPECIFIC AND NARROWLY DEFINED DOMAIN.



General AI

"HUMAN-LEVEL AI".
HAS A GENERAL PROBLEM SOLVING ABILITY THAT
ENABLES IT TO LEARN NEW TASKS ACROSS SEVERAL
DOMAINS.



"No-touch S&OP" as a generic challenge for AI to achieve is unrealistic. We need to think about specific tasks we want intelligent techniques to solve!

Learning 2: The most advanced techniques could be out of reach for the problems facing us in supply chain, but we can already reach concrete results with simpler techniques



Regression,
Lasso

XG Boost

Genetic
Algorithms

Neural nets

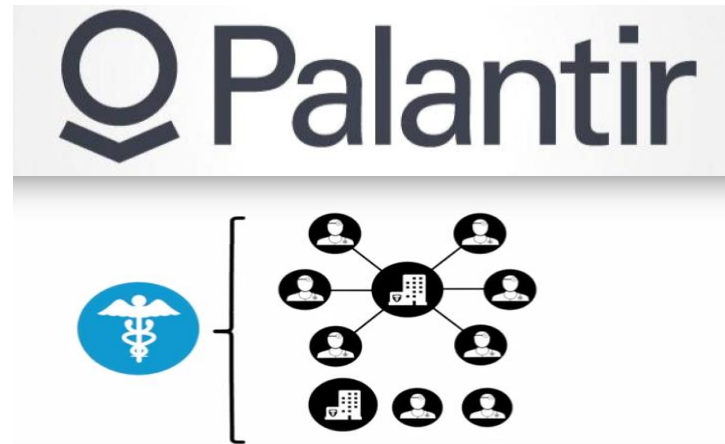
Deep
Learning

Learning data is typically labeled beforehand at large quantities, or generated in a 'simulation' with a reward function. Typically: the more advanced the technique, the more it needs.

*Do we have this data for our supply chain problems?
Can we train deep learning AI from real life or simulations?*



Learning 3: IA > AI: Intelligence Amplification has already demonstrated to bring more value than pure automation



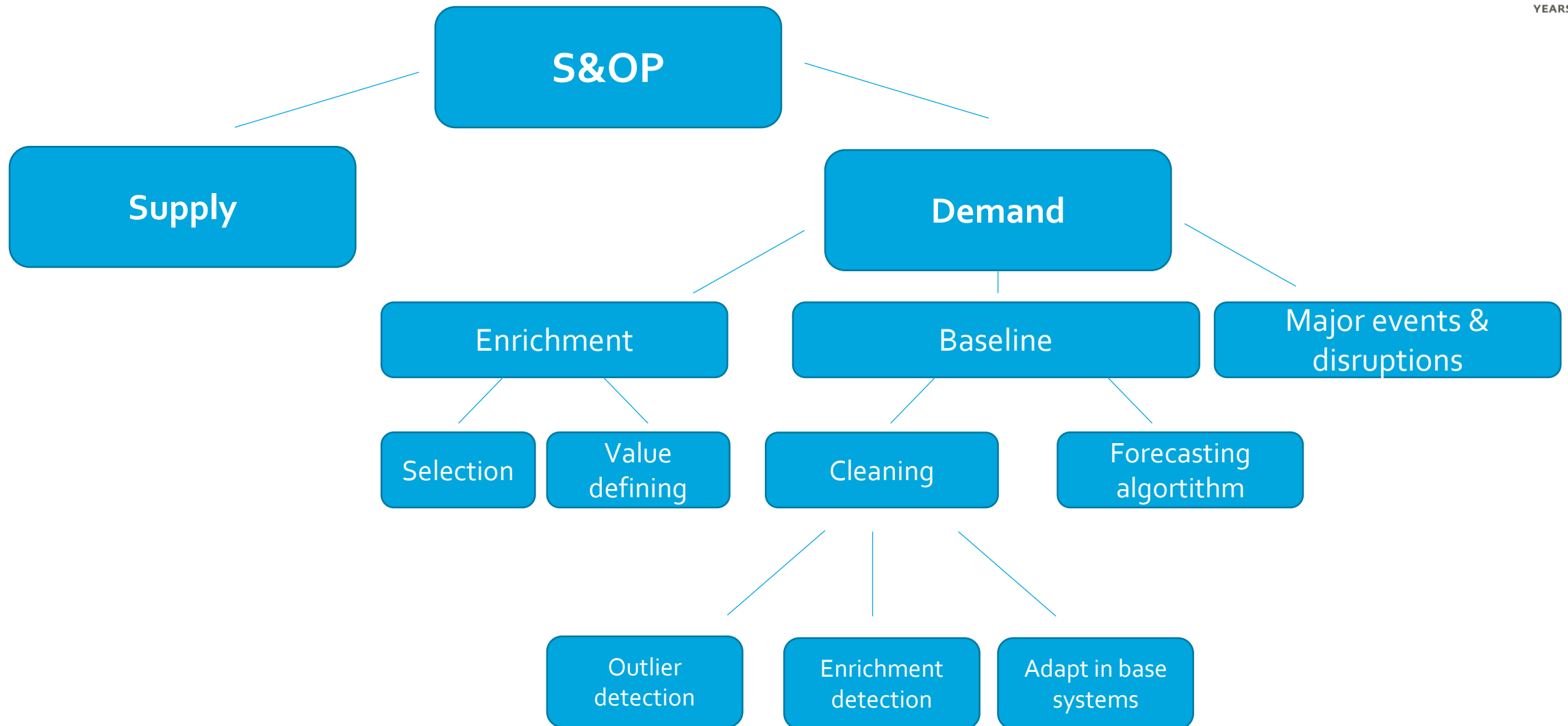
Amateurs win at freestyle chess:
"Weak human + weak machine + **better process is better** than strong human + strong machine + **inferior process.**"
Gary Kasparov

"**Integrate, enrich**, model, and analyze any kind of quantitative data"
"Fostering **human-computer symbiosis**"
Palantir Tech, hot startup in Silicon Valley

"**Together, Alexa and the planner** devise a test and learn **scenario** to better **understand** customer behavior and change assortment to maximize opportunities" – Lora Cecere

The analytical role of the planner can evolve towards a 'coach' or 'orchestrator' of the automation. But how can we make the computers 'play nice' with human decision makers?

General vs specific problems: let's zoom in!



History cleaning: what are typical issues in distinguishing signal from noise?

Consumer products

Was I running a promo?

Was my competitor running a promo?

Was my seasonality influenced by the weather?

What was the cause of my historical peak or dip?

Does my competitor have supply issues?

Was I suffering from stock-out or capacity issues?

Process Industries

I see a recent trend, is this lasting or temporary?

I see a recent trend, is this lasting or temporary?

Did my competitor adjust pricing?

Were my actuals affected by base commodity prices?

Were customers gaming with their order pattern to reduce inventories or gaming with prices?

Questions to the group

- Who records their unconstrained demand?
- Who records situational factors around their actuals?
- Who records information about competitor development?
- Who can feedback this type of information into their planning system?
- How can we go about making that happen?



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