



Sales Forecasting and Stock optimisation

AI Monday Leipzig

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Lead Data Scientist



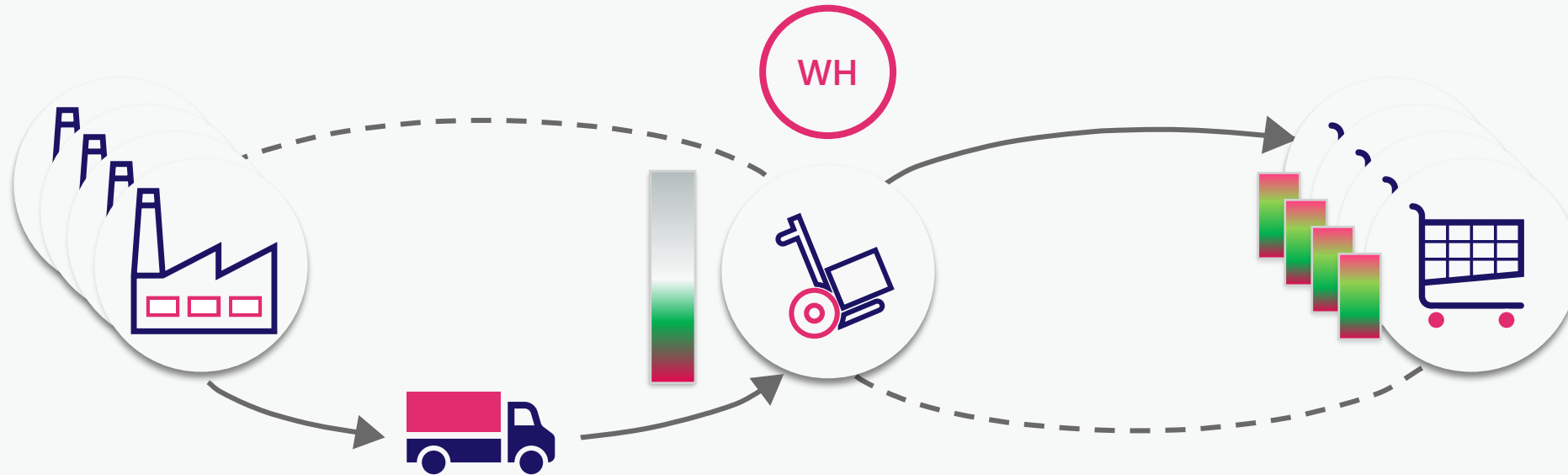
Agenda



1. Introduction
2. Ordering procedure
3. How can AI help Bob?
4. How does this work and why does it work?
5. Does it work for me?
6. Benefits?
7. Conclusion

Introduction

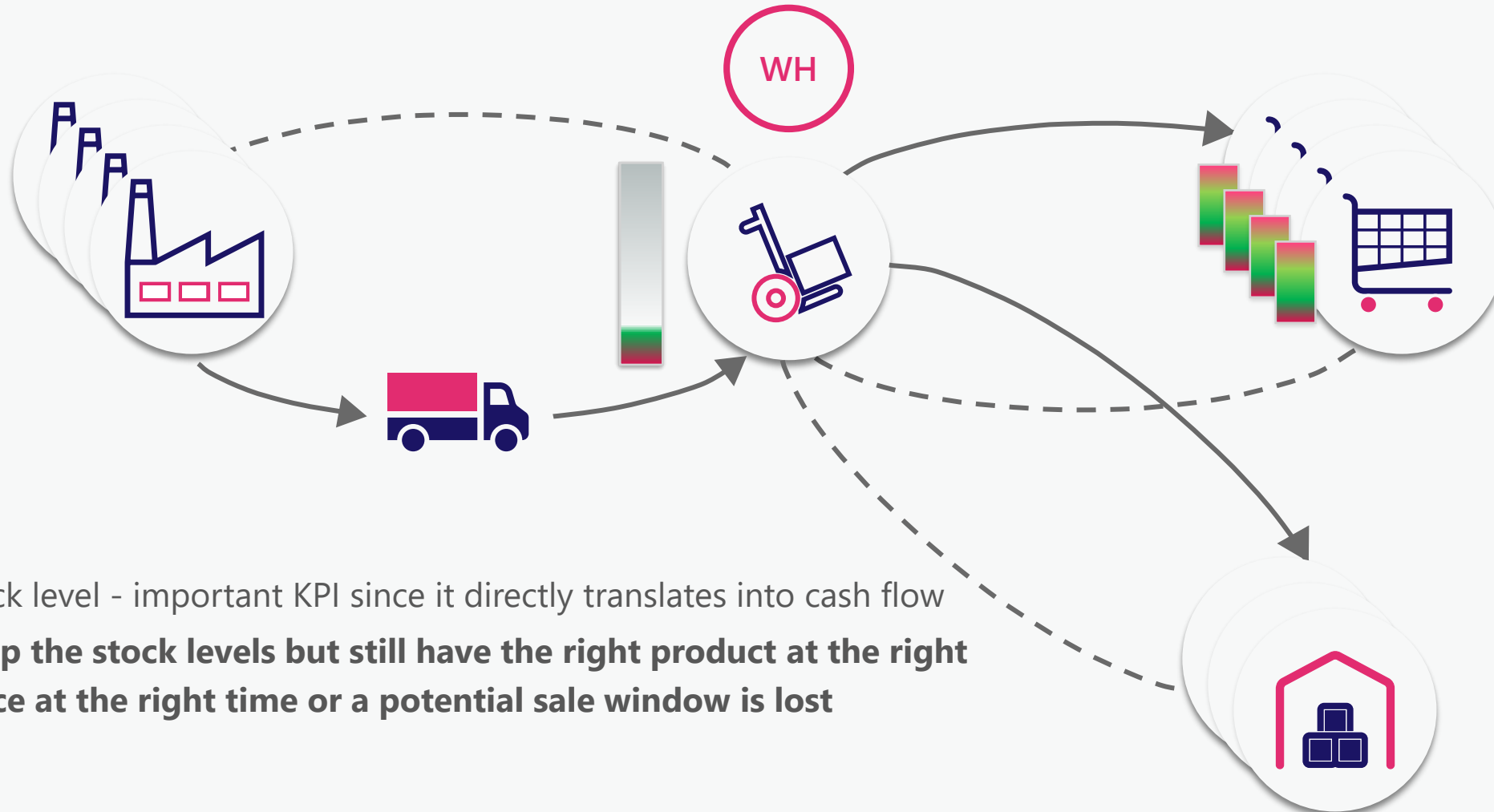
Challenge



- Stock level - important KPI since it directly translates into cash flow

Introduction

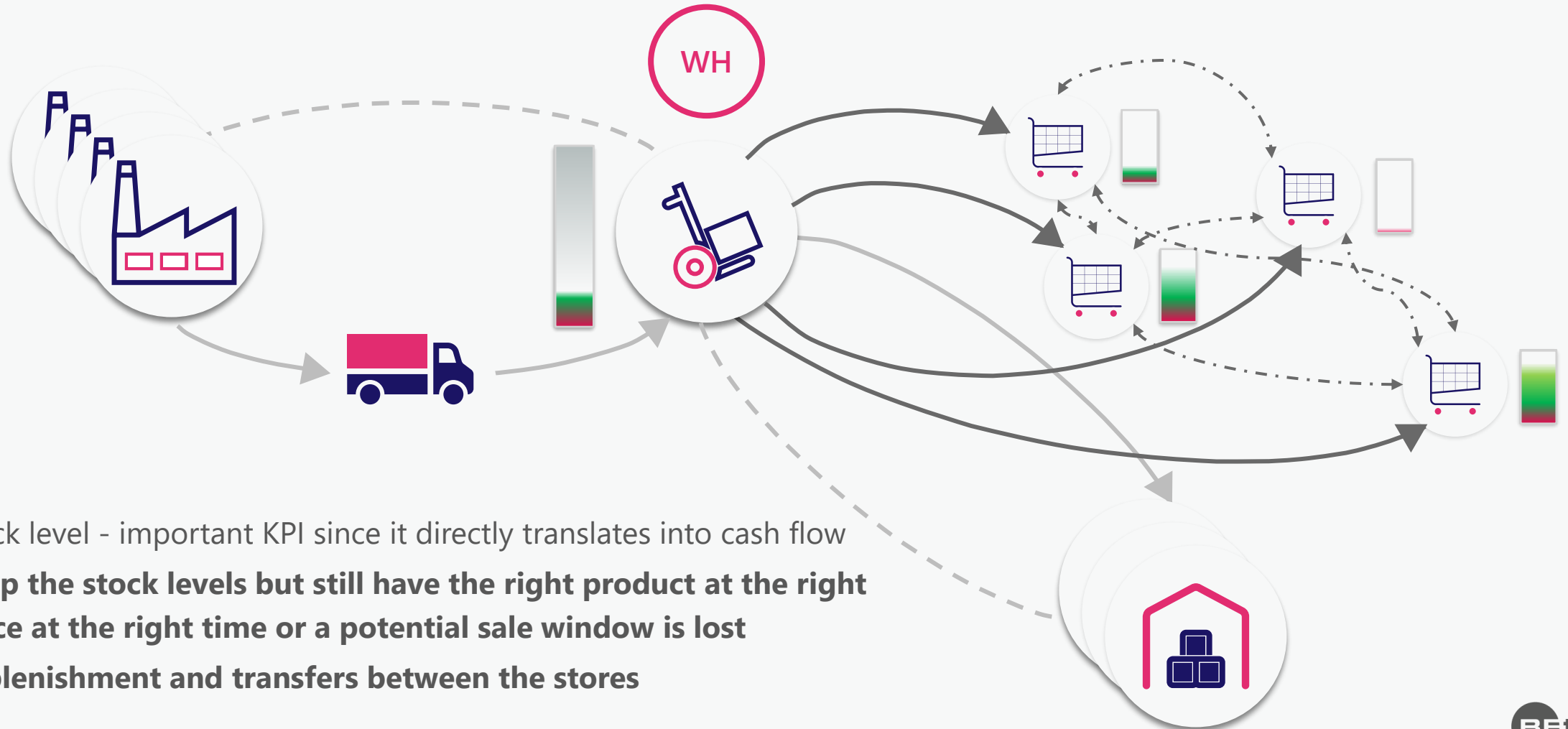
Challenge



- Stock level - important KPI since it directly translates into cash flow
- **Keep the stock levels but still have the right product at the right place at the right time or a potential sale window is lost**

Introduction

Challenge



- Stock level - important KPI since it directly translates into cash flow
- **Keep the stock levels but still have the right product at the right place at the right time or a potential sale window is lost**
- **Replenishment and transfers between the stores**

Ordering procedure

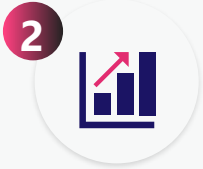
Warehouse - filling orders for ~600 items

For each item:



1

Analyse current stock



2

Analyse sales (weekly, monthly, seasonally)



3

Evaluate the date of the next purchase order



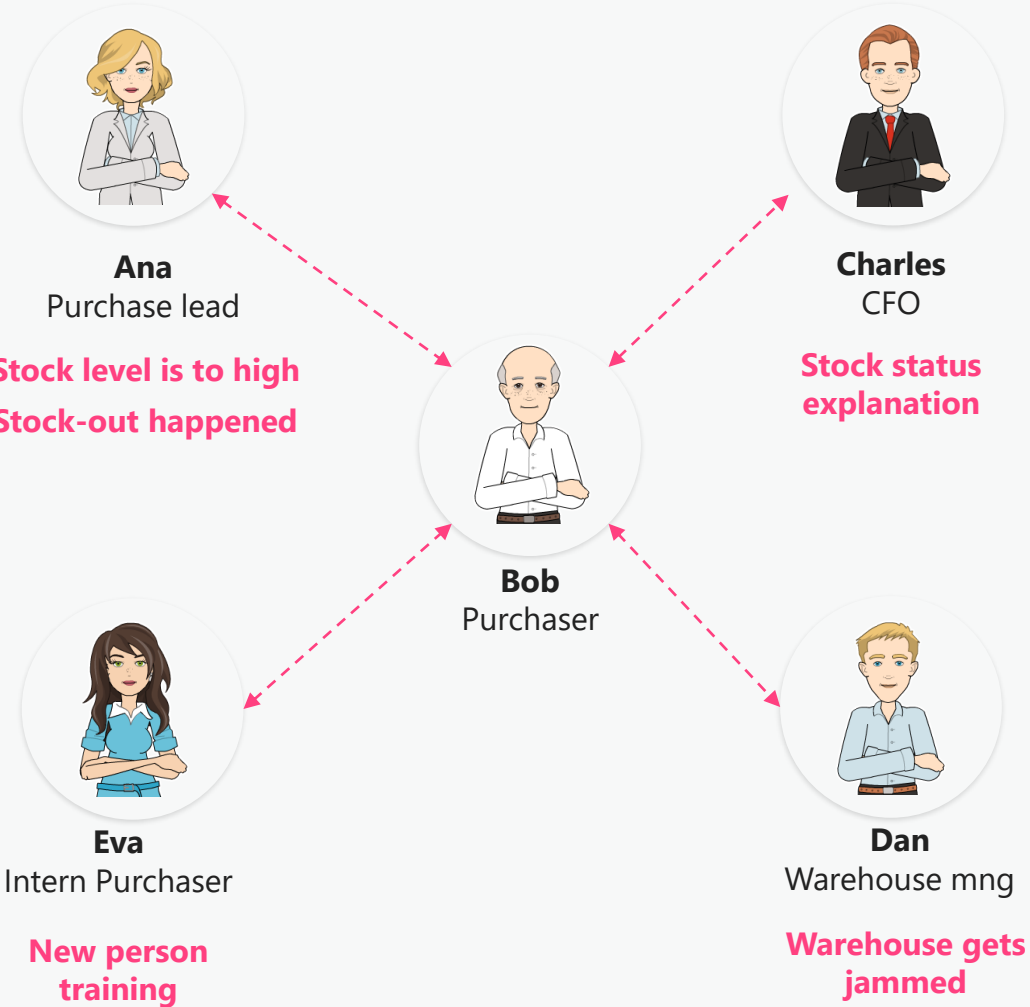
4

Set order quantity



5







Input order into the purchase form

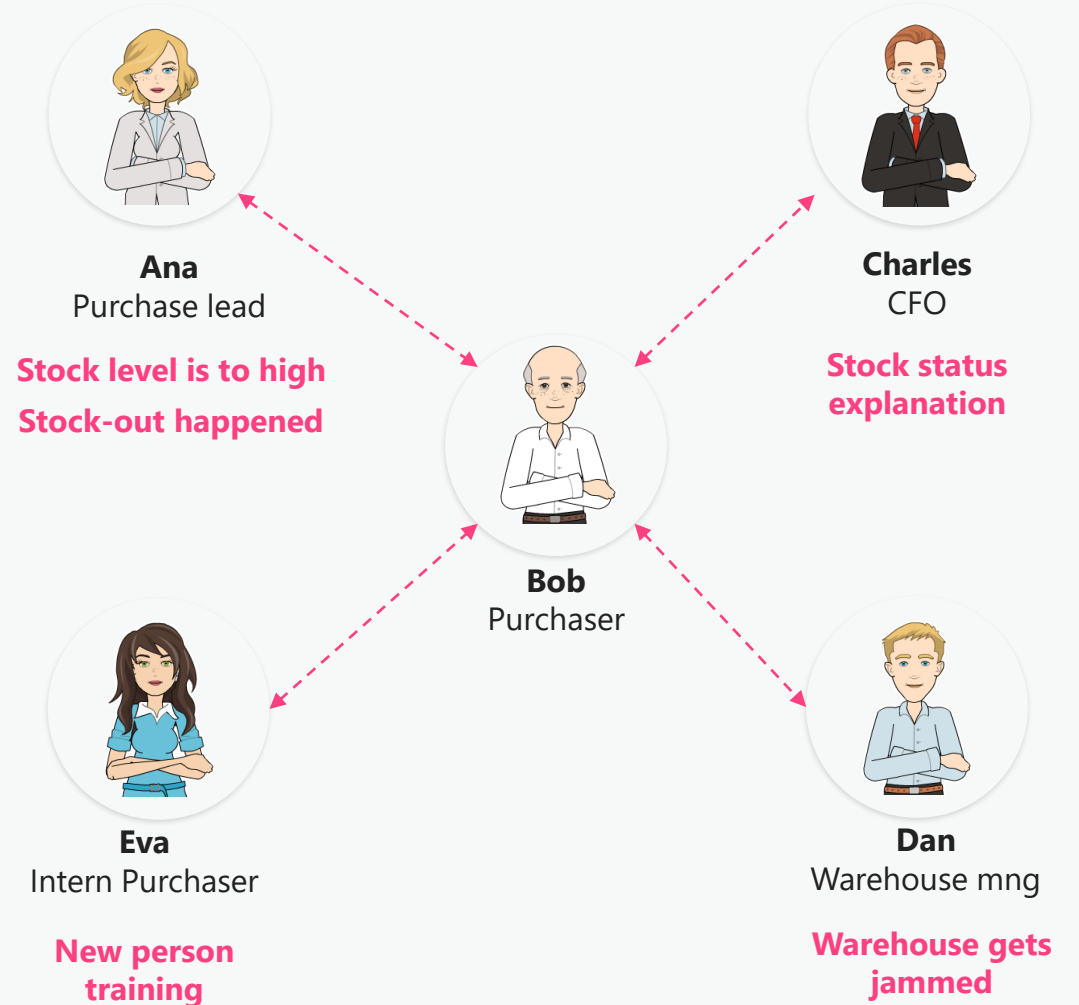


Ordering procedure

Retail store - filling orders for ~1 store (1k+ items)

For each item:

-  Analyse current stock
-  Analyse sales (weekly, monthly, seasonally)
-  Evaluate the date of the next purchase order
-  Set order quantity
 **Check availability in the warehouse**
Check for potential transfer
-  Input order into the purchase form



How can AI help Bob?

Stock optimisation with AI

- **Employ technology to crunch the data and return recommendations**
- The steps Bob takes for generating a single order can be encoded into an algorithm
- Connect warehouse orders with retail store orders and introduce possibility of transfers

INPUT

CRM



ERP



BI



WEB

MOBILE



3rd PARTY
DATA



STOCK MONITOR

Detect & Quantify

- Alerts
- Overstock
- Stockouts

Decide on procedure

- Warehouse order
- Retail store replenishment
- Transfer procedure

FORECAST & ORDER QUANTITY

Forecast sale per item

- Evaluate granularity
- ML model per type of item

Recommend order per procedure

- Evaluate forecast
- Quantify order
- Use constraints (item, vendor, ...)

CARGO & LOGISTICS

Cargo optimisation

- Use logistic constraints (truck, container, volume ...)

TRANSFER OPTIMISATION

Stock availability

- Use stock availability
- Use locations/route

OUTPUT

CRM



ERP



BI



WEB

MOBILE



How can AI help Bob?

Stock optimisation with AI

- Bob is presented with results – **Purchase order in ERP**



Bob
Purchaser

← Requisition Worksheets | Work Date: 1/27/2022 ✓ Saved

Name

Manage Process Report Drop Shipment Special Order Line Item Availability by More options

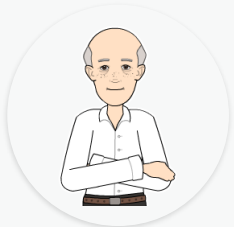
Type	No.	Accept Action Message	Description	Location Code	Quantity	Unit of Measure Code	Direct Unit Cost	Due Date	Replenishment System
→ Item	70074	<input checked="" type="checkbox"/>	Coca-Cola	GREEN	120	PCS	0.664	1/28/2022	Purchase
Item	70075	<input checked="" type="checkbox"/>	Apple juice	GREEN	80	PCS	0.232	1/28/2022	Purchase
Item	70076	<input checked="" type="checkbox"/>	Banana juice	GREEN	60	PCS	0.232	1/28/2022	Purchase
Item	70077	<input checked="" type="checkbox"/>	Black coffe	GREEN	1,400	PCS	0.15	11/2/2020	Purchase
Item	70078	<input checked="" type="checkbox"/>	Tea	GREEN	800	PCS	0.13	1/28/2022	Purchase

Description Buy-from Vendor Name

How can AI help Bob?

Stock optimisation with AI

- Bob is presented with results – **Purchase order in ERP + BI Application**



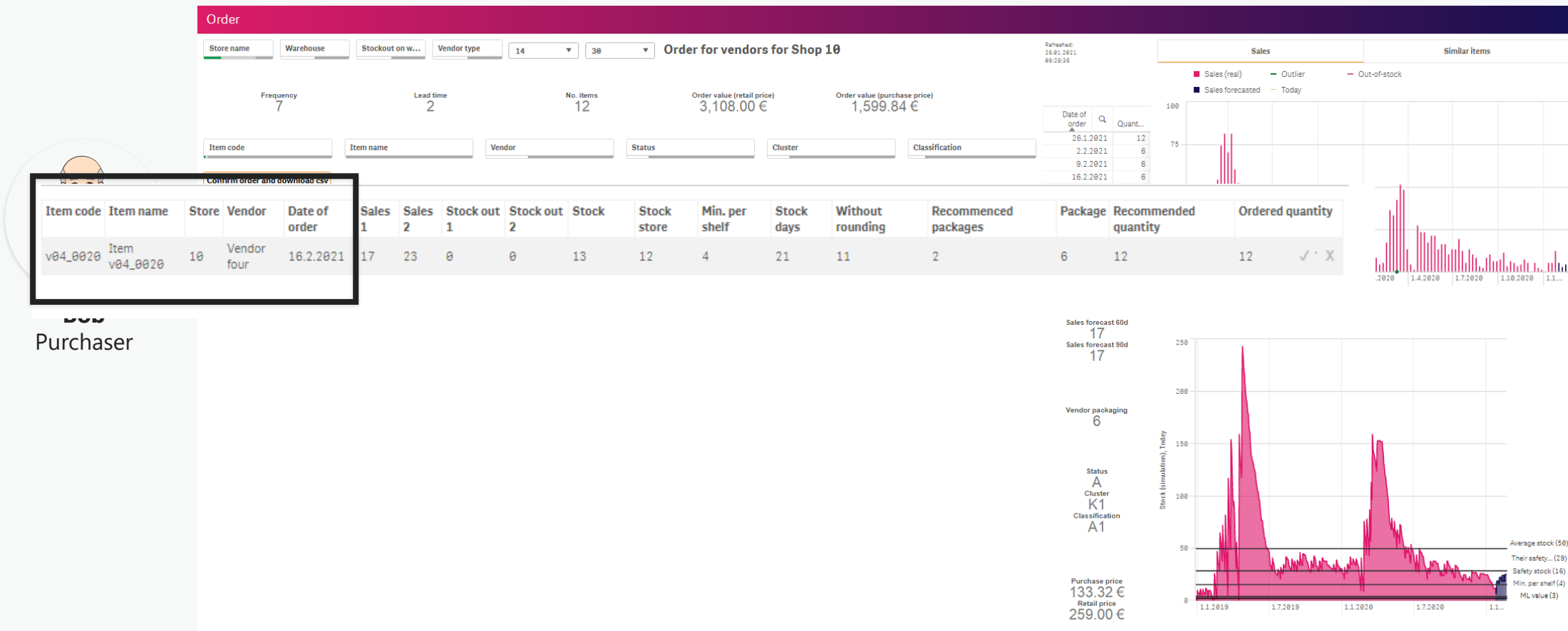
Bob
Purchaser



How can AI help Bob?

Stock optimisation with AI

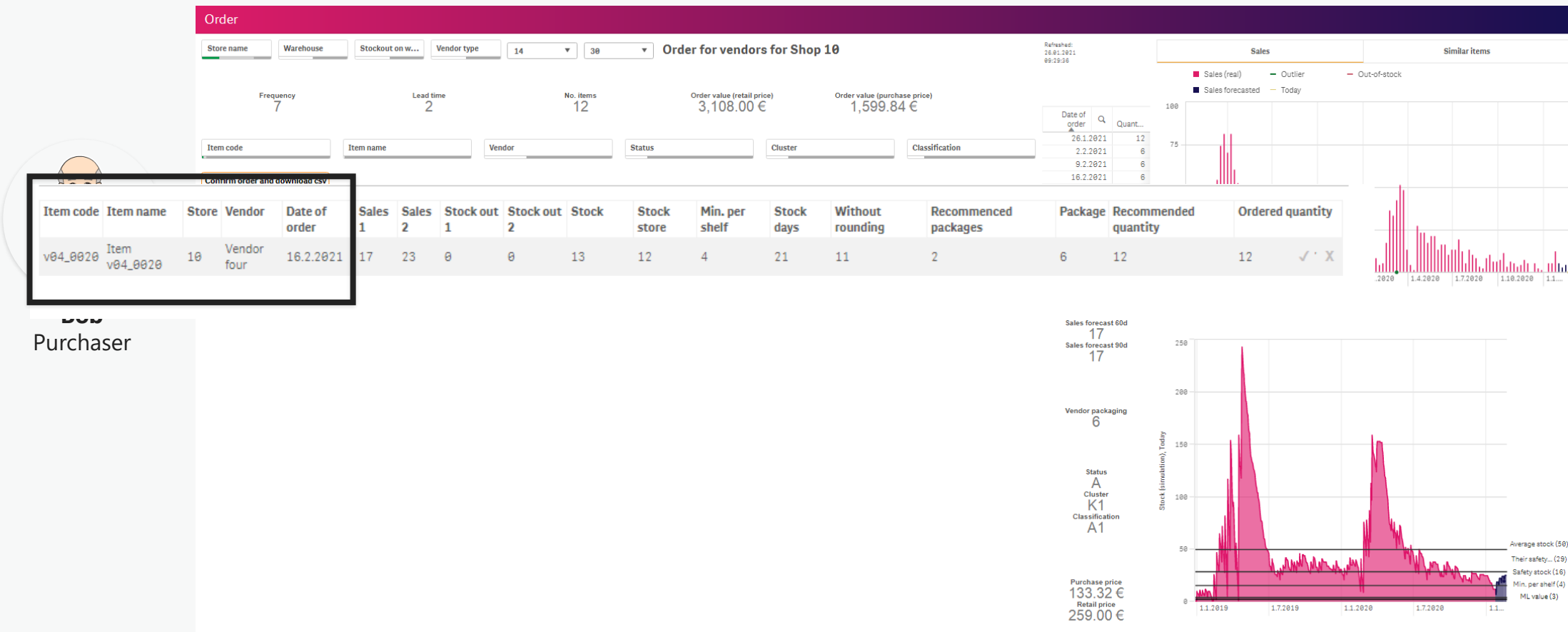
- Bob is presented with results – **Editable BI application**



How can AI help Bob?

Stock optimisation with AI

- Bob is presented with results – **Editable BI application**

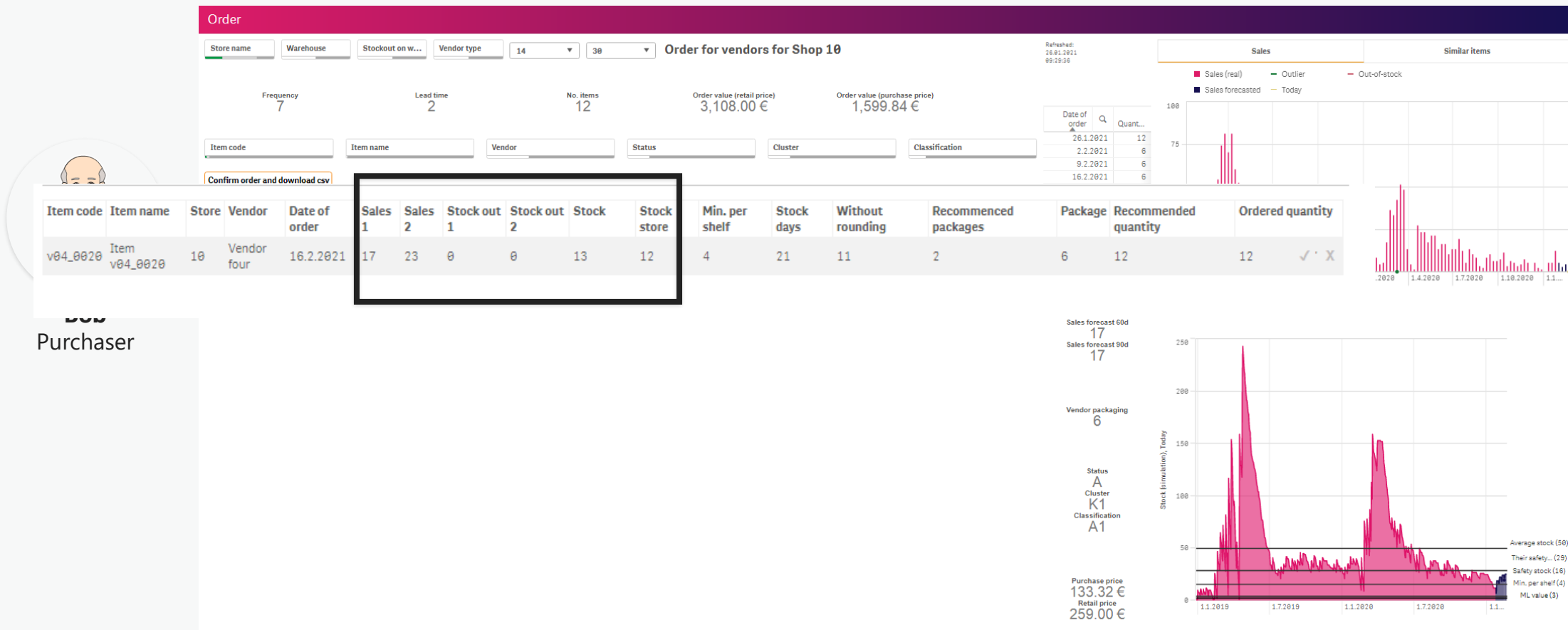


Purchaser

How can AI help Bob?

Stock optimisation with AI

- Bob is presented with results – **Editable BI application**



How can AI help Bob?

Stock optimisation with AI

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Bob
Purchaser

Order

Store name Warehouse Stockout on w... Vendor type 14 30 **Order for vendors for Shop 10**

Frequency 7 Lead time 2 No. items 12 Order value (retail price) 3,108.00 € Order value (purch) 1,599.8

Item code Item name Vendor Status Cluster

[Confirm order and download csv](#)

Item code	Item name	Store	Vendor	Date of order	Sales 1	Sales 2	Stock out 1	Stock out 2	Stock	Stock store	Min. per shelf	Stock days	Without rounding	Recommended packages	Package	Requ
v84_0020	Item v84_0020	10	Vendor four	16.2.2021	17	23	0	0	13	12	4	21	11	2	6	12

Refreshed: 26.01.2021 09:29:36

Sales Similar items

■ Sales (real) ■ Outlier - Out-of-stock
■ Sales forecasted - Today

Sales forecast 14d 12
Sales forecast 30d 17
Sales forecast 60d 17
Sales forecast 90d 17

Vendor packaging 6

Status A
Cluster K1
Classification A1

Purchase price 133.32 €
Retail price 259.00 €

Stock (simulation), Today

Average stock (50)
Their safety... (29)
Safety stock (16)
Min. per shelf (4)
ML value (3)

How can AI help Bob?

Stock optimisation with AI

- Bob is presented with results – **Editable BI application**



Bob
Purchaser

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ck s	Without rounding	Recommended packages	Package	Recommended quantity	Ordered quantity
	11	2	6	12	12 ✓ X

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How does it and why does it work

Data



Enough data

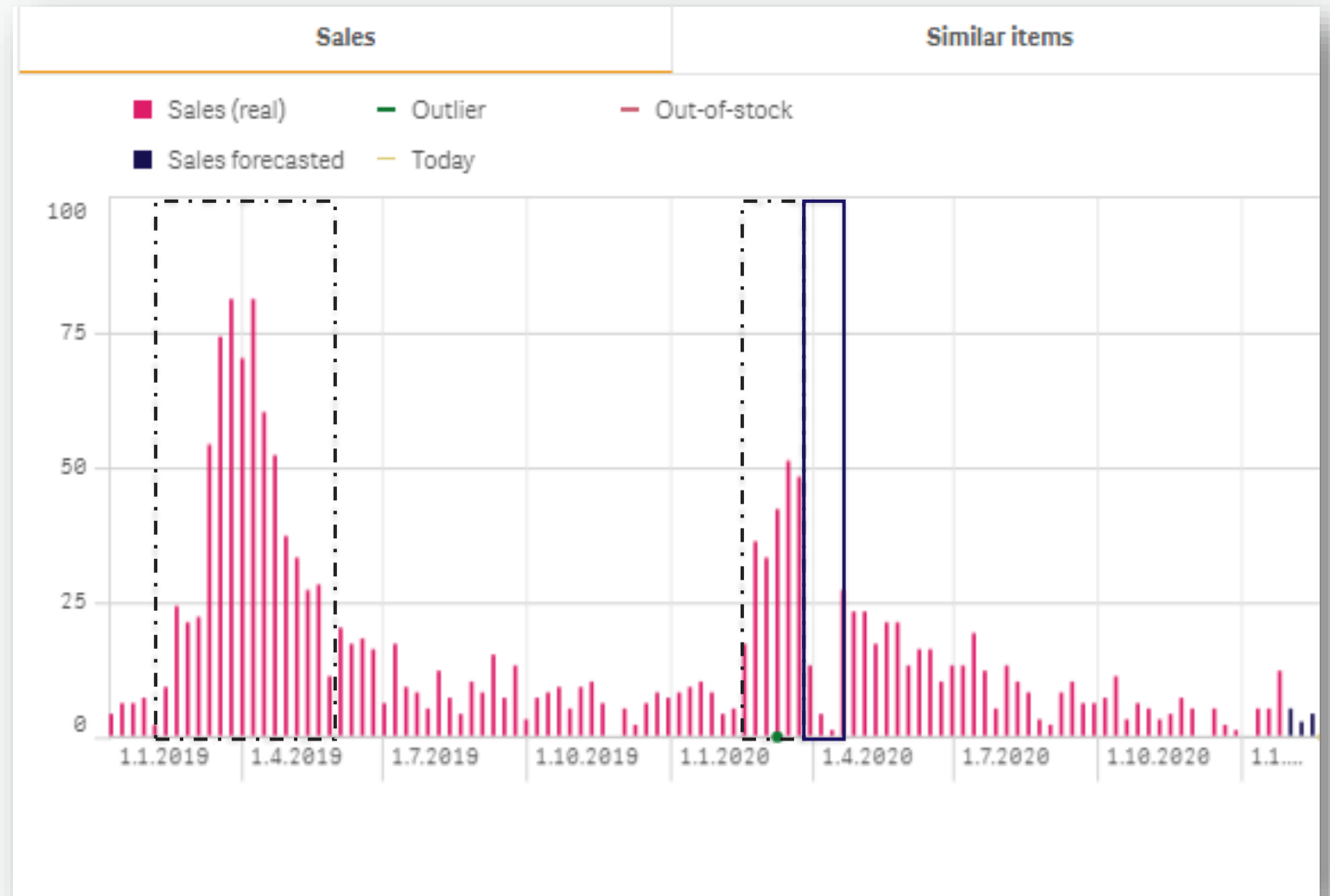


Relevant and true data



Contextual data

Outliers, weather, substitutes, promotions...



How does it and why does it work

Data



Enough data



Relevant and true data

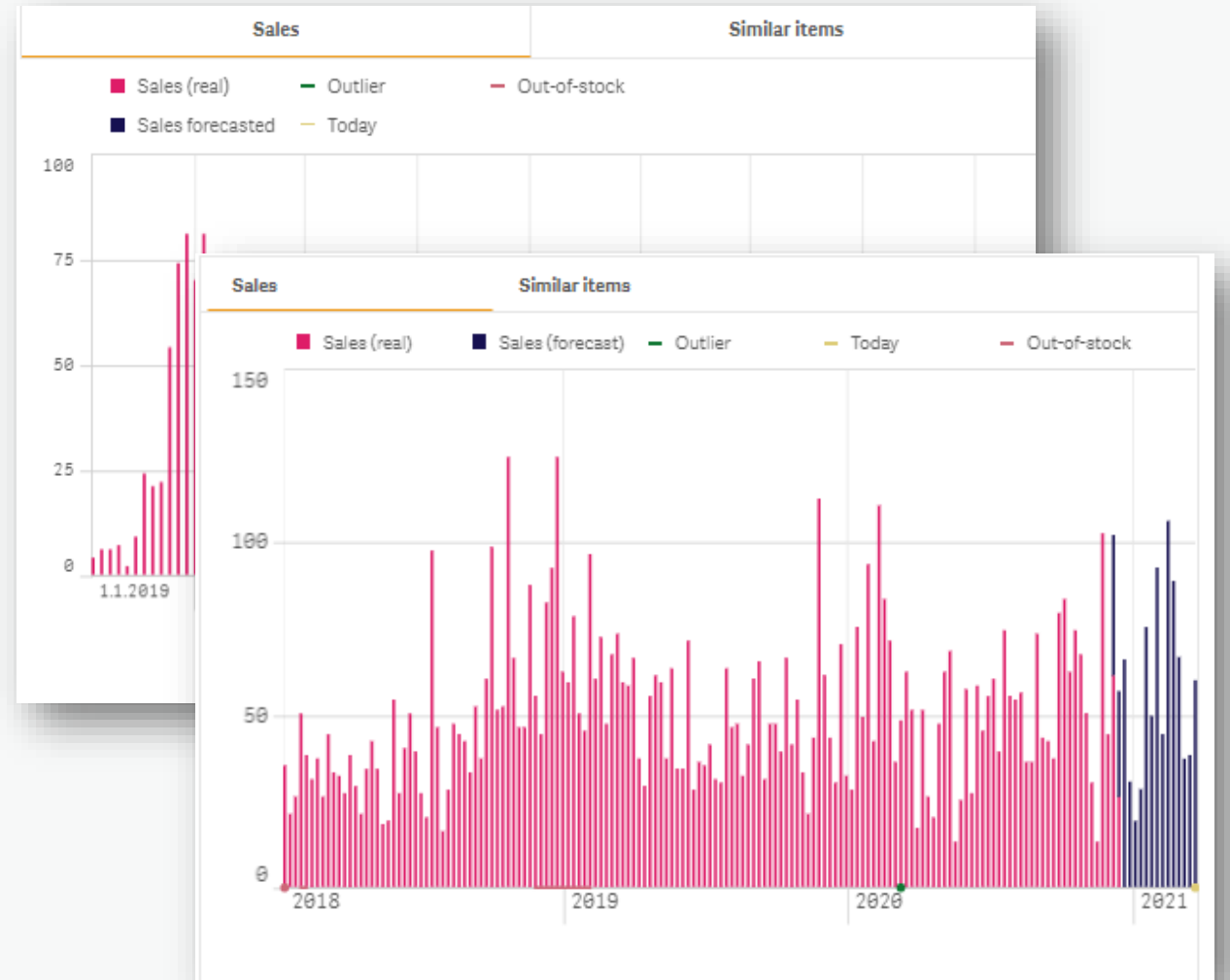


Contextual data

Outliers, weather, substitutes, promotions...

Forecast sales

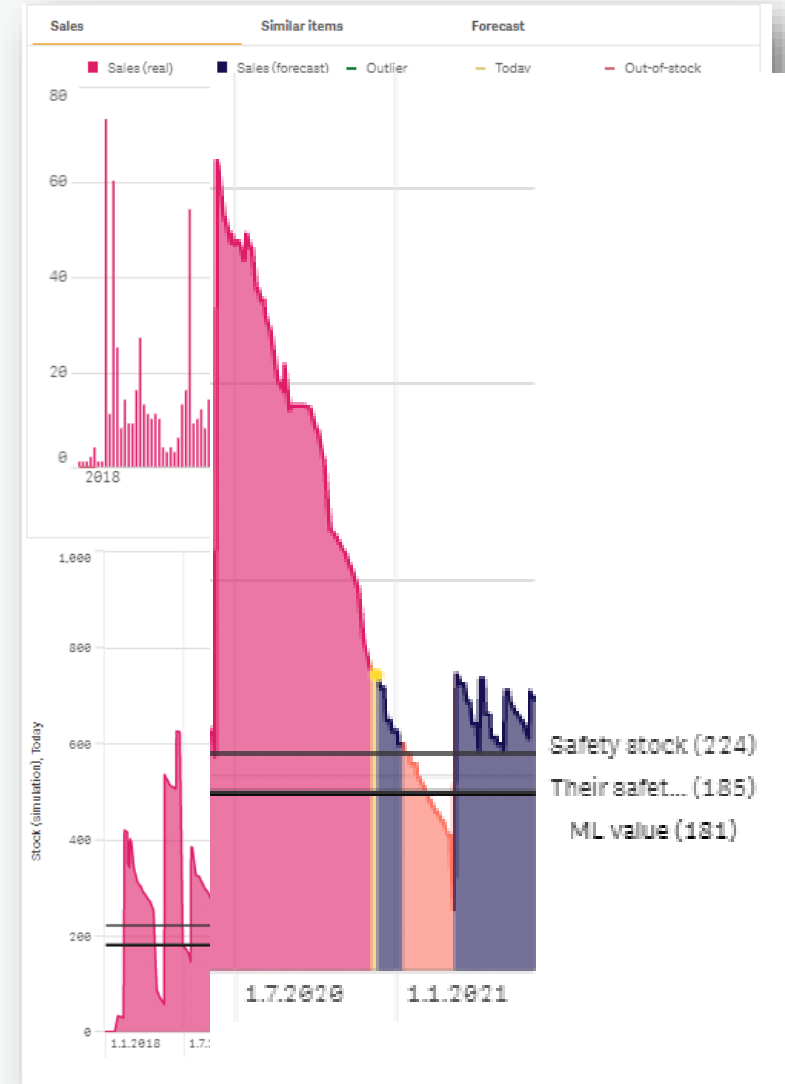
- Daily, weekly, monthly
- Forecast sales for a period of time
- Forecast sales per item per location



How does it and why does it work

Detection

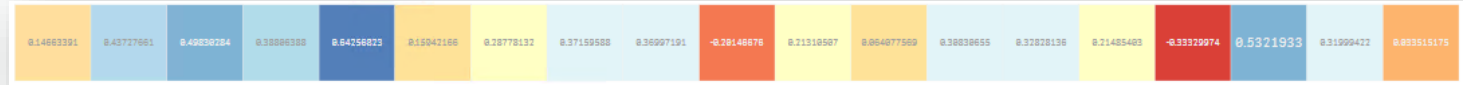
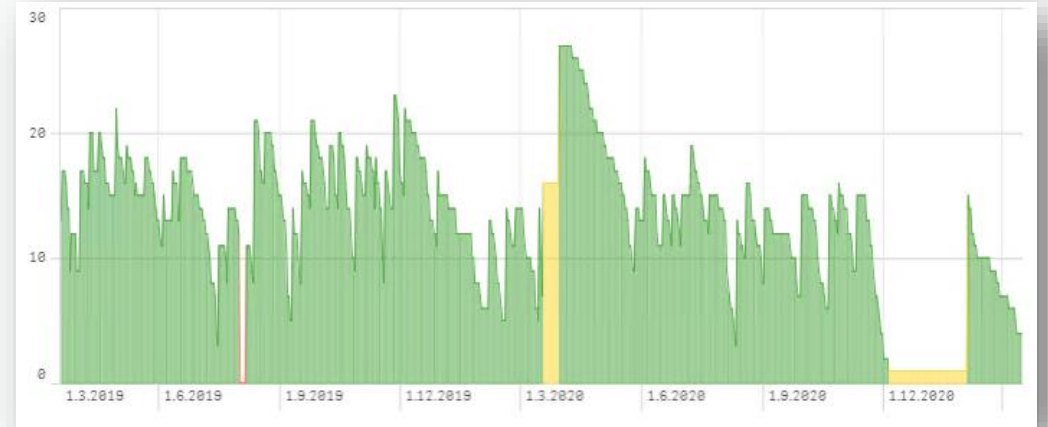
- Item location pair specific
 - Alert, outlier, anomaly, stock-out, over stock, dead stock, ...
 - Similar items, correlation between items, ...



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How does it and why does it work

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- Item location pair specific
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Generate order recommendation

- Vendor/item constraints (min order, ...)
- Rounding (package, pallet, ...)
- Location

Item name	Store	Vendor	Date of order	Sales 1	Sales 2	Stock out 1	Stock out 2	Stock	Stock store	Min. per shelf	Stock days	Without rounding	Recommended packages	Package	Recommended quantity	Ordered quantity
Item v04_0020	10	Vendor four	16.2.2021	17	23	0	0	13	12	4	21	11	2	6	12	12 ✓ X

How does it and why does it work

Detection

- Item location pair specific
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 - Similar items, correlation between items, ...

Generate order recommendation

- Vendor/item constraints (min order, ...)
- Rounding (package, pallete,...)
- Location
- **Fair transfers**

	Store 10	4
Store 5 13	Store 15	4
	Store 2	3
	Store 29	2

Does it work for me?

PoC evaluation

Data

- Sales & stock data for ~250 items
- a warehouse & a retail store

Evaluation

- Is the data suitable for the system
- Type of items according to sales dynamics

Forecasts

- How accurate are the forecasts (MAE, MAPE, RMSE)?
- Which forecasts are suitable (models & granularity)

Orders

- Evaluation of recommended orders (quantity)
- Automatisations of orders (Stock-out, over stock)

Forecast: MAPE = 11%



Does it work for me?

PoC evaluation

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- Sales & stock data for ~250 items
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Orders

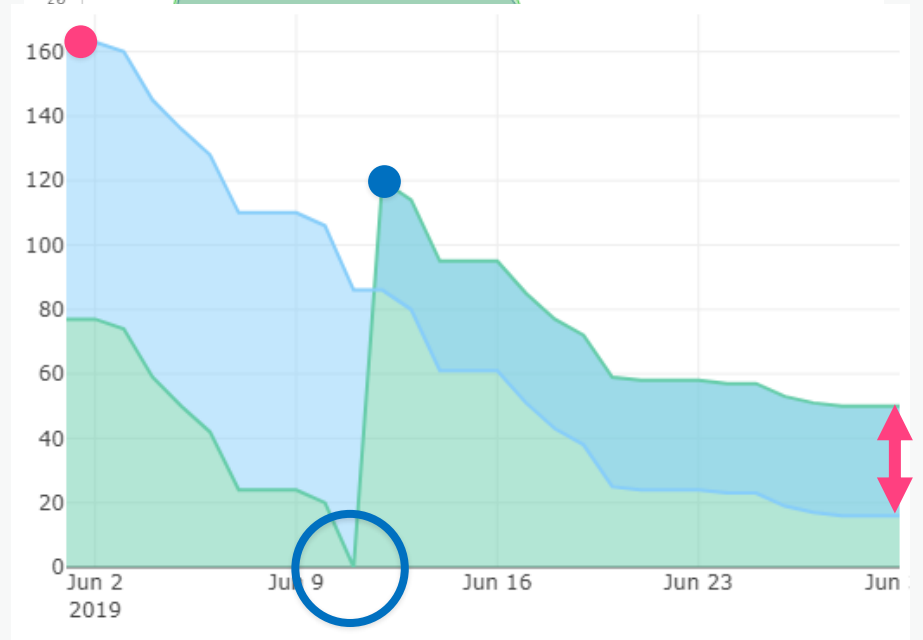
- Evaluation of recommended orders (quantity)
- Automatisation of orders (Stock-out, over stock)

Forecast: MAPE = 8%

Weekly forecasts



Recommended orders



Does it work for me?

PoC evaluation

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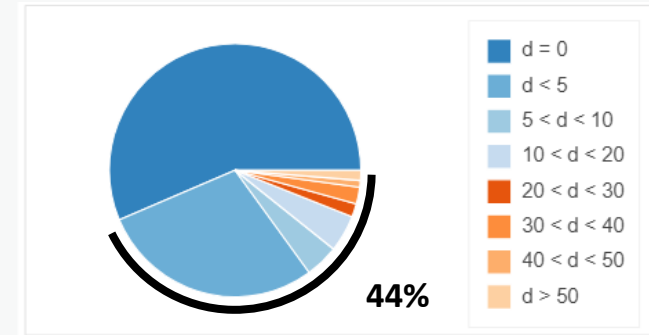
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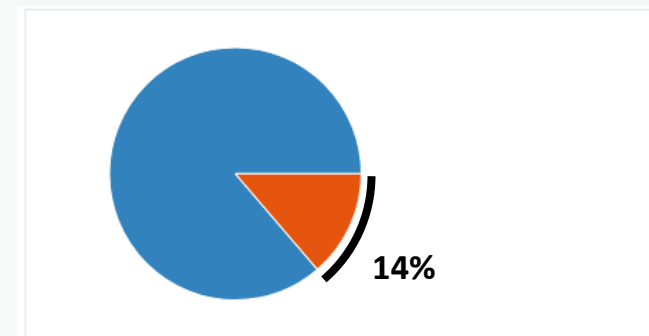
Orders

- Evaluation of recommended orders (quantity)
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Manual orders



ML Platform

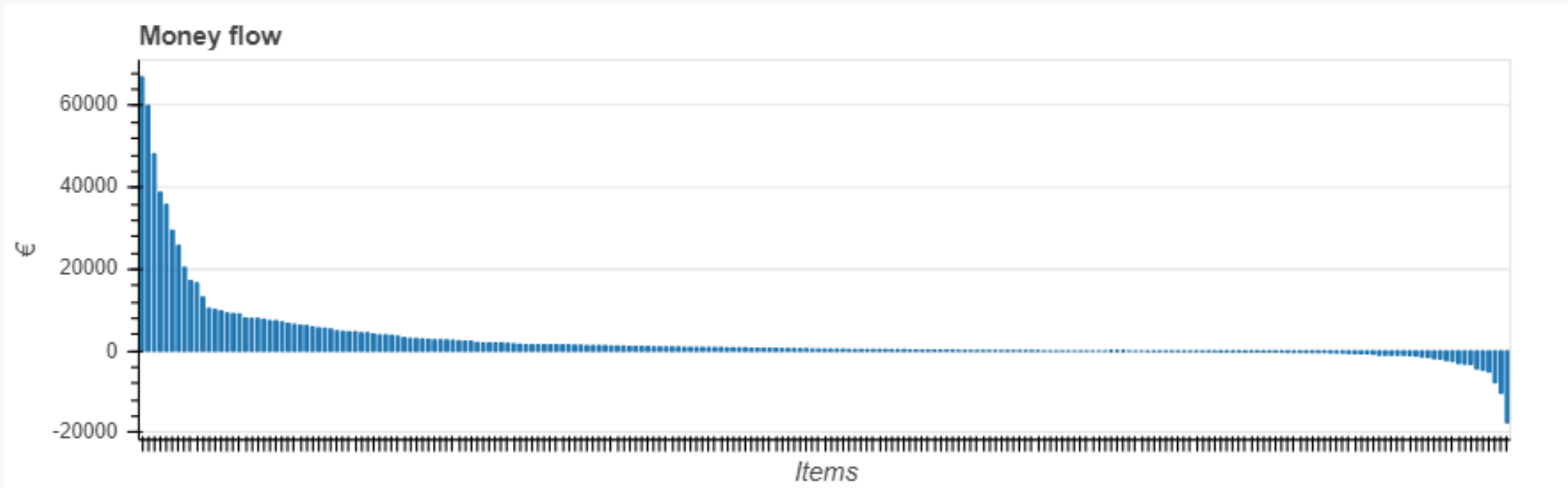


Does it work for me?

PoC evaluation

Stock level & value

- On historical data



Benefits?

Company

The ordering procedure is transferred into algorithms of ML platform

- **~80%** of items can be ordered automatically
- Time spent filling orders is decreased
- Quicker learning curve for new purchasers (replacements)



Increased cash flow due to controlled stock level

- Stock levels can be decreased from **25%-65%**
- Overstock is transferred to a location with higher probability of sale



Service level is **increased**

- Decreased number of stock-outs
- Optimal transfers



Ana
Purchase lead



Charles
CFO

Benefits

Other stakeholders



Extra time can be spent on complex & new items & new vendors



Roll-out on if new warehouses and retail stores are opened



Verification of orders through dashboard



Possibility of controlling order frequency per vendor

- Date of incoming trucks/containers
- Important items are in the first shipments (trucks/containers)
- Less jams in warehouses

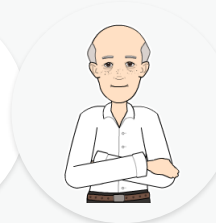


Advantage in negotiations with vendor

Set suitable bonuses for costumers / better promotional activities



Ana
Purchase lead



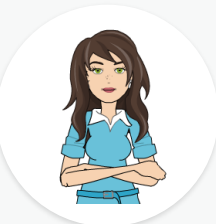
Bob
Purchaser



Charles
CFO



Dan
Warehouse mng



Eva
Intern Purchaser



Filip & Greta
Marketing team

Conclusion

Using technology as a tool for crunching large amounts of data unlock benefits:

Automatisation of orders

Controlled and optimised stock

Increased service level

Timely detection of specific events

Controlled movement in the warehouse

... so, we are really able to have:



Right product



At right place



At right time

across different industries!





Thank you!

Božidara Cvetković

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