Under the patronage of **H.E. Dr. Abdullah Belhaif Al Nuaimi -** Minister of Infrastructure Development

CONFERENCE OMAINTEC 2019 EXHIBITION

17th Edition

International Operations & Maintenance Conference in the Arab Countries

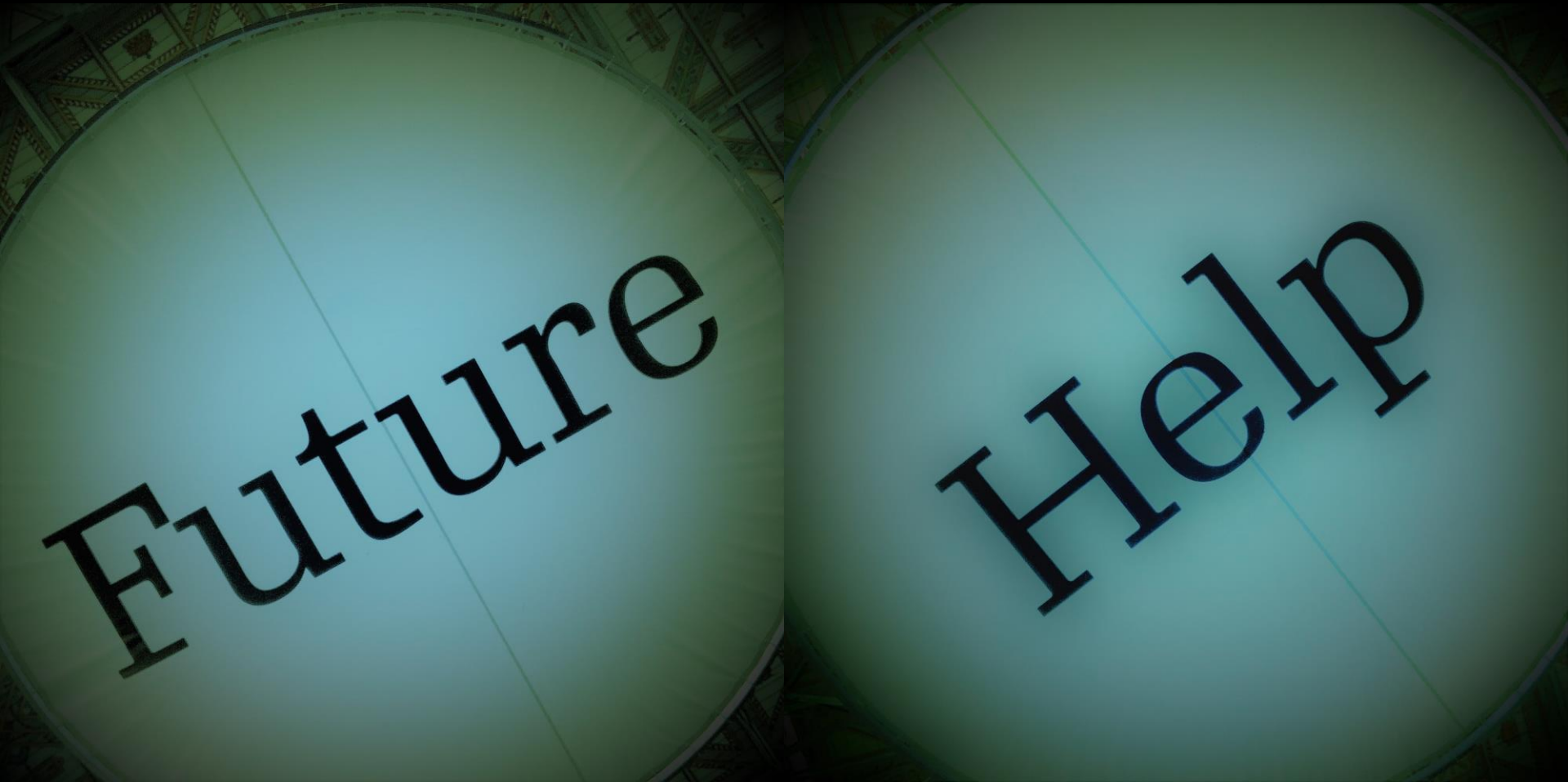
19, 20, 21 NOV 2019
Le Meridien Dubai Hotel
& Conference Centre
United Arab Emirates

Under the Theme:
Enhancing Maintenance Through Big Data Management

MONETIZING DATA

Data-driven spare parts management

Eng. Tomáš Hladík, M.Sc., Ph.D.
Logio, Prague

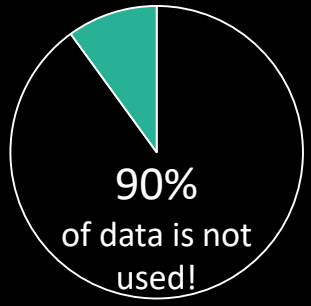

Future
Help

*We **overestimate** impacts of new technologies in **short term**.*

*We **underestimate** impacts of new technologies in **long term**.*

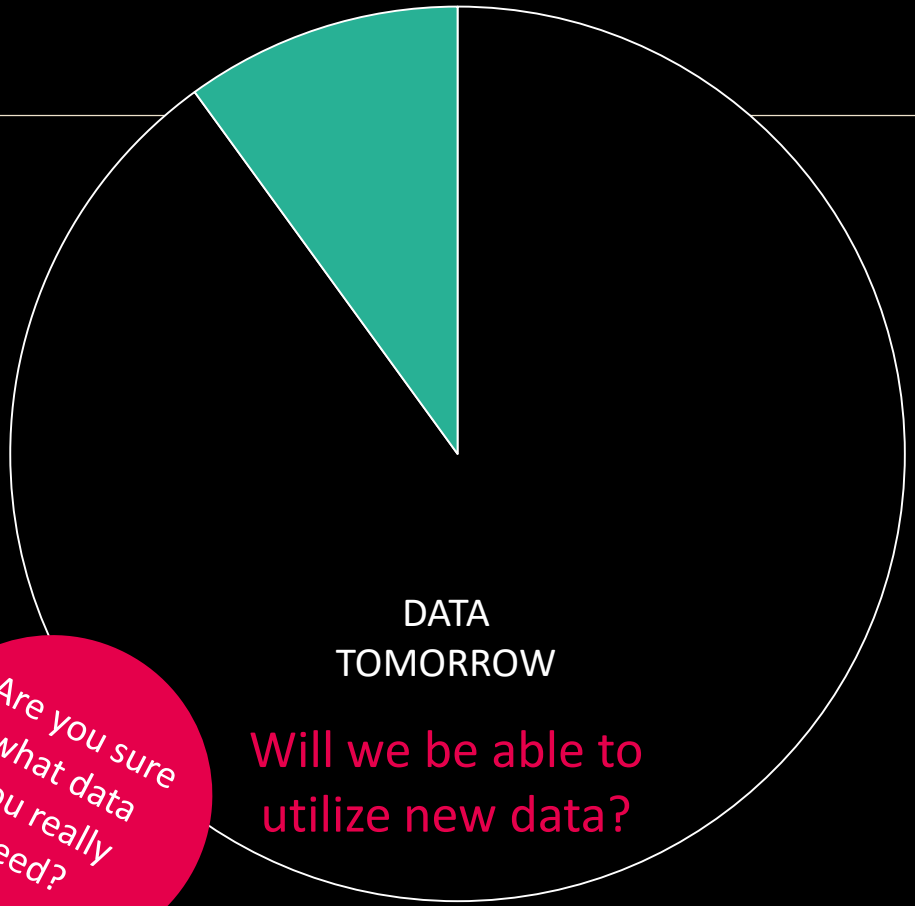
DATA REVOLUTION

We have so much data today
that we are not able to use it



DATA
TODAY

~~Do we have enough data?~~
Do we have right data?
Are we able to use ít?



DATA
TOMORROW

Will we be able to
utilize new data?

Are you sure
what data
you really
need?

Final product classification	Count of products - Active	Revenues	Margin	Profit	Inventory turnover	Inventory - current
00 - Healthy portfolio	20 318	660 323 843	%	231	5,64	77 541
01 - Dead Stock	6 791	1 419 985	%	516	0,07	14 919
02 - Controversial	2 443	127 449 810	%	174	6,14	20 335
03 - Tail	5 747	1 469 994	%	417	0,50	3 331
Total	**35 299**	**790 663 631**	**%**	**155**	**4,94**	**116 127**

Data monetization!

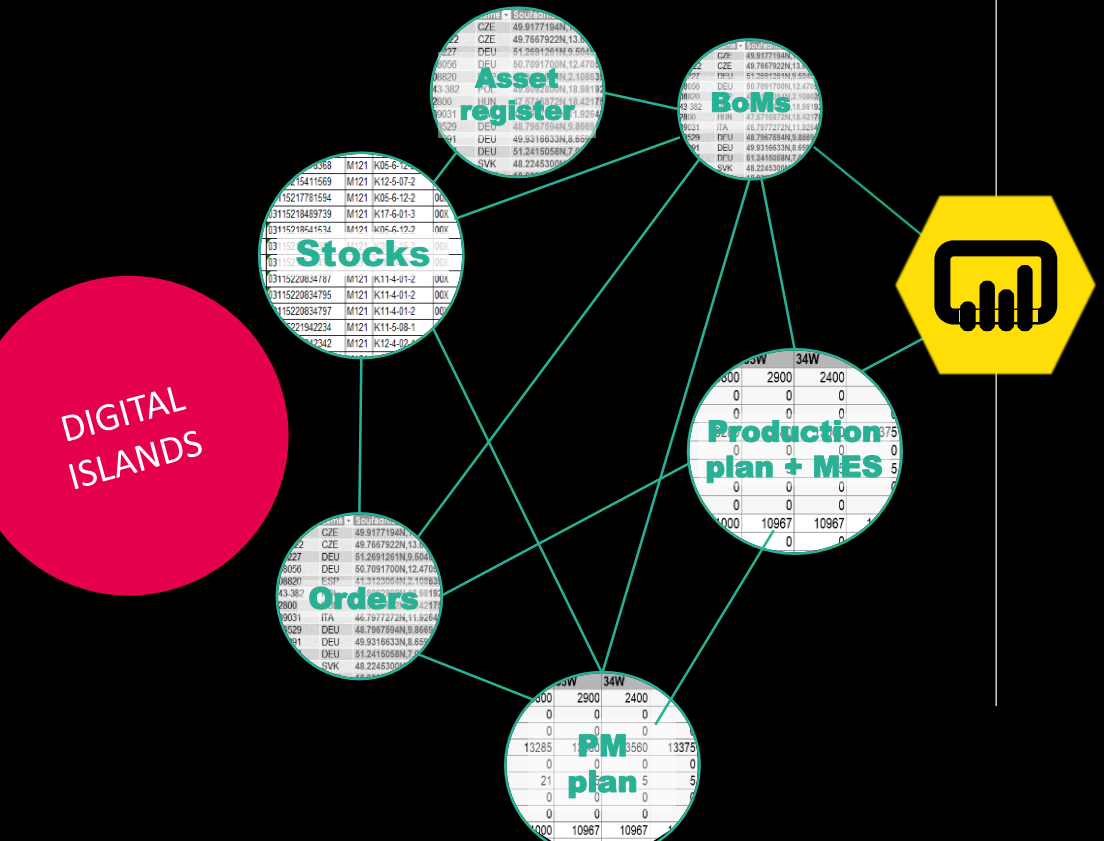
PowerBI is the new excel!

Data

⇩

Information

from Excels



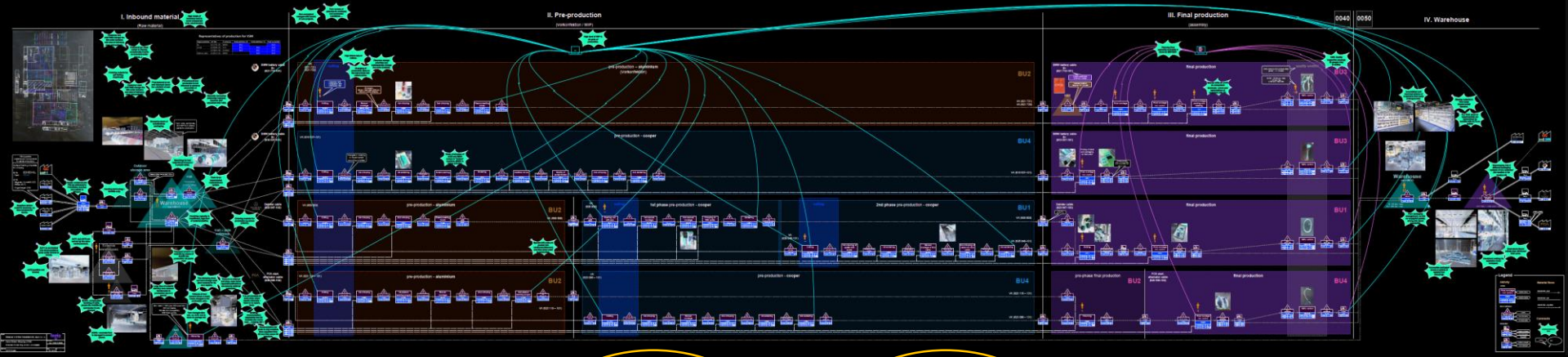
to Power BI

- One data = one truth
- Quick combination of various data sources
- Intuitive and visual outputs

from Excels

to Power BI

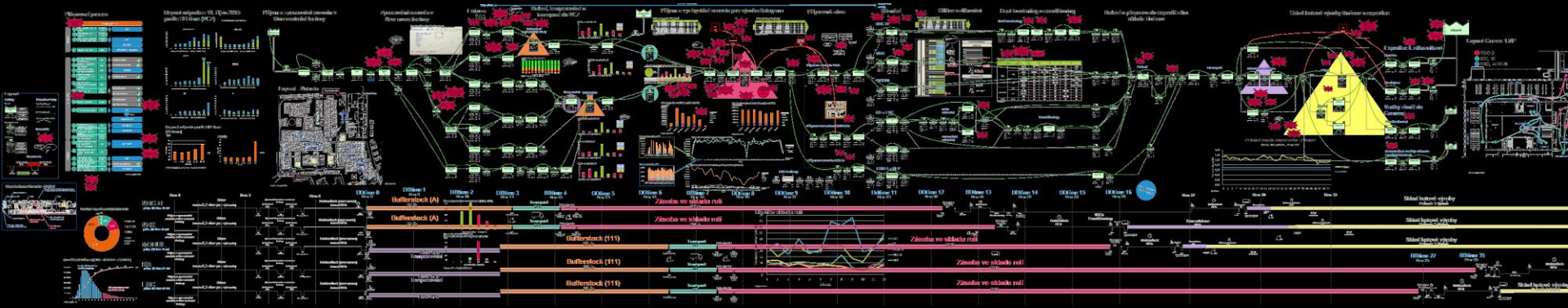
DATA-DRIVEN PROCESS AND VALUE STREAM MAPPING



Planning process and S&OP improvement

15 action plans of changes

DATA-DRIVEN PROCESS AND VALUE STREAM MAPPING



Production duration reduction

22 action plans of changes

DIGITAL TWIN, SIMULATION, PREDICTIVE MANUFACTURING

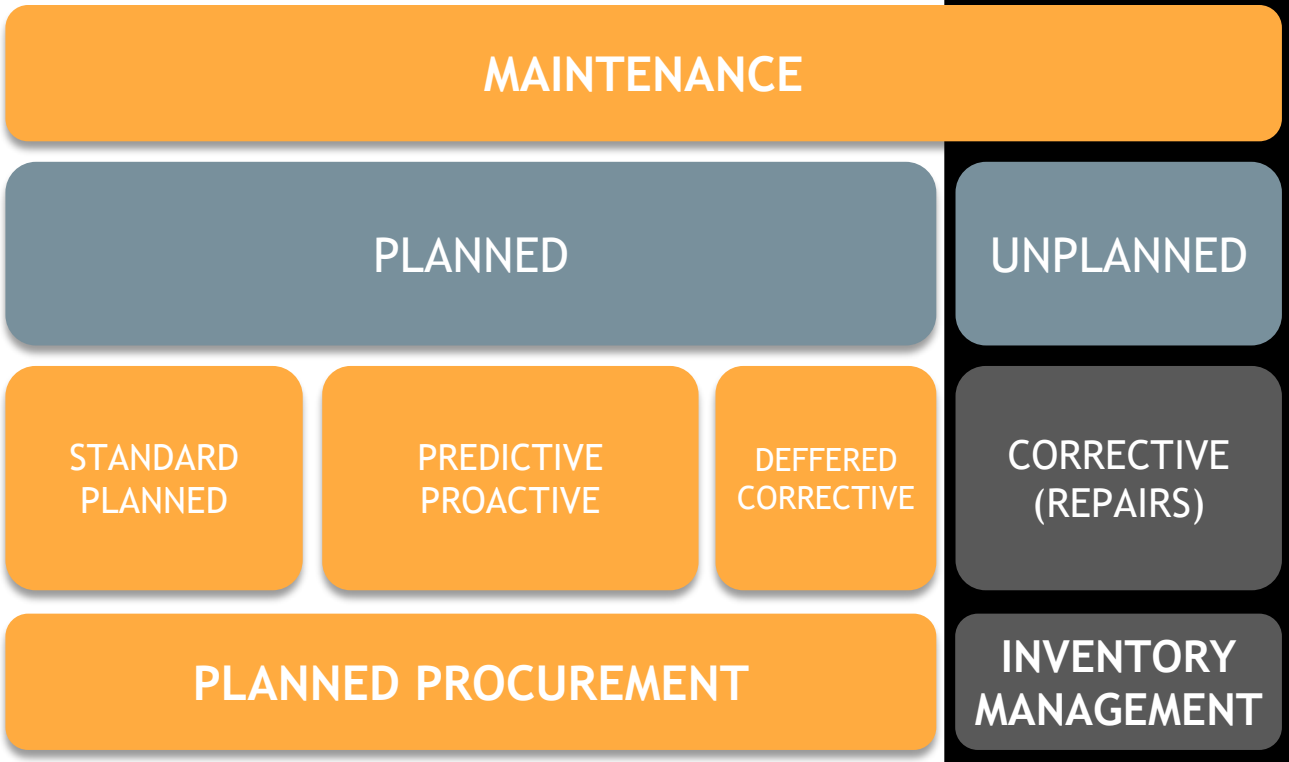
Whole plant
in a computer

Digital
twin

▸▸ EIGHT RULES FOR EFFECTIVE SPARE PARTS MANAGEMENT

1) Go for preventive maintenance!
2) Eliminate process problems
3) Segment your spare parts portfolio
4) Evaluate spare parts criticality
5) Spare parts management starts with good forecasting
6) Use special methods for intermittent demand items
7) Consider the whole life cycle of your equipment
8) Data, computers and technologies will help you

GO FOR PREVENTIVE MAINTENANCE!



ARTIFICIAL INTELLIGENCE IS WORKING FOR US:

Diagnostics from acoustic emission using neural networks

NEURON SOUNDWARE

We recognize broken machines using sound

NeuronBox NB.6 IoT Device

nBox

Let the smart device check the machines for you

nCard

Listen to your machines anytime, anywhere

Sound sensor

See standard sensors used in NSW installations

https://www.youtube.com/watch?v=yuZtnEZEOxw

Predictive maintenance!

Analysis of data in place of origin: Edge computing

Remote diagnostics

ELIMINATE PROCESS PROBLEMS

SP NEED IDENTIFICATION	No direct **responsibility** of maintenance engineers/technicians **for "their" items and spare parts** levels.
REQUEST FOR ORDER	RFO created by someone else, not the technician who requested part. The step of RFO may not be necessary in the process.
APPROVAL	**How often are orders approved**? **Who approves?** Approving in IS workflow or by signing a paper copy? Or both? Approving both RFO and then issued order again? **Too many approvers**, complicated procedure and hierarchy. Approving on high levels of management.
PROCUREMENT	**Insufficient information available to procurement**, poor spare identification – the buyer hardly knows what should be bought, additional communication with maintenance technician is needed. **Missing or incomplete procurement specification in the IS**.

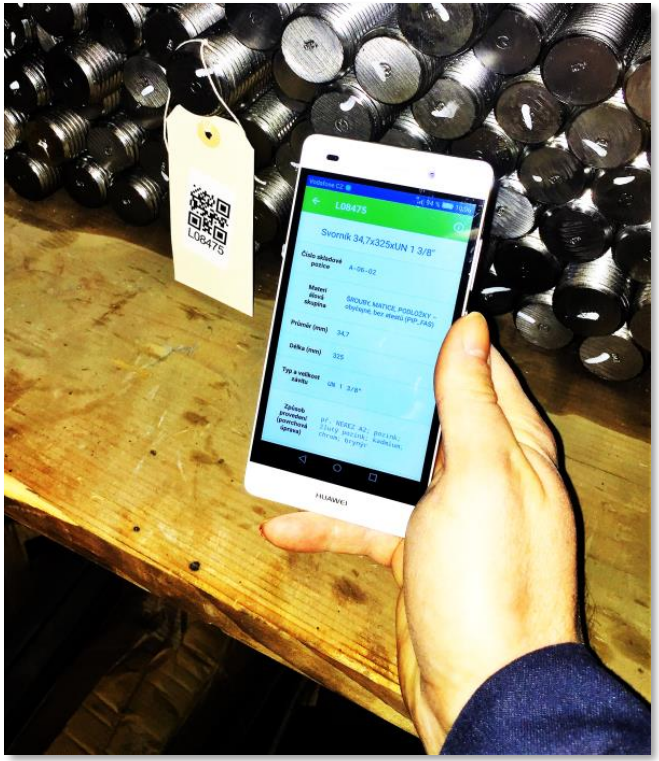
60-80% procurement specifications missing

ELIMINATE PROCESS PROBLEMS

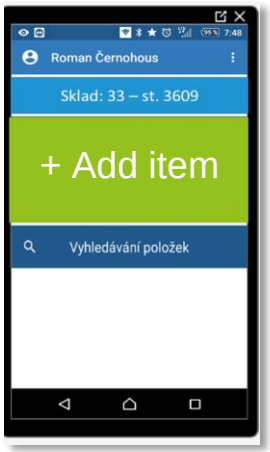
RECEPTION	Problems with missing (undelivered) documentation for the received material (certificates, declarations). Lost spare parts documentation – only “paper-based” archiving.
WAREHOUSING	Insufficient **identification of spare parts** in the warehouse. Problems to find items stored. Inventory count discrepancies, physical stock different from information system data. Non-real value of stock in the information system. Out-of-system stocks.
CONSUMPTION	Slow spare part issues in case of sudden need. Issued spare parts are not consumed in fact. What happens ther Consumption of external material even in case the part is on stock.
WAREHOUSE RETURNS AND REFURBISHED SPARE PARTS	**Refurbished parts return to warehouse while new are bought.** Accounting price of refurbished items is much higher (or lower) than the non-realistic value of items on stock. Problematic or impossible returns of parts issued but not consumed. Insufficient control of parts dismantled from the maintained object (the information system has no information about these).

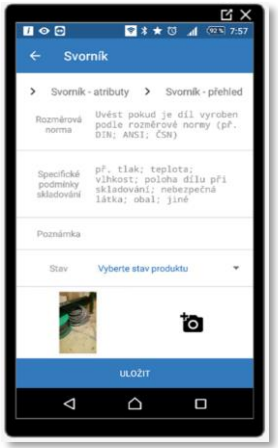
Spare parts identification data missing

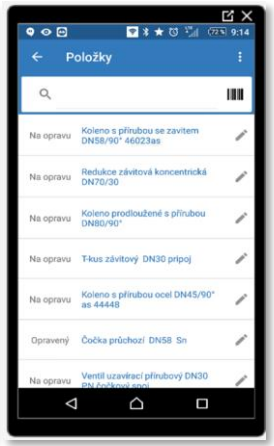
IDENTIFICATION OF SPARE PARTS IN SMARTPHONE



Android application for support and collection of identification data including photos of spare parts.





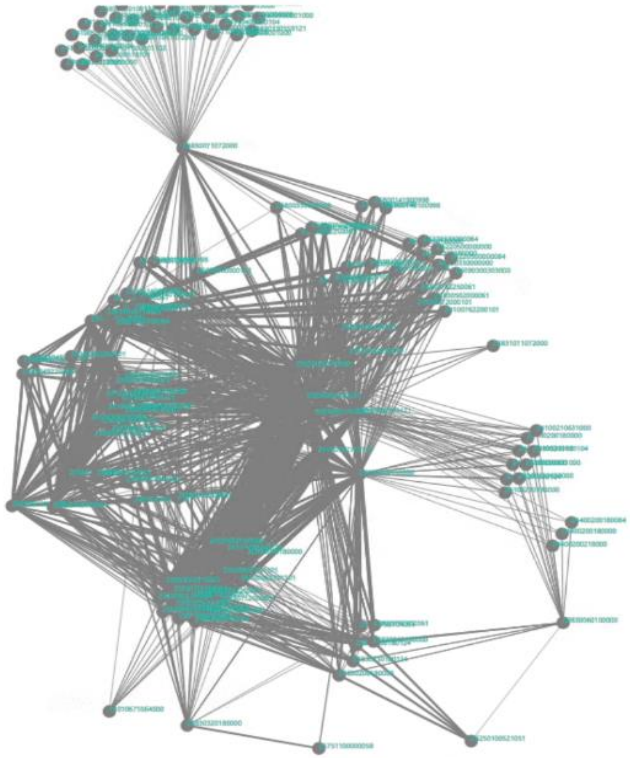


FINDING DUPLICATES IN MASTER DATA

Level1

80,00 % 99,38 %

Similarita by Výrobek ID and Substitut ID



Výrobek ID		Substitut ID		Similarita
23830100300000		23830491708121		99,4 %
23830491708121		23830500000000		99,4 %
23830491708121		23830500001000		99,4 %
23830491708121		23830500001124		99,4 %
23830491708121		23830500503000		99,4 %
23830491708121		23830500510000		99,4 %
23830491708121				99,4 %
23830491708121				99,4 %
23830491708121				99,4 %
23830491708121				99,4 %
23830500000000				99,4 %
23830500001000				99,4 %
23830500001124				99,4 %
23830500503000				99,4 %
23830500510000				99,4 %
23830500518000				99,4 %
23830500523000				99,4 %
23830500530000				99,4 %
23830500573121				99,4 %
23830330000				99,4 %
23830330001				99,4 %
23830330511				99,4 %
23830330511				99,4 %
23830491708				99,4 %
23830491708				99,4 %
23830491708				99,4 %
23830491708121				99,3 %
Total				**88,2 %**

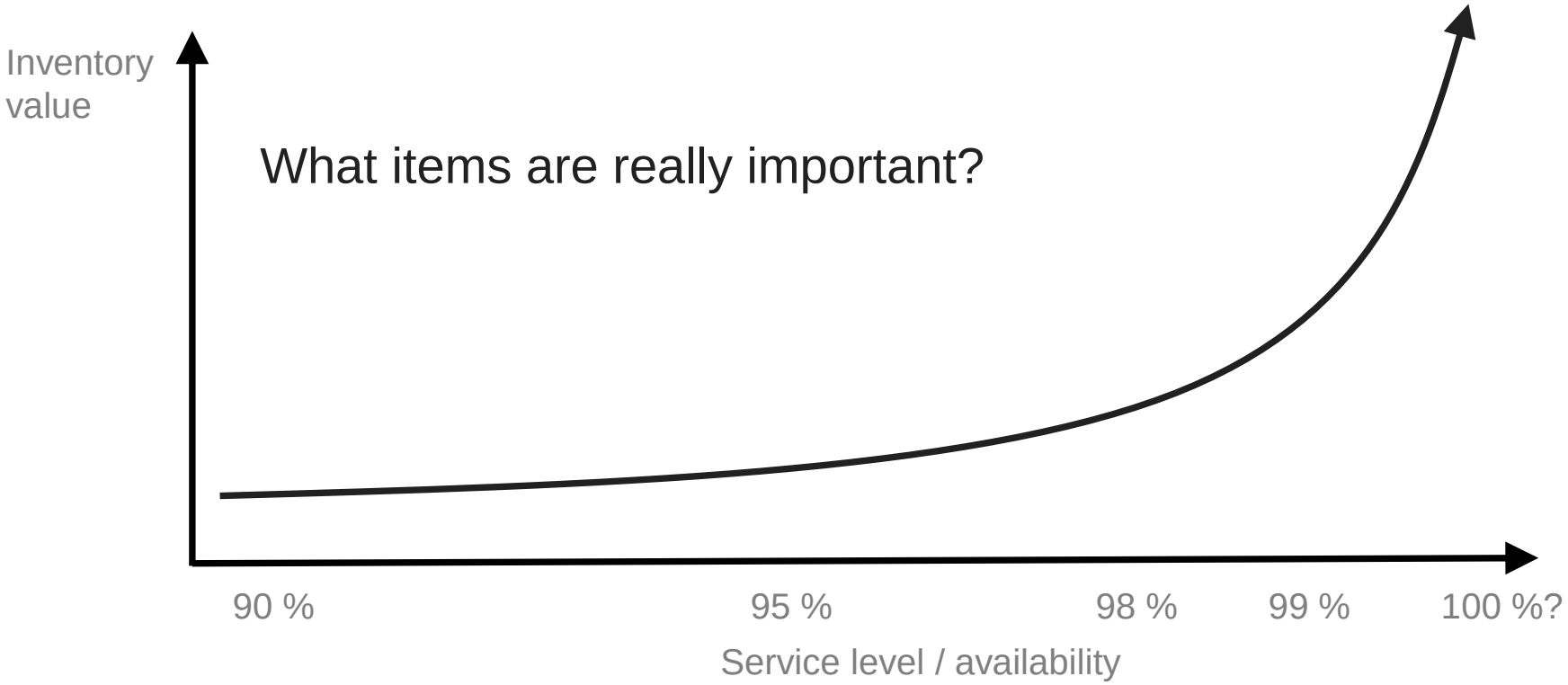
Matching algorithm

Triplets analysis

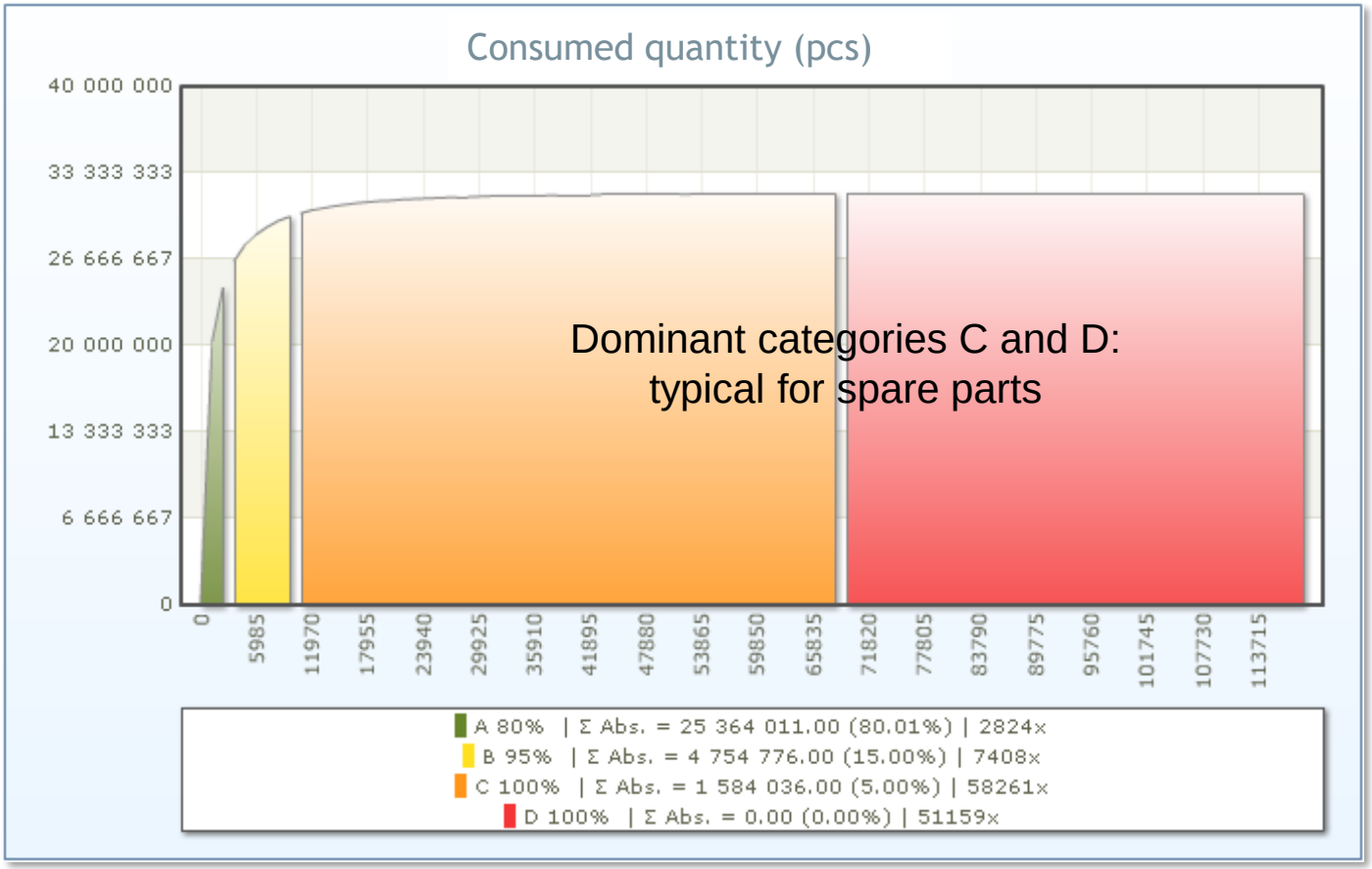
Comparing identification attributes

logio

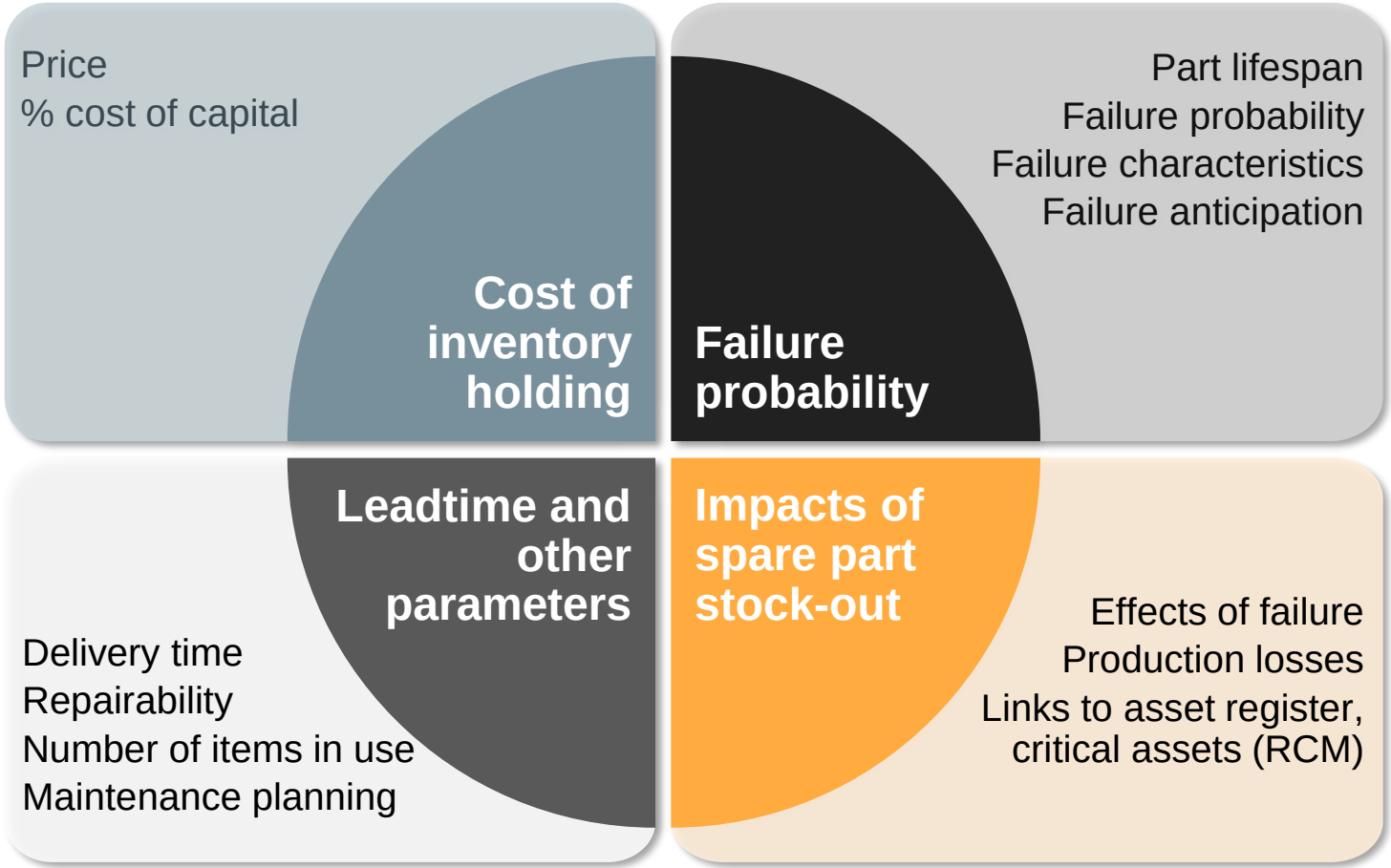
SERVICE LEVEL X LOCKED-IN CAPITAL



WHAT ITEMS ARE REALLY IMPORTANT?



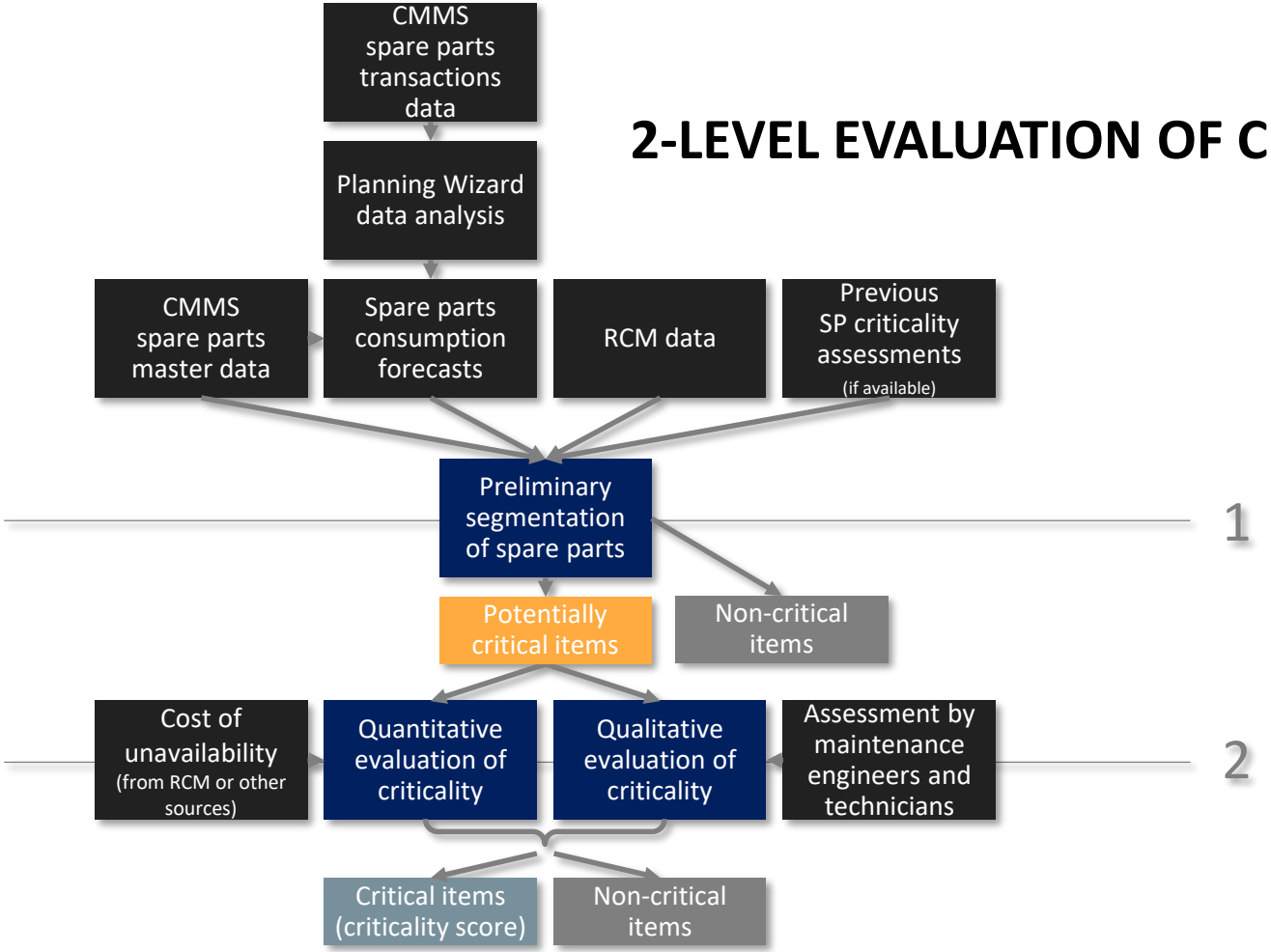
SPARE PARTS CRITICALITY – 4 PIECES OF INFORMATION



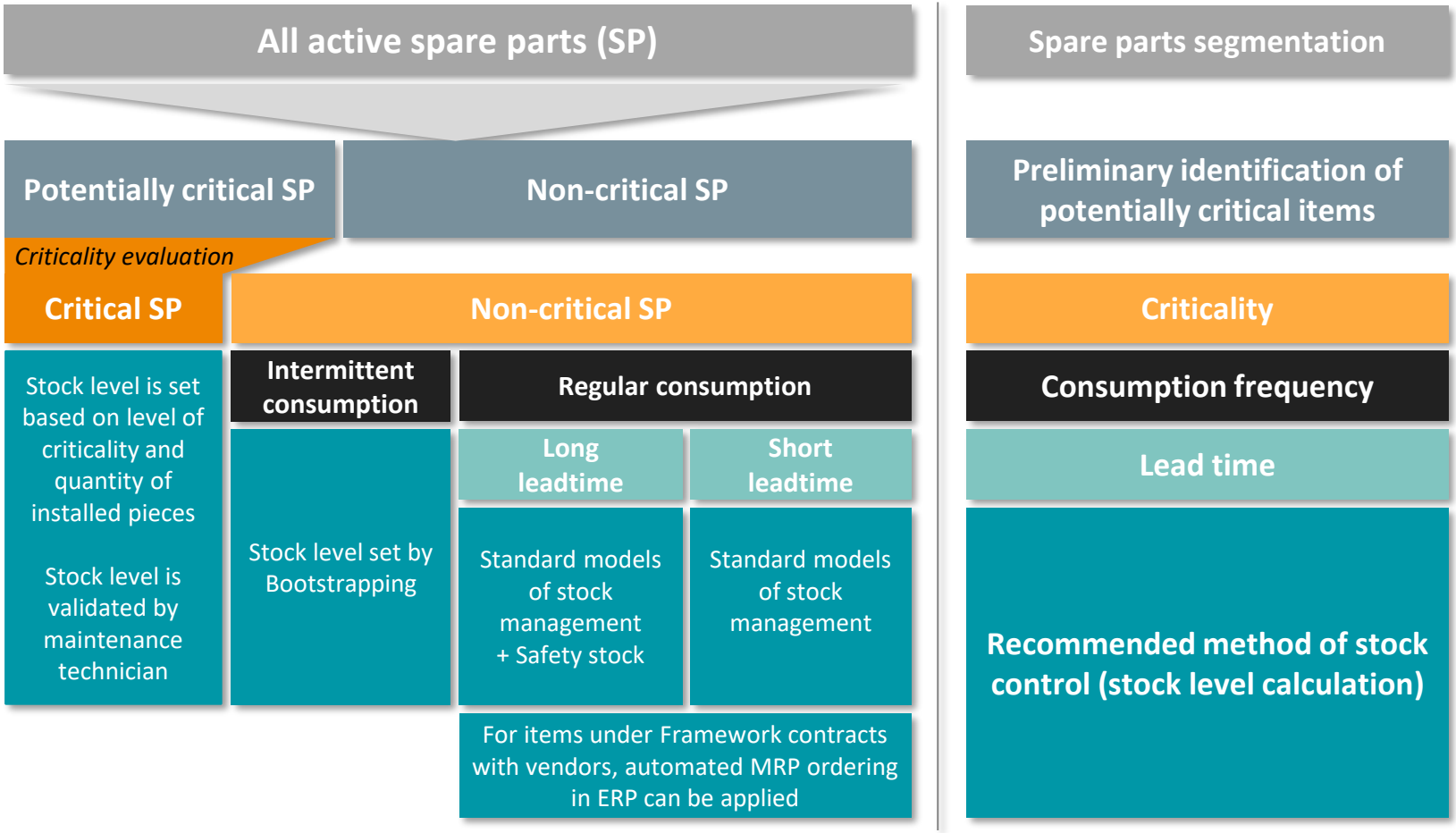
CRITICALITY CALCULATION

$$C_{inv} = C_{un} * LT * f$$

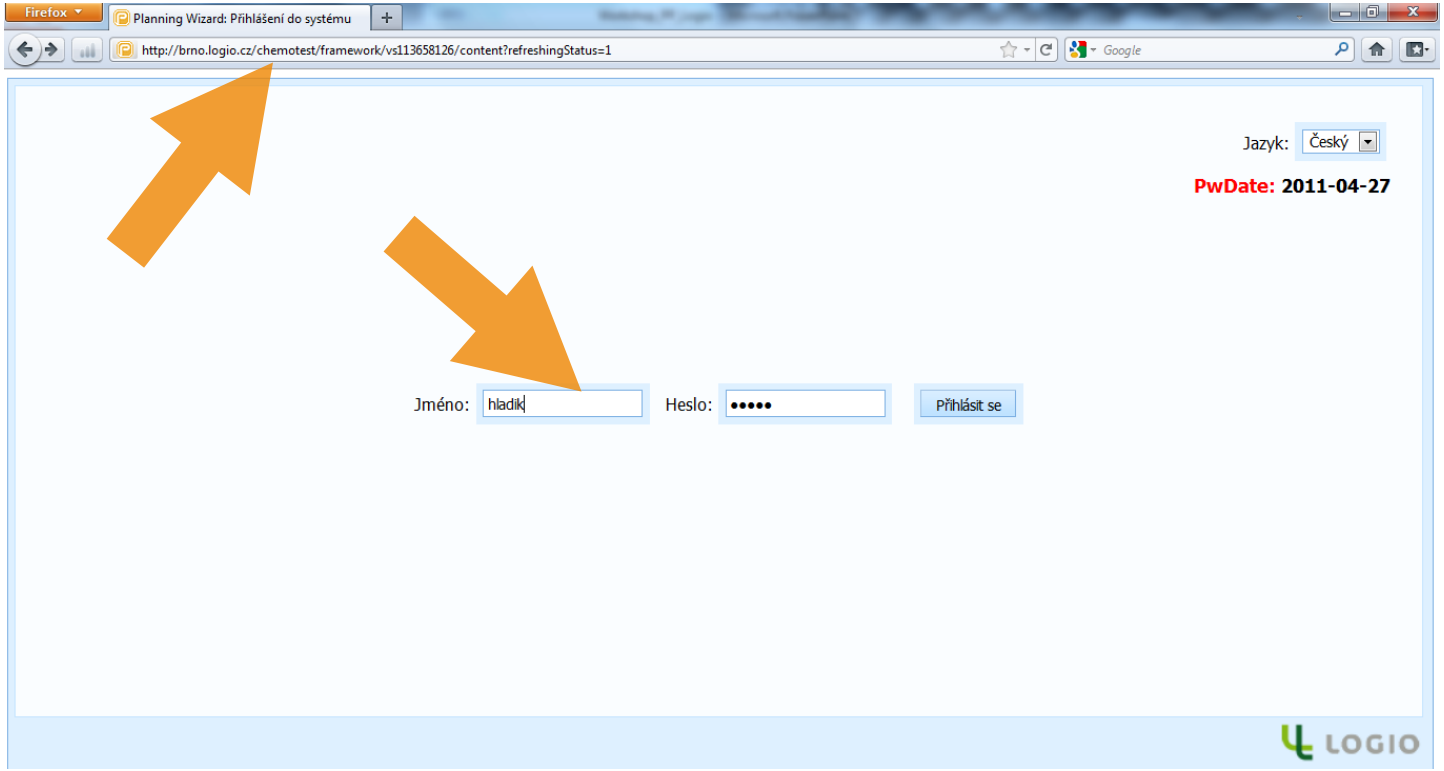
2-LEVEL EVALUATION OF CRITICALITY



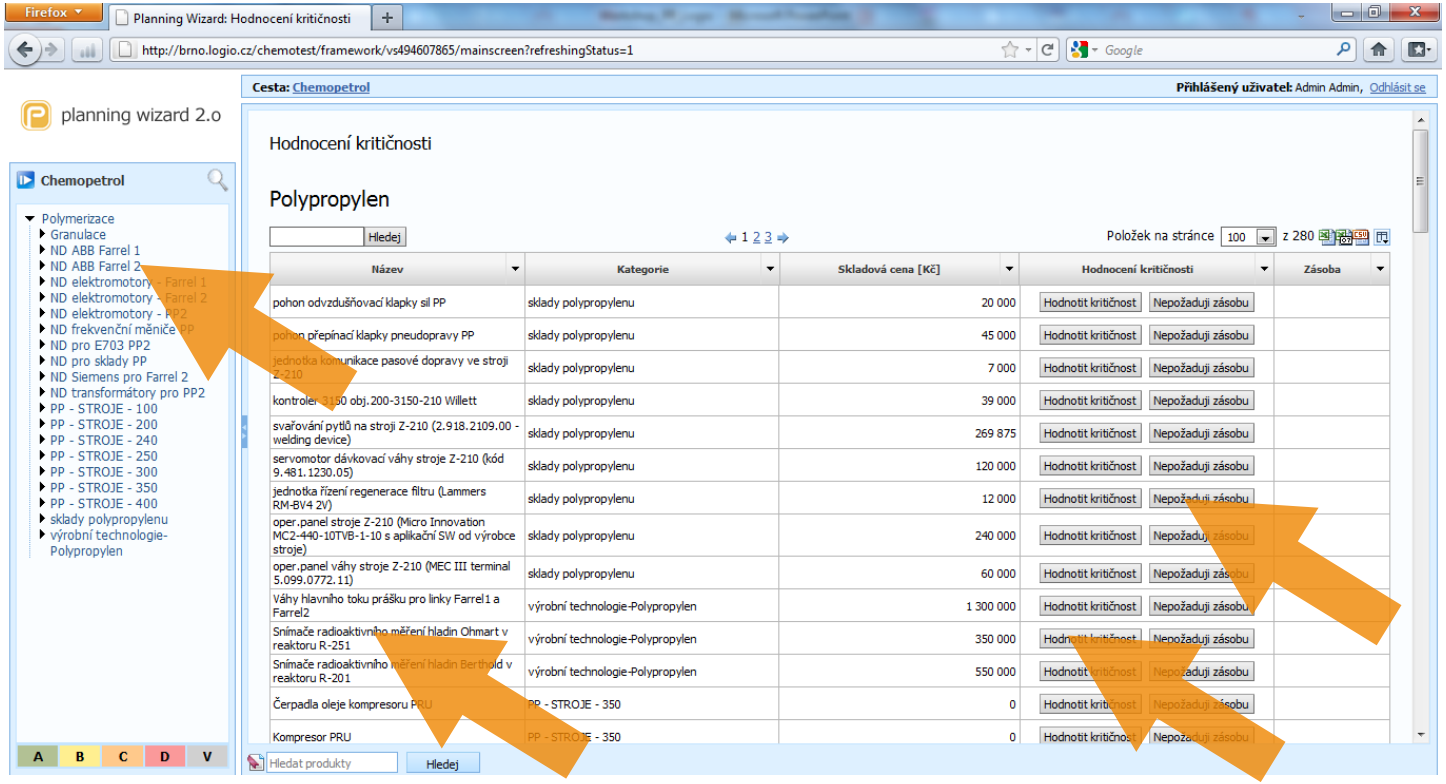
SELECTING SUITABLE STOCK CONTROL METHOD FOR EACH SEGMENT



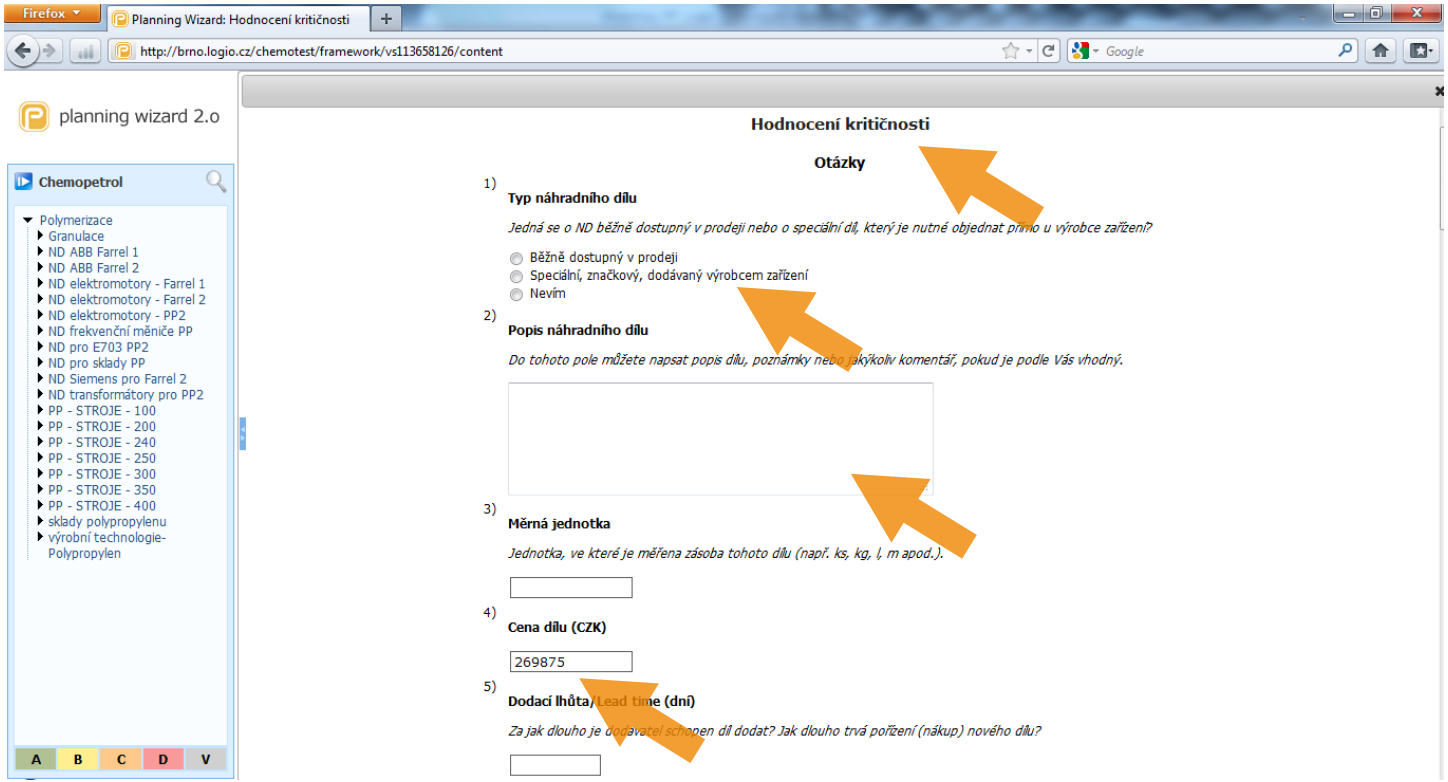
QUALITATIVE CRITICALITY ASSESSMENT – ONLINE APP



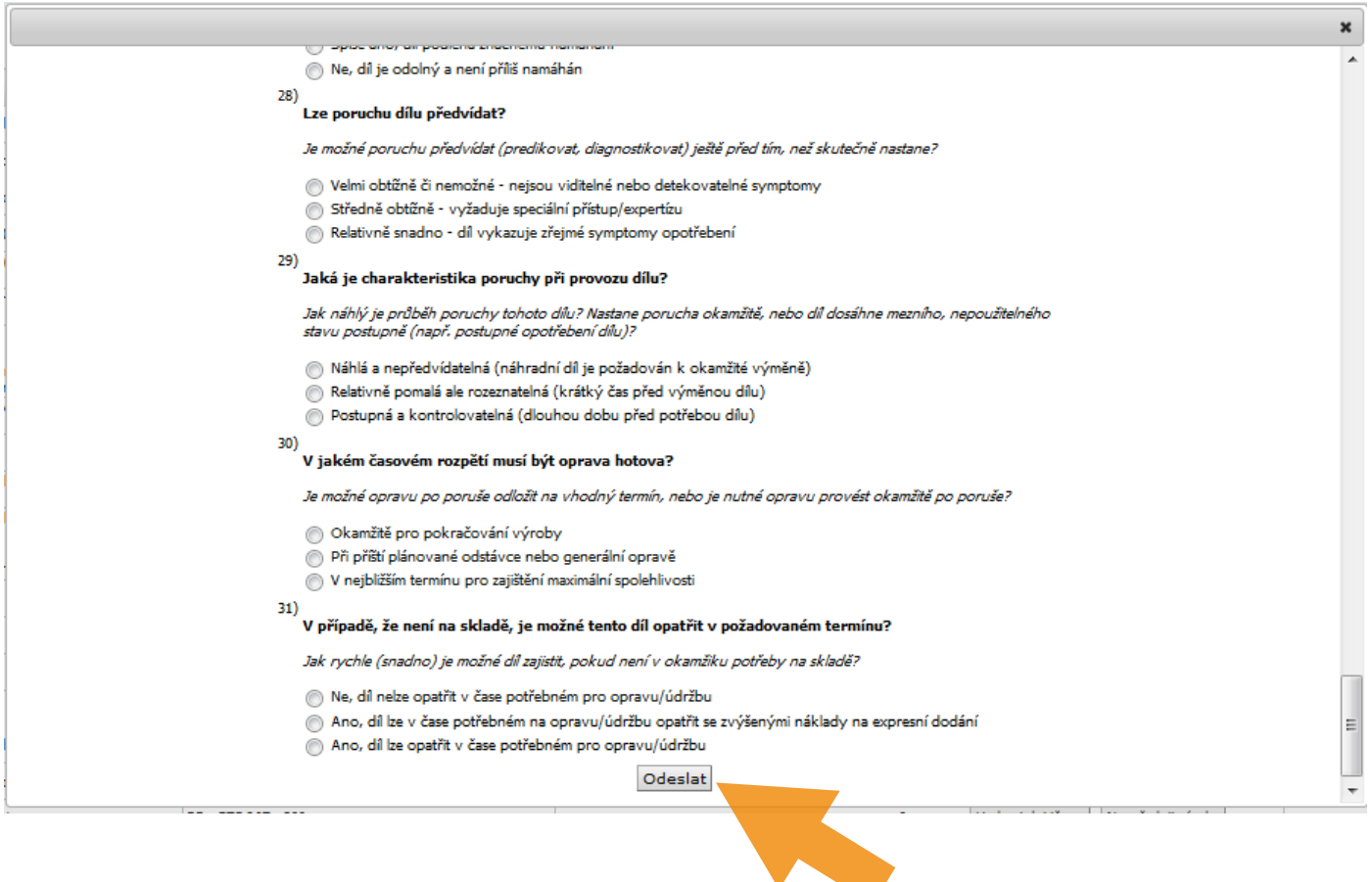
SELECTION OF ITEMS TO EVALUATE



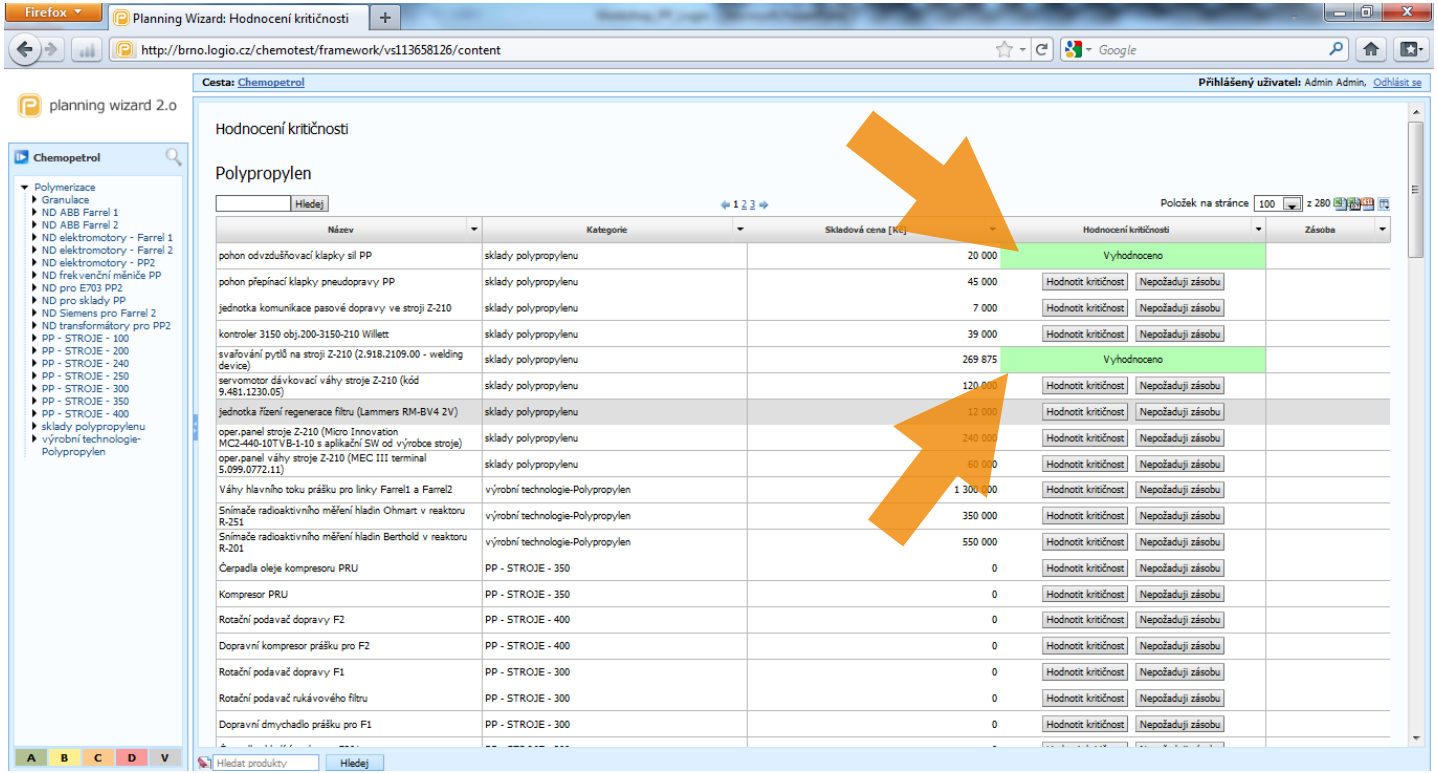
ANSWERING FEW SIMPLE QUESTIONS



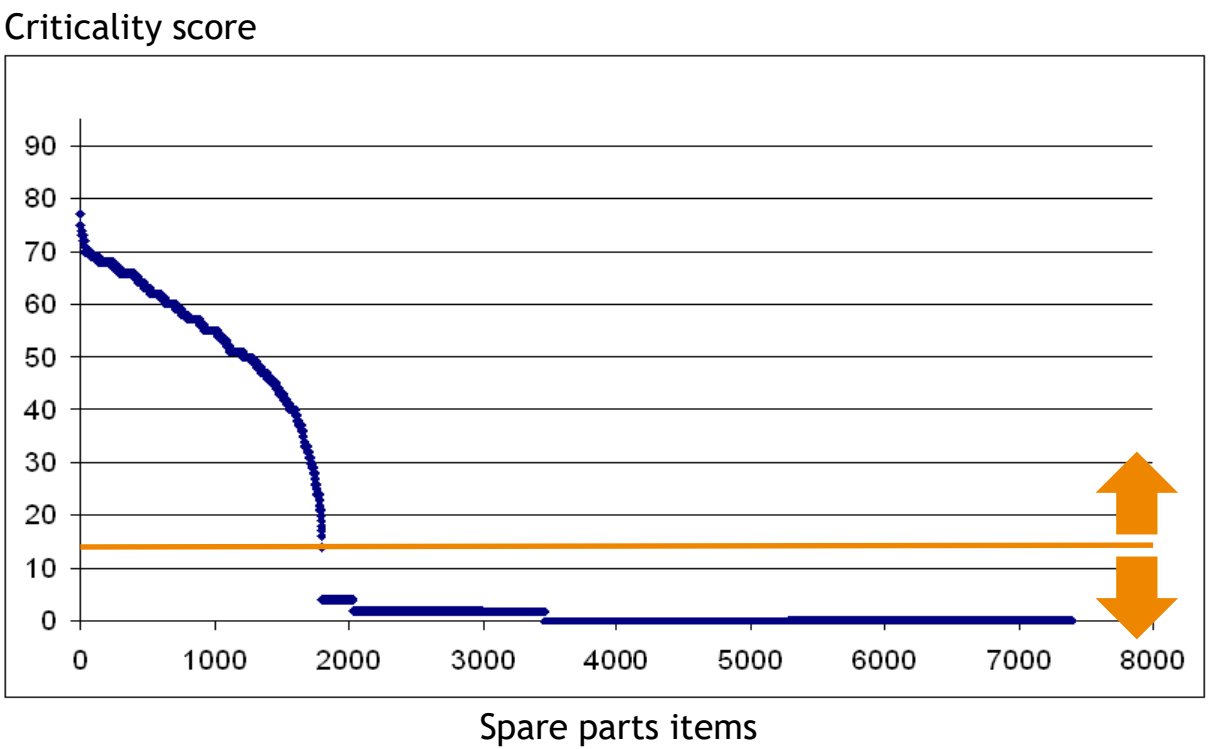
ANSWERING FEW SIMPLE QUESTIONS, THEN SUBMIT



DONE – ITEMS EVALUATED



SPARE PARTS CRITICALITY ANALYSIS RESULT

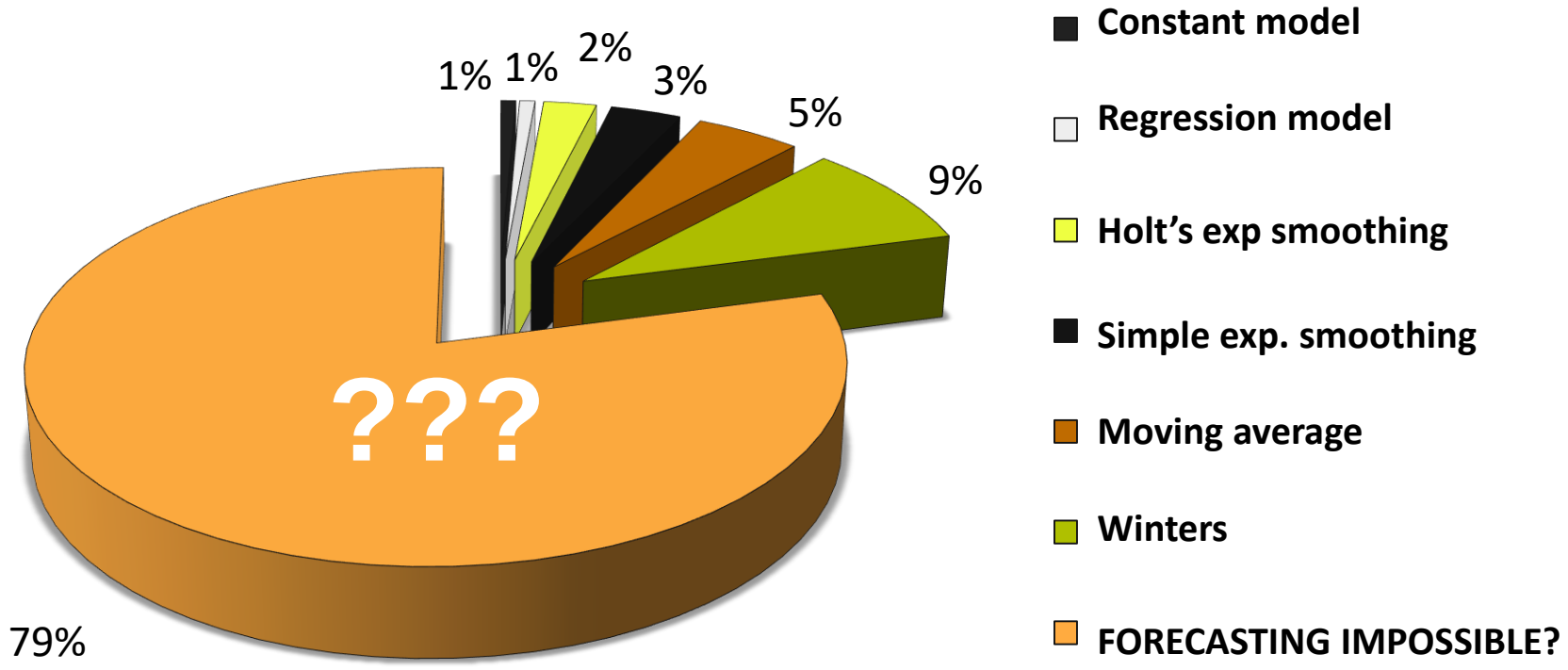


▸▸ QUANTITATIVE METHODS X COMMON SENSE

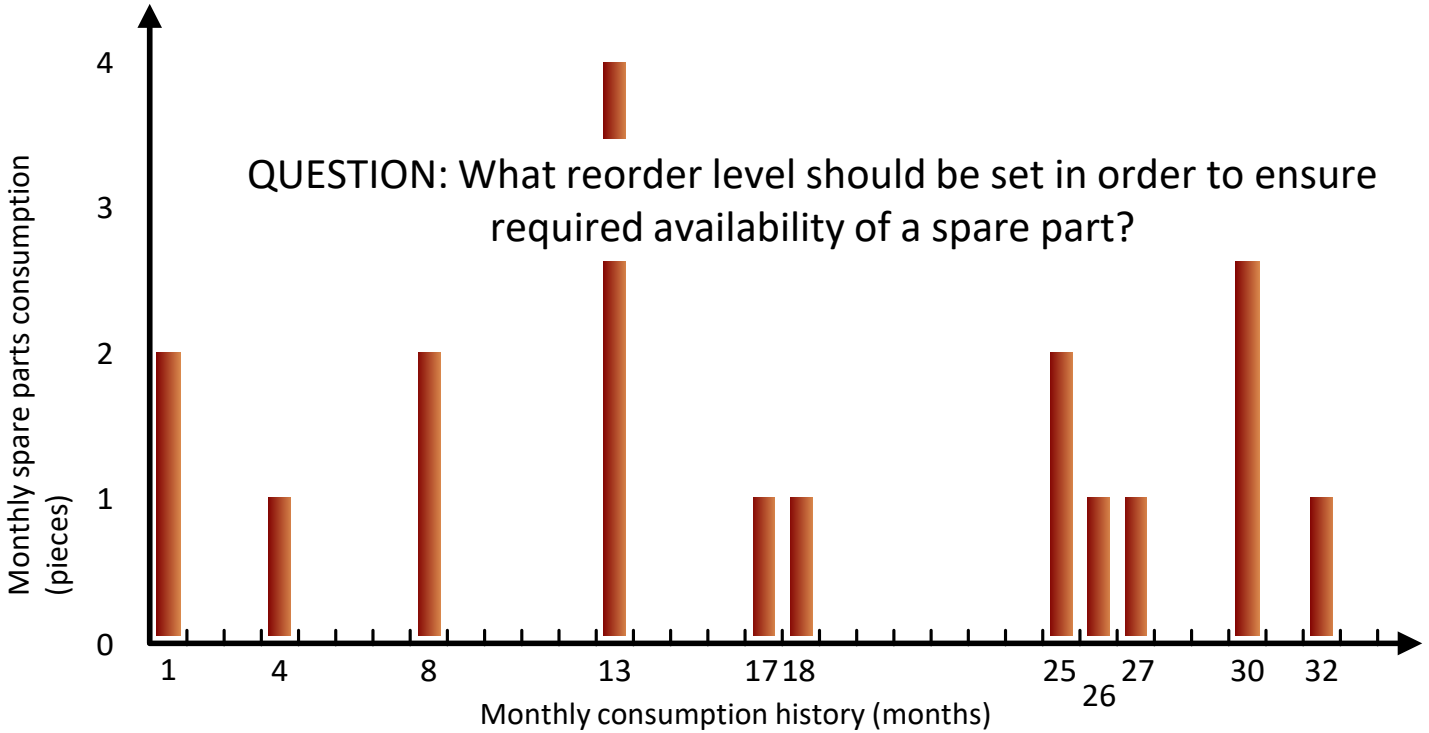
▸▸ FORECASTING STEP BY STEP

1. **Visualisation of time series**
   For better understanding of the time series
2. **Calculation of forecasts using all available methods**
3. **Calculation of accuracy**
   Absolute and relative errors, evaluation on testing season
4. **Selection of the best method**
   Best accuracy and reliability

WHICH FORECASTING METHOD IS BEST FOR SPARE PARTS?

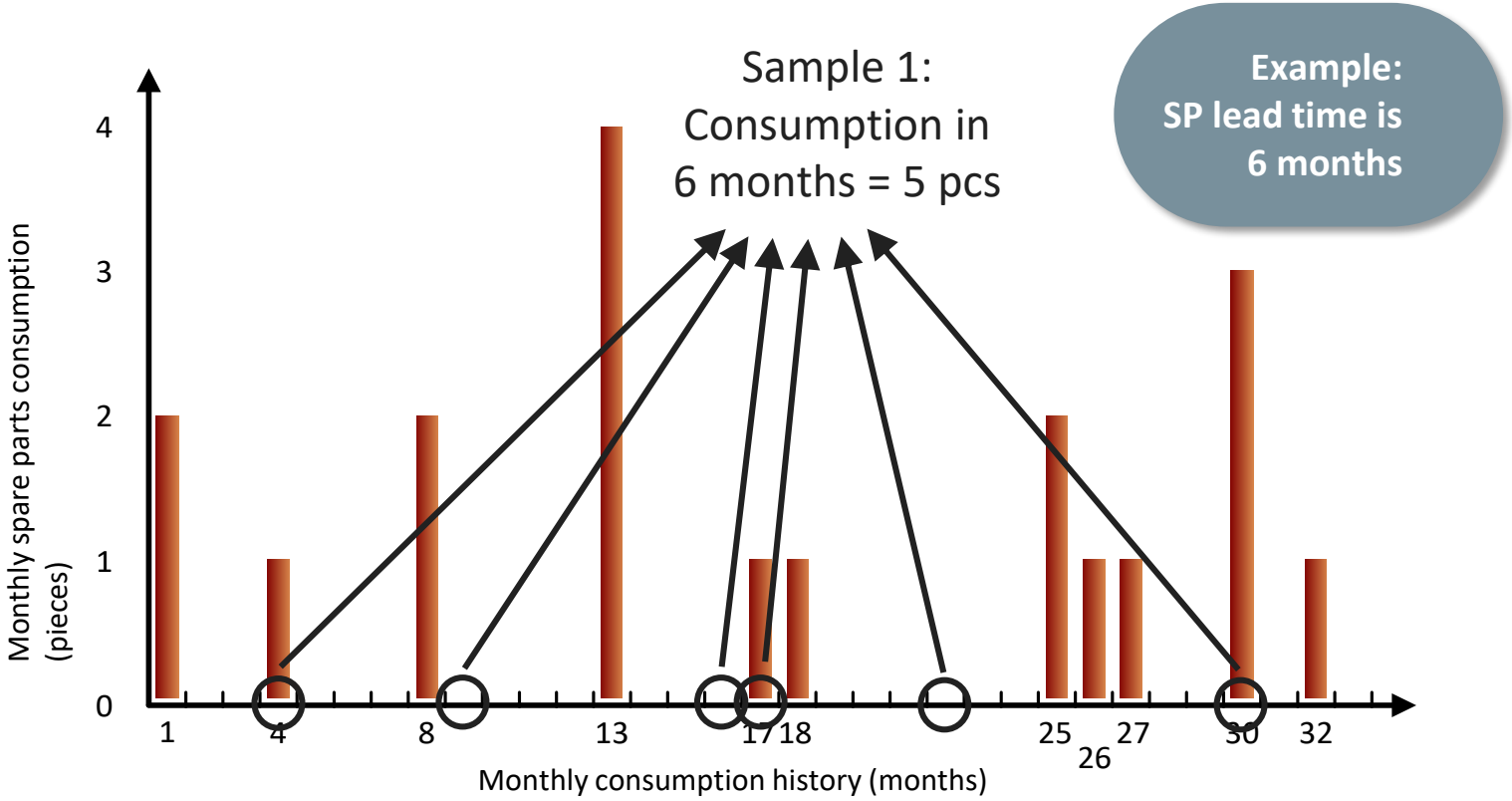


SPARE PARTS – INTERMITTENT DEMAND



BOOTSTRAPPING

Bootstrapping = random sampling from history of consumptions.
SP consumption for lead-time period is sampled from history



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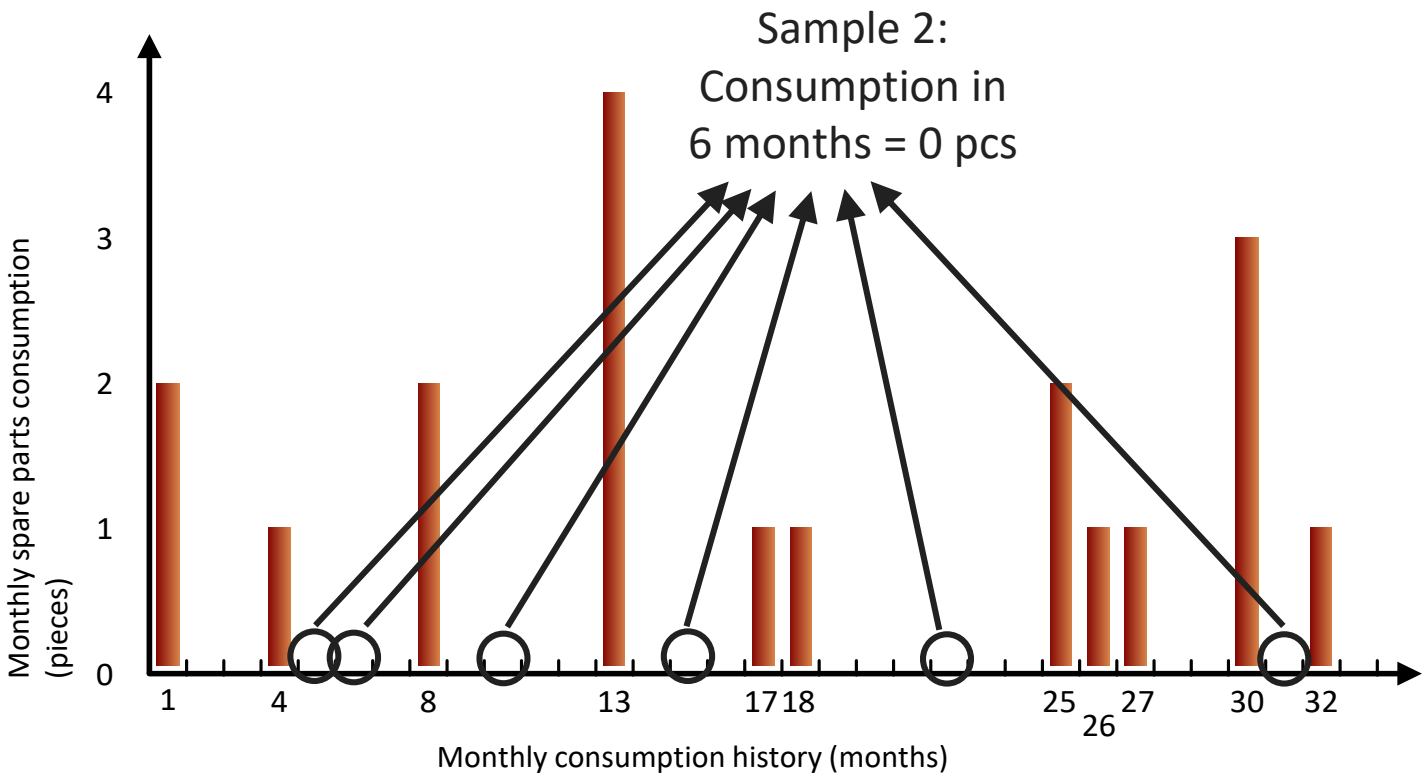

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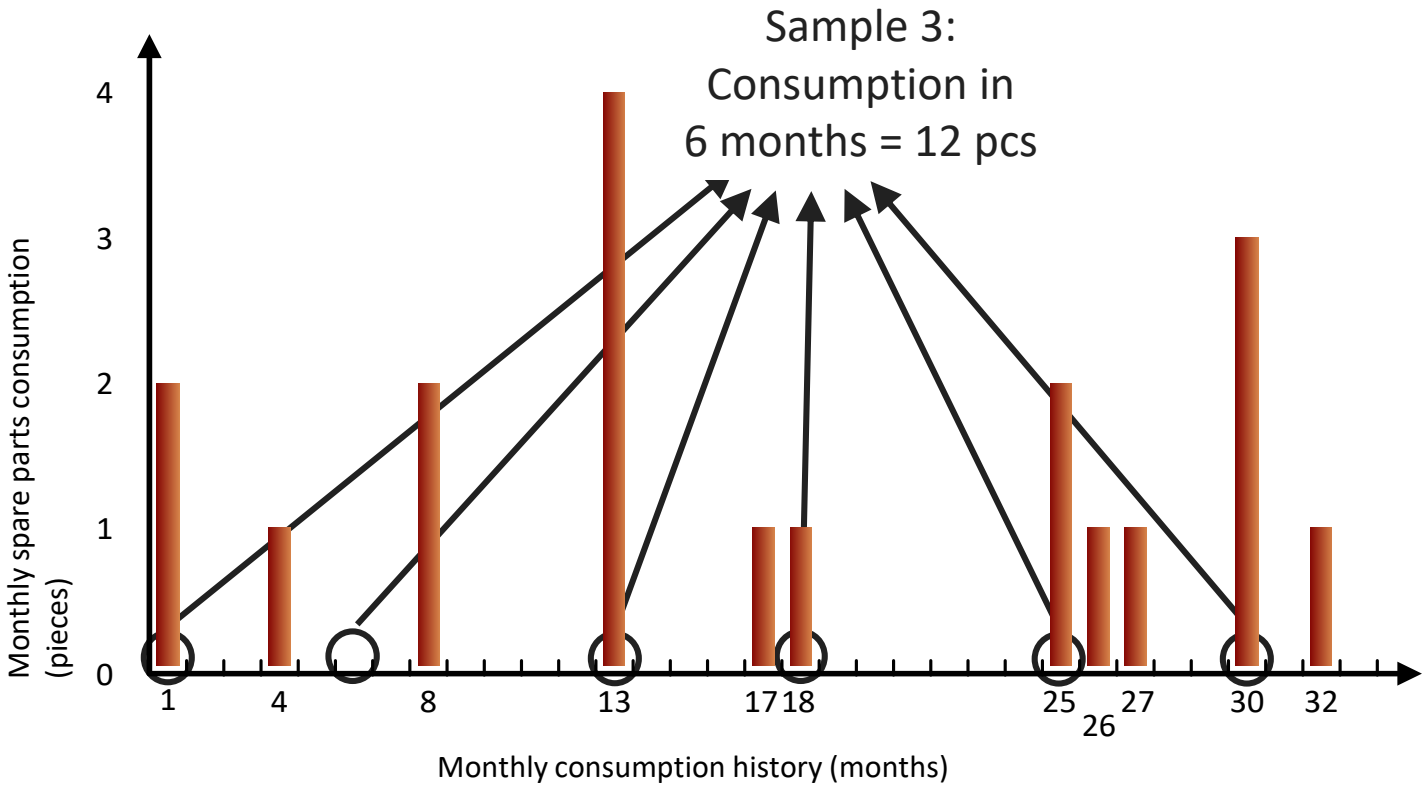
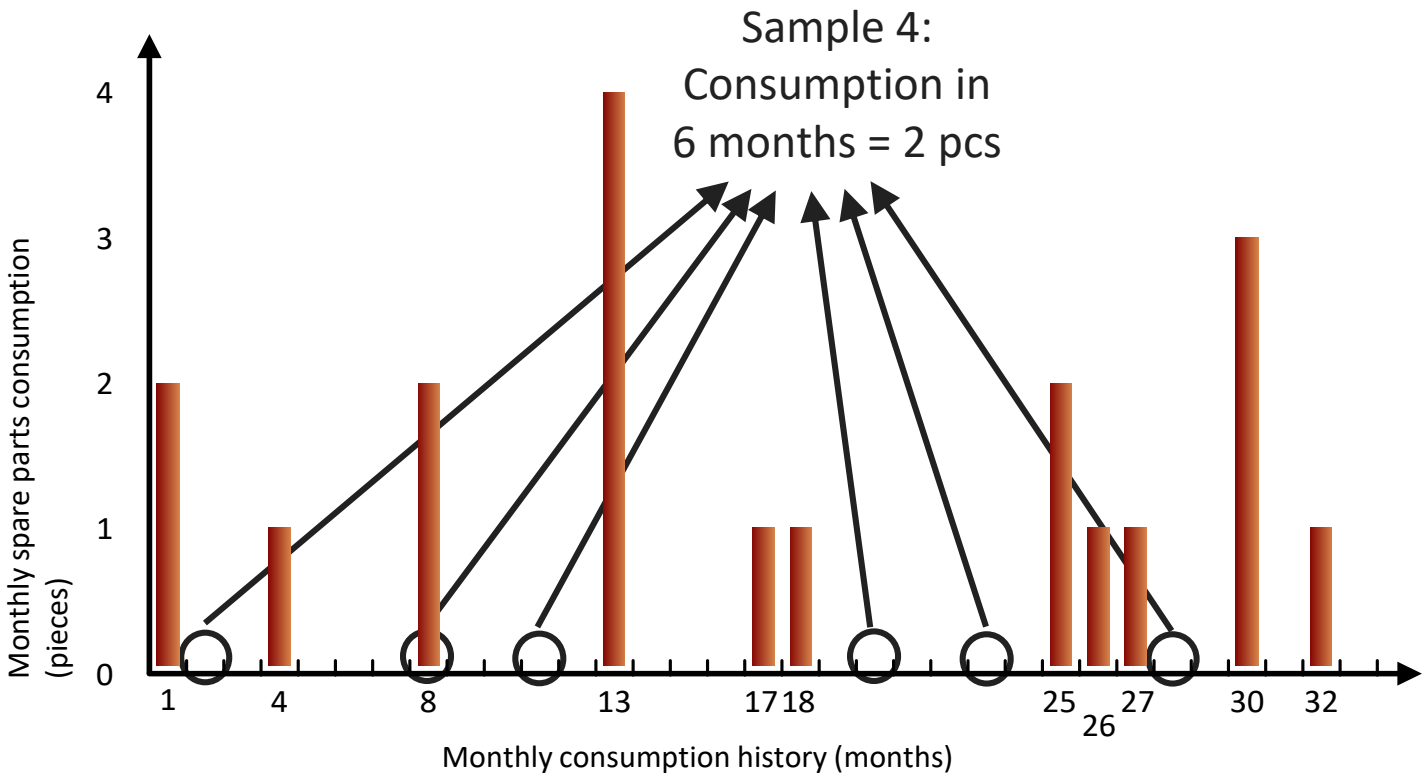
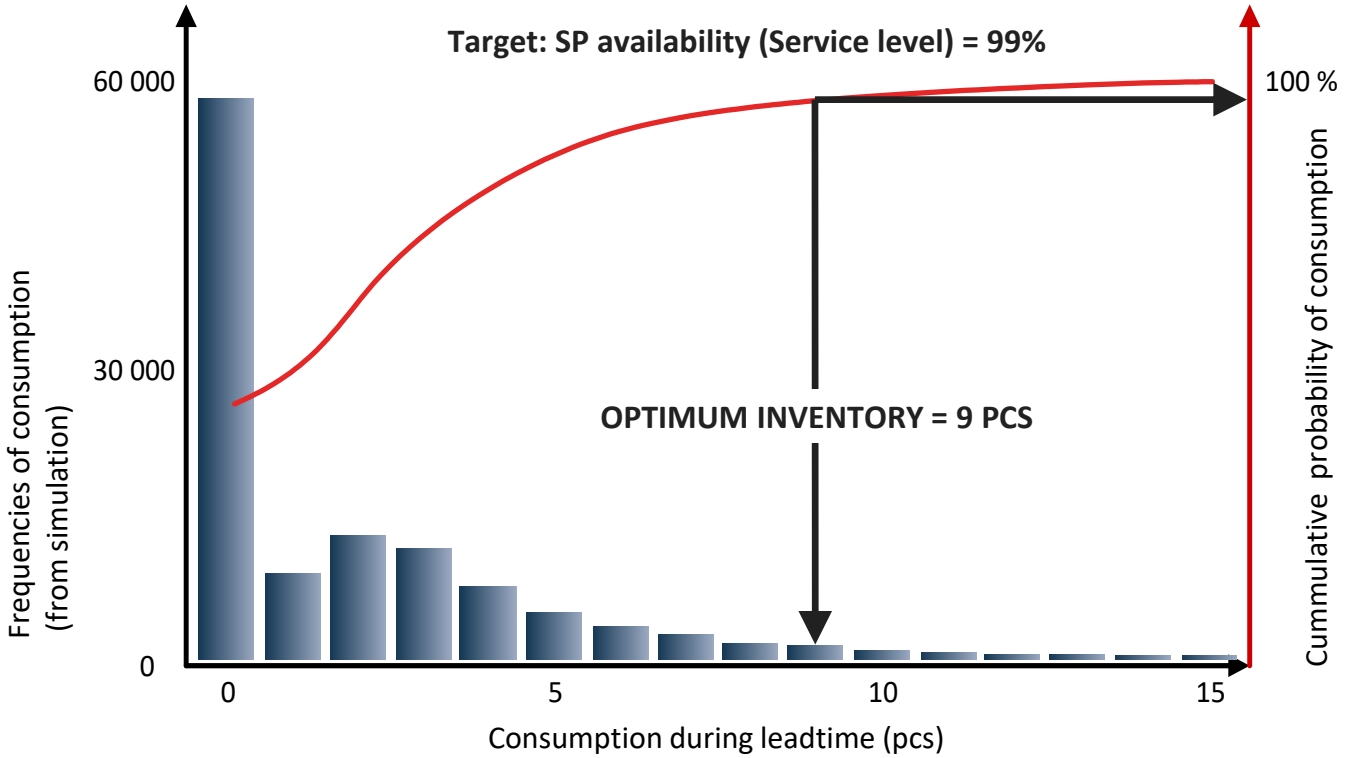


BOOTSTRAPPING



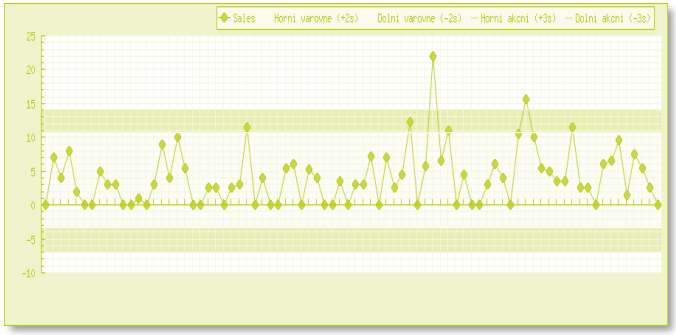
EXAMPLE OF 100 000 SIMULATIONS OF SP CONSUMPTION

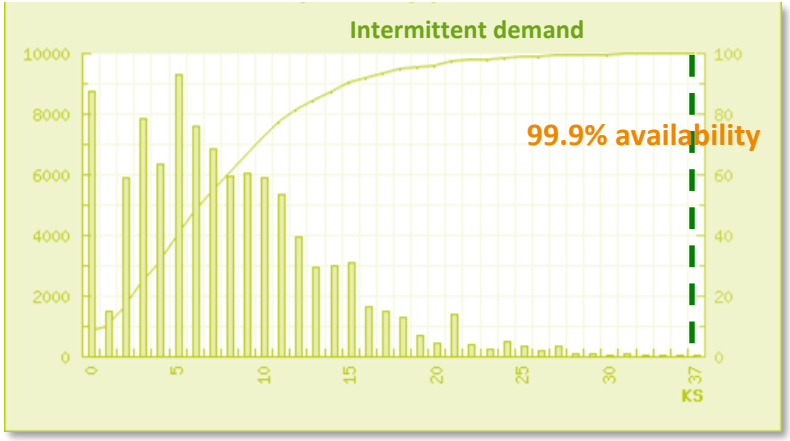


▸▸ BOOTSTRAPPING APPLICATION – A REAL CASE STUDIES

Original inventory: **17 000 EUR**
(49 pcs)

Spare part lead-time: **32 days**





Recommended inventory:

29 pcs = 10 000 EUR

Savings: 7 000 EUR

planning wizard 2.0

Detail | Objednávky | ABC Analýza | Trend | Struktura | Reporty

Cesta: Schäfer a Sýkora > Náhradní díly > 590 - Centrální sklad Rumburk > Tuzemské díly > Těsnění,Kalina > Těsnění,Kalina > 3517-0001

Produkt: Papír těsnící 0,5 mm,1500x750x0,5 Reinz AFM 38

Schäfer a Sýkora

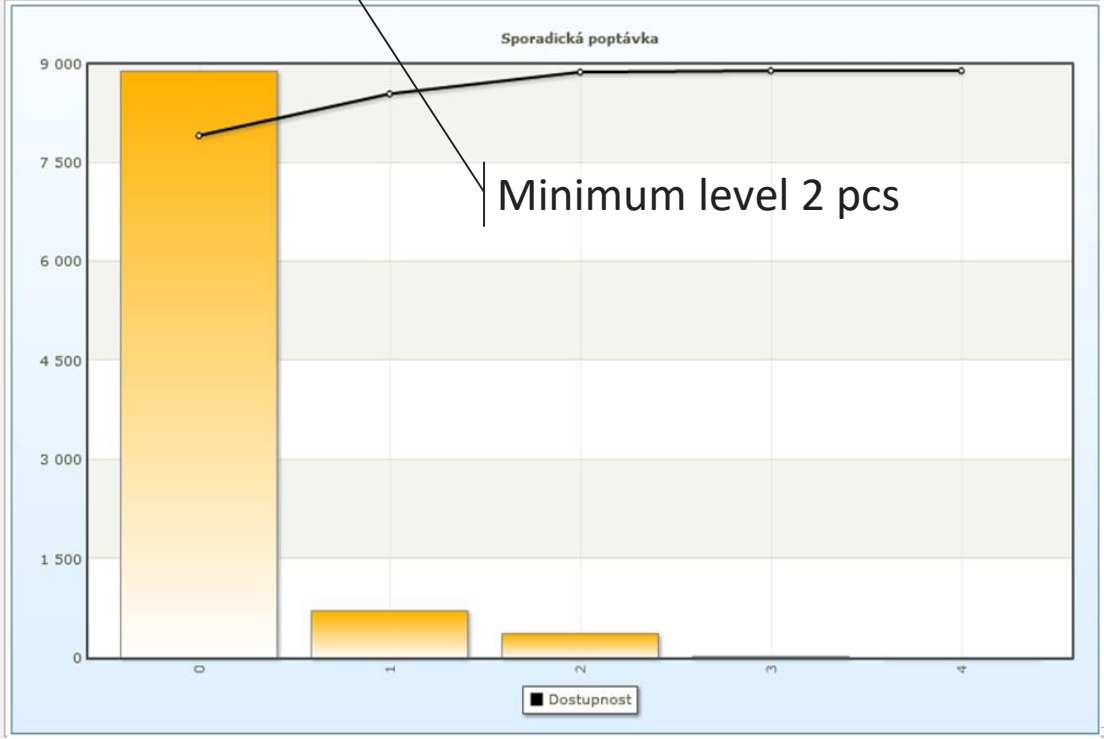
- Náhradní díly
- Osvětlovací technika
- Konsignace

Disponibilní zásoba	MIN. zásoba	ABC	Service level	PC	OBJ	Blokace
0.00 Kč (0 KS)	859.76 Kč (2 KS)	A (A)	100,0% (99.1%)	524.58 Kč	0.00 Kč (0 KS)	0 (mj)
				SC 429.88 Kč	Na cestě 0.00 Kč (0 KS)	

Logistické ukazatele

Detail | Forecast | Očistění forecastu | Očistění prodejů | Očistění leadtime

Sporadická poptávka



Minimum level 2 pcs

EFFECTIVE SPARE PARTS MANAGEMENT – 8 RULES

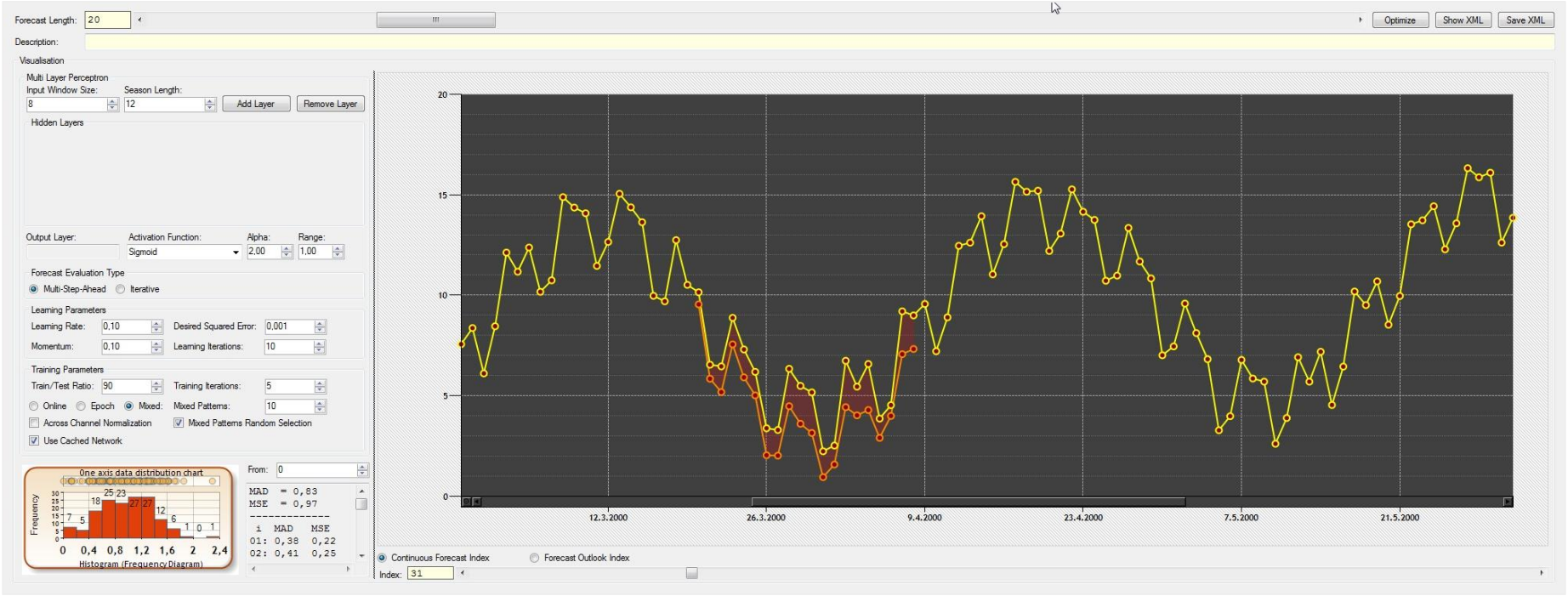
Preventive maintenance	Smooth SP processes
Segment your SP portfolio	Assess criticality
Good forecasting	Special methods for intermittent demand items
Life cycle thinking	**Purpose-driven data and smart tools to automate**

CULTURE / TECHNOLOGY

Culture Eats Strategy For Breakfast, Innovation For Lunch, And Transformation For Dinner

FORECASTING OF SPARE PARTS CONSUMPTION WITH NEURAL NETWORKS

AI and advanced statistics work for us.



DATA REVOLUTION

We have so much data today
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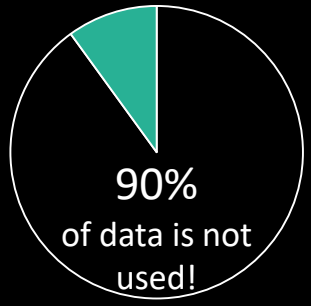

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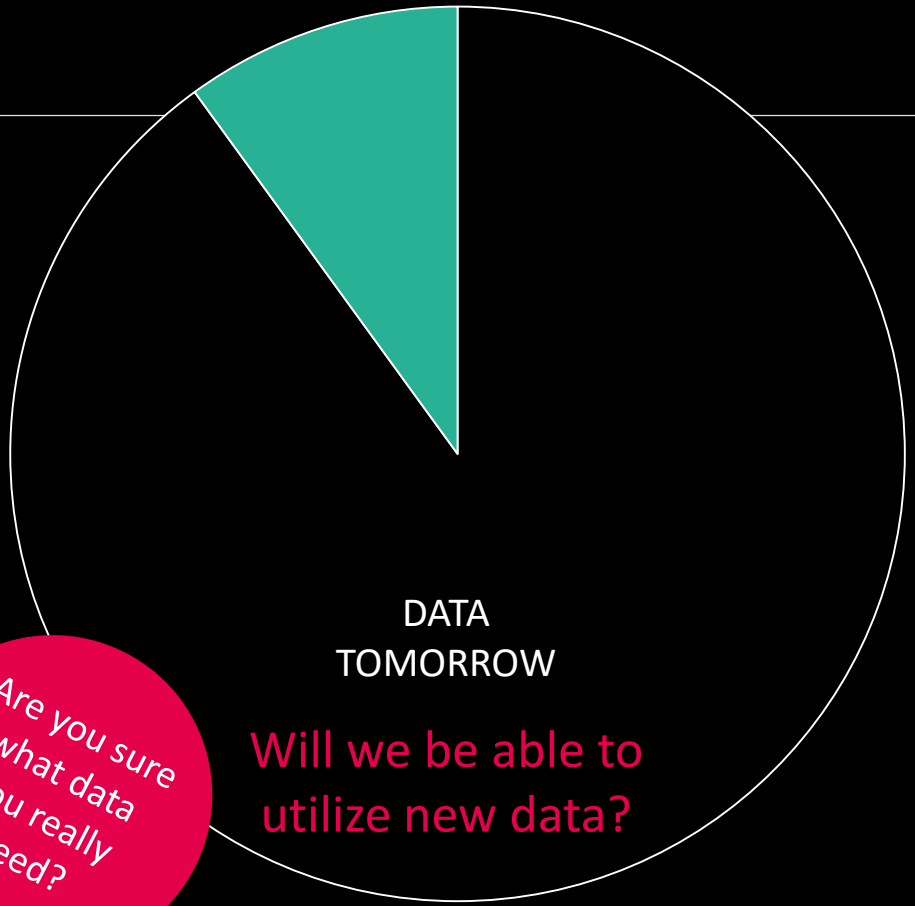

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