



# NEXT GENERATION SUPPLY CHAIN PLANNING

## EXECUTIVE SUMMARY



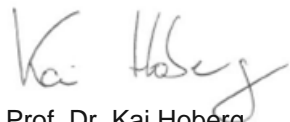
**”The supply chain stuff is really tricky”**

- Elon Musk -

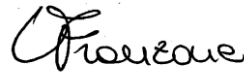
While many companies still struggle with supply chain management, industry leaders have a clear vision of the value that outstanding supply chain practices can provide. In particular, supply chain planning processes have the potential to boost the operational performance in many settings and have received a lot of attention recently.

New digital technologies, new data sources, and new software solutions offer the opportunity for much further and wider optimization. As part of an extensive study on next generation supply chain planning, the joint KLU/Bayer project team has collected scientific and practical materials and interviewed many leading supply chain experts.

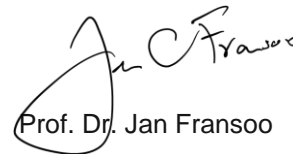
Based on the insights gained we have proposed a set of eight themes that will shape next generation supply chain planning. In this document we will outline these themes and anticipate the changes required to move ahead on this endeavour.



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# 8 KEY THEMES EMERGE AROUND THE BEST-PRACTICES FOR NEXT GENERATION SUPPLY CHAIN PLANNING



## Key Themes Identified

- #1 **Supply chain planning workflows will become more automated** and move from manual routine activities to system-guided decision-making and exception-based interventions.
- #2 **Automation** of processes and critical supply chain decisions **is driven by trust and incentives** for the planners.
- #3 **AI/rule-based approaches** play an important role on the journey but **require experimentation** with relevant use cases, potential data sources, and user acceptance.
- #4 **Transactional and master data quality is critical** and requires continuous improvement and measurement.
- #5 **Process mining as an essential tool** to boost data quality and to create insights into current realities
- #6 The required **supply chain planning technologies mature quickly** and will support the new processes
- #7 **More holistics, strategic roles will emerge** from the current supply chain planner's job profiles
- #8 **New dedicated roles around data science and data stewardship** are required to augment supply chain planners



# AGENDA

## #1 Supply chain planning workflows will become more automated

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Conclusion and next steps

## WHAT WE HEAR IN THE INTERVIEWS



” Automated systems support decision making by showing all necessary insights and thereby **eliminate time-consuming communication and activities.**

Director of SC and Transformation

” Transaction activities are not value adding. **These activities should be eliminated and automated.**

SVP Global Business Services

” The future supply chain is dominated by a number of **technologies that make it become more integrated, transparent and automated.**

Managing Vice President

” The first step of automation is the identification and automation of **products that can work autonomously without any manual input by the planner.**

Head of Planning and SC Excellence

### Key Insight #1

**Supply chain planning workflows will become more automated** and move from manual routine activities to system-guided decision-making and exception-based interventions.

# DECISION EXPLOSION: WHY TODAY'S BUSINESSES REQUIRE AUTOMATION OF SUPPLY CHAIN PLANNING



## Causes

-  Global sourcing
-  Customer expectations on availability
-  Product and brand diversification
-  More granular manufacturing
-  Distribution diversification

## Decision Explosion

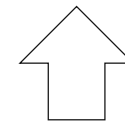
Character of supply chain decisions change in terms of

- Higher complexity
- Higher frequency
- Higher amount



## Effects

- Higher process complexity
- Big data storm is created
- Information asymmetry
- More complex sourcing lines



Digitization and automation required to successfully handle these effects

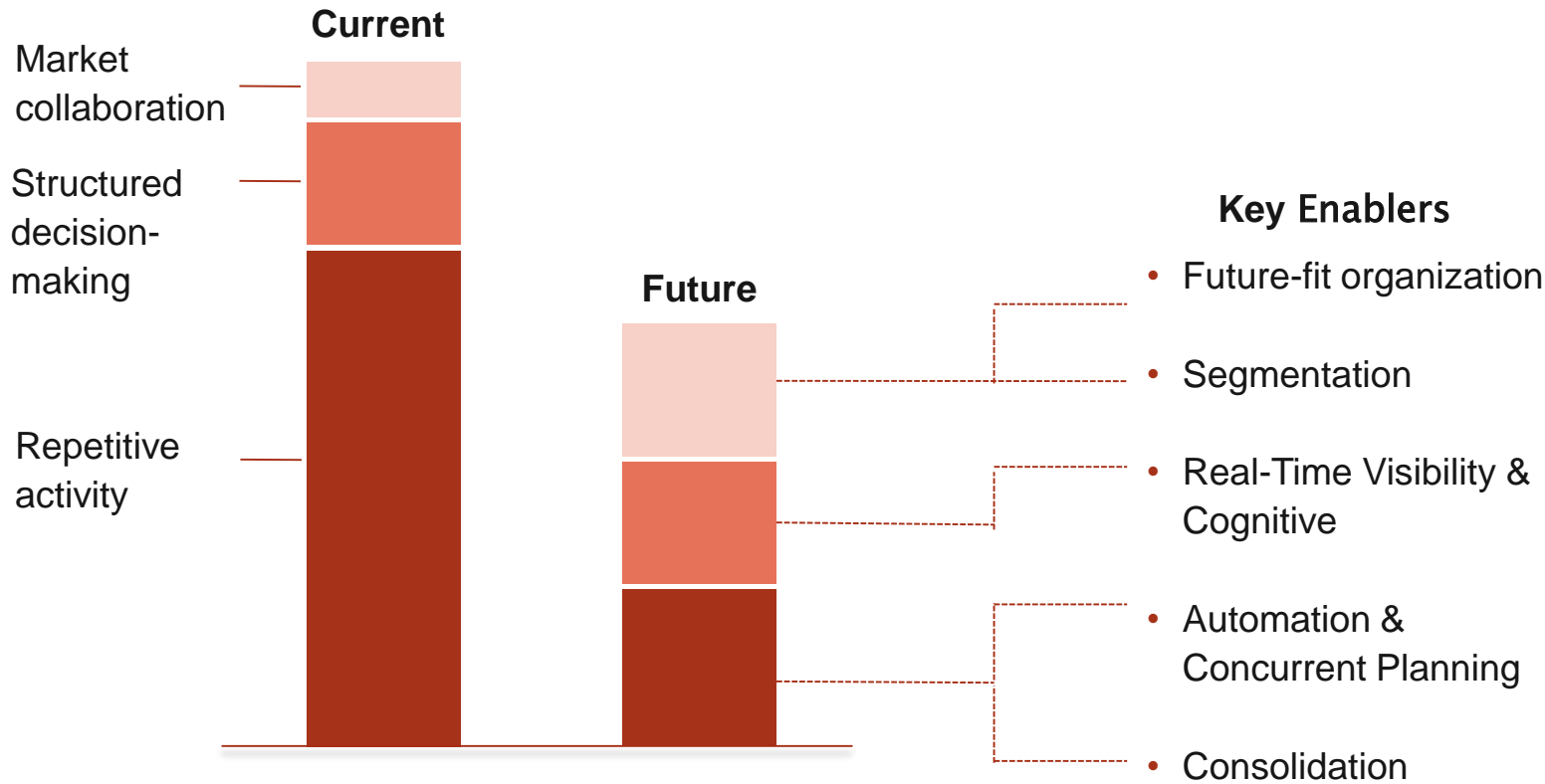
## Comments

- Many **environmental changes** such as the higher number of products, increased customer expectations, or more granularity in planning have triggered **increased complexity in supply chain planning**
- We refer to the higher number, higher frequency and higher complexity of decisions as **decision explosion**
- As a result, supply chain planning has to deal with many effects that adversely affect the processes and **drive the effort of planners**
- To address this challenge efficiently, **automation of supply chain planning is required**

# THE WORKLOAD OF PLANNERS IN THE FUTURE WILL CHANGE BASED ON INCREASED AUTOMATION AND AUGMENTATION



Time spent on planning activities



- ### Comments
- Current, not digitized planning processes are strongly dominated by **repetitive activities that need to be performed by the planner**
  - In the future, **these repetitive activities should be reduced to a minimum** – at least for the human, because these activities will be highly automated
  - Additionally, the **planner will focus on planning activities around market collaboration** and strategic thinking. Here, more interaction with the business and increased communication is needed
  - In contrast to the reduction of repetitive planning activities, the amount of **repetitive data management activities will increase**



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Conclusion and next steps





## WHAT WE HEAR IN THE INTERVIEWS

” It is essential to build trust in the **system** to make the system work properly.

Senior Director SCM

” **People need to understand and highlight the value-add of intelligent planning.**

Head of SCM & Information Systems

” **The adoption of assistive AI systems is limited by a lack of trust** of humans into an AI's prediction.

Reseracher

” **Acceptance and Understanding** that the collaboration of the machine and the planner will lead to better results is important.

Senior Director SCM

### Key Insight #2

**Automation** of processes and critical supply chain decisions **is driven by trust and incentives for the planner.**

# WHITE BOX VS. BLACK BOX AI

## Black Box AI

- AI makes recommendations but the underlying explanation is unknown and the logic behind the algorithm is unclear
- Complex data processing and models: Algorithms take millions of data points and correlate specific data to get a certain output
- Input and operations are not visible or understandable to the user
- Exact relationships and connections are unclear



## Components

- More collaborative data science
- Trust in data
- Involving employees
- Including tools
- Creating intuitive interfaces
- Increasing algorithm transparency



## White Box AI

- Interpretable, explainable models of AI
- Understandable, explainable, and accountable results are presented based on the data analyzed for the use case
- Features become understandable and the ML process becomes transparent
- User can understand behaviors and relationships between influencing variables and the output predictions

## Comments

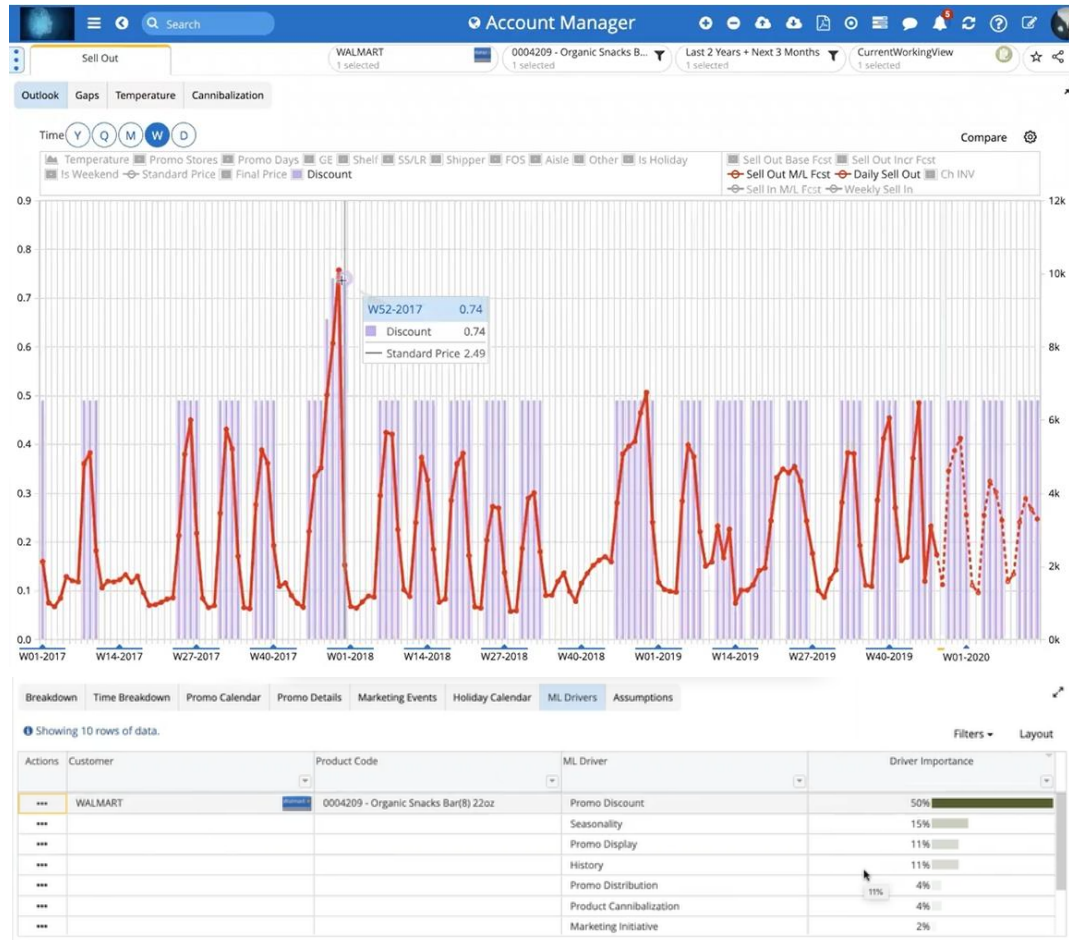
- Black box AI simply **spits out solutions without a comprehensible reasoning**; to open up this black box and turn it into a white box for employees, some important components are needed
- Creating **white box AI algorithms could allow people to collaborate with AI** and break down a wide variety of complex problems into easy-to-understand steps **leading to innovation and process improvement**
- Observable/understandable behaviors, features, and **relationships between influencing variables and the output predictions need to be made clear** (similar to linear regressions and decision trees that highlight causal relations)

# VISUALIZATION AND FEATURE IMPORTANCE CAN CREATE UNDERSTANDING AND TRUST



## User interface example

Visualisation of relationships, e.g.: sales & discounts



Over of important sales drivers e.g. feature importance

## Comments

- To enable planners to understand the relationships, **many software packages provide easy visualizations and highlight the feature importance**
- The O9 example shows historical sell-out data for a specific product (red line) and the predicted future sales (dotted line)
- **The self-service visualization** (in blue) highlights the discounts given and allows to easily observe the relationships with sales and can be easily adapted for other variables
- **Unpacking the black box and making it transparent by including demand drivers** such as promotions, temperature, holidays, or seasons in the data presentation that show the exact correlation and the actual sell-outs using the feature importance



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## WHAT WE HEAR IN THE INTERVIEWS

” **It is important to identify use cases rather** than entire business problems that need to be solved.

VP Industry Outreach & Thought Leadership

” **The development of AI planning systems has to be realized in layers.** On the way from basic ML to AI we are still in the middle of the process.

Senior Director SCM

” The first step in the direction of intelligent autonomous planning in the **automation of repetitive tasks.**

VP Worldwide Planning & Customer Service

### Key Insight #3

**AI/rule-based approaches** play an important role on the journey but **require experimentation** with relevant use cases, potential data sources, and user acceptance.

## STEPS FOR A SUCCESSFUL AI ROLL OUT



### Use cases definition Readiness check

What is the company's current situation regarding automation/AI?  
Does the company have know-how, skills, employees?  
Where are possible areas of AI application?  
What are possible challenges for the company regarding AI?  
Which requirements are needed for a successful application?



### Procedure model Prototyping Testing

Which model is suitable for the chosen use case?  
How does this model work for the prototype?  
Can we identify any other problems that have not been found before?  
Does the model pass all relevant tests?



### Minimum Viable Product System integration

Where can the AI system first be applied?  
How can the system optimally be integrated in current functions?  
How to overcome implementation challenges?  
How to build acceptance from the workforce?



### Monitoring Re-training Service management

How does the system currently work?  
Does the algorithm have to be adjusted?  
Are the employees skilled enough to work with the system?

### Comments

- Implementing AI in the company has to be realized in several steps.
- First, it has to be **identified where AI can actually be applied** to support the employee and improve the current process.
- Second, the right **model has to be selected and tested** for a certain use case.
- Third, the developed **AI system can finally be integrated** into the chosen and prepared business process.
- Finally, the integrated system has to be constantly **monitored, adjusted, and improved**.

# AI ALREADY WORKS WELL IN MANY SUPPLY CHAIN PLANNING SETTINGS

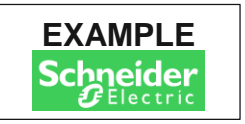


## SENSE

## SOLVE

## SUGGEST

## SERVE



Source

- Quota optimization
- Procurement control tower

- Commodity price prediction
- Supplier payment terms

- Pricing anomalies
- Track performance & compliance

Make

- Inventory control tower
- Manufacturing control tower

- Predictive maintenance
- Production planning optimization

- Time management
- Factory replenishment

Plan

- Sales order dashboard
- Demand review

- Demand forecasting
- Intelligent production line management

- Shortage risk alert to supplier
- Plant production order replenishment

Deliver

- Global DC Scorecard
- Stocking policy

- Service analytics
- Warehouse optimization

- Shipping mode modification
- Plant change

Care

- E2E lead time
- Customer dashboard

- Predictive maintenance
- Production planning optimization

- Customer pull flow
- Doc control

## Comments

- AI can contribute to the realization of these four aspects, that can lead to a better **flexibility, agility, and resilience** of the companies' supply chain processes and decision making
  - **Sense:** Collect data & create E2E supply chain visibility
  - **Solve:** Compute for insights, clean outliers, modelling, highlight abnormalities
  - **Suggest:** Create scenarios, predict events, recommend actions
  - **Serve:** Update systems & tools with decisions, feedback loops, reinforcement learning





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## WHAT WE HEAR IN THE INTERVIEWS

” **There is a high importance of data** – the application of AI comes along with a very high velocity of data, which creates a challenge for the companies.  
B2B Technology Innovator

” **The more automation is realized, the more important data maintenance becomes.**  
Head of SCM & Information Systems

” **Data management is the core challenge for companies** as they create a mass of data that needs to be prepared, maintained, and used accordingly.  
VP Global SC & Advanced Analytics

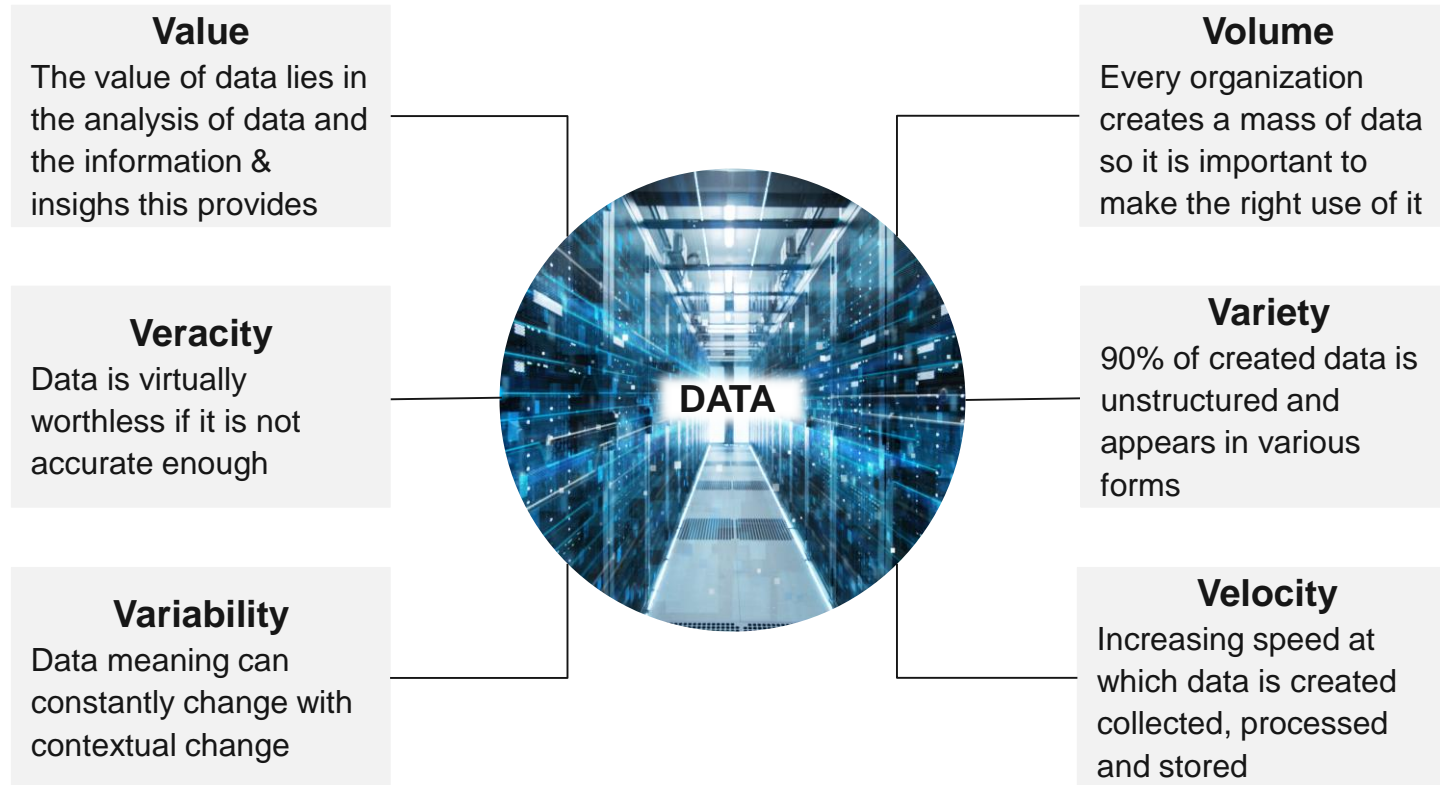
” To successfully apply and use AI, **data cleanness and quality is crucial.**  
Distinguished Professor of SCM

### Key Insight #4

**Transactional and master data quality is critical** and requires continuous improvement and measurement.

# DATA ANALYTICS TO DRIVE SUPPLY CHAIN PERFORMANCE

## THE 6 V OF DATA



### Comments

- Big data has six important characteristics that should be known to be prepared for both, challenges and advantages of big data analytics
- **All of these aspects** of big data will, in the context of further business transformations, **increase significantly** in the future
- Big data analytics becomes even more relevant for companies. Data on its own basically can be worthless according to these aspects, **the value of data lies in the accurate and effective analysis to gain information and insights**



# THE ROUTE TOWARD BETTER MASTER DATA MANAGEMENT



- | Comments  |
|---|
| <ul style="list-style-type: none"><li>▪ In many organizations employees still do not full acknowledge the importance of data management and quality</li><li>▪ It is an important effort as the amount of <b>master data increases in the future</b></li><li>▪ This nine-step framework serves as a guideline for master data improvements and basically includes three focus areas:<ul style="list-style-type: none"><li>– Communication of master data relevance</li><li>– Organizational setup and governance</li><li>– Processes and incentives</li></ul></li><li>▪ <b>Without improved master data management organizations will lose their ability to leverage the latest IT innovations</b> to implement intelligent and automated supply chain decision-making</li></ul> |



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## WHAT WE HEAR IN THE INTERVIEWS

” **Process mining should ideally support the parameter maintenance** by identifying the deviation from the status quo.

SVP Global Business Services

” It is important to identify where significant problems exist in the supply chain network. **Process mining tools highlight these problems.**

SVP Global Business Processes

” If automation is in the play, you'll need the right tools and expertise to handle your complex processes. **Our process mining journey supports you in turning discovered opportunities into real business outcomes.**

Company Founder

### Key Insight #5

**Process mining is an essential tool** to boost data quality and to create insights into current realities.

# TECHNOLOGY TO UNDERSTAND HOW WORK ACTUALLY GETS DONE TO DRIVE CHANGE IN THE ORGANIZATION



## Discover

- Develop a true understanding of how work gets done
- Where is effort reduction potential?
- Understand work at the task and process level

## Priorize

- Highlight of key insights
- Course of action: Clean up, automate a process or both
- Build a process transformation roadmap

## Realize

- Realization of automation by choosing and implementing the right tools and according expertise

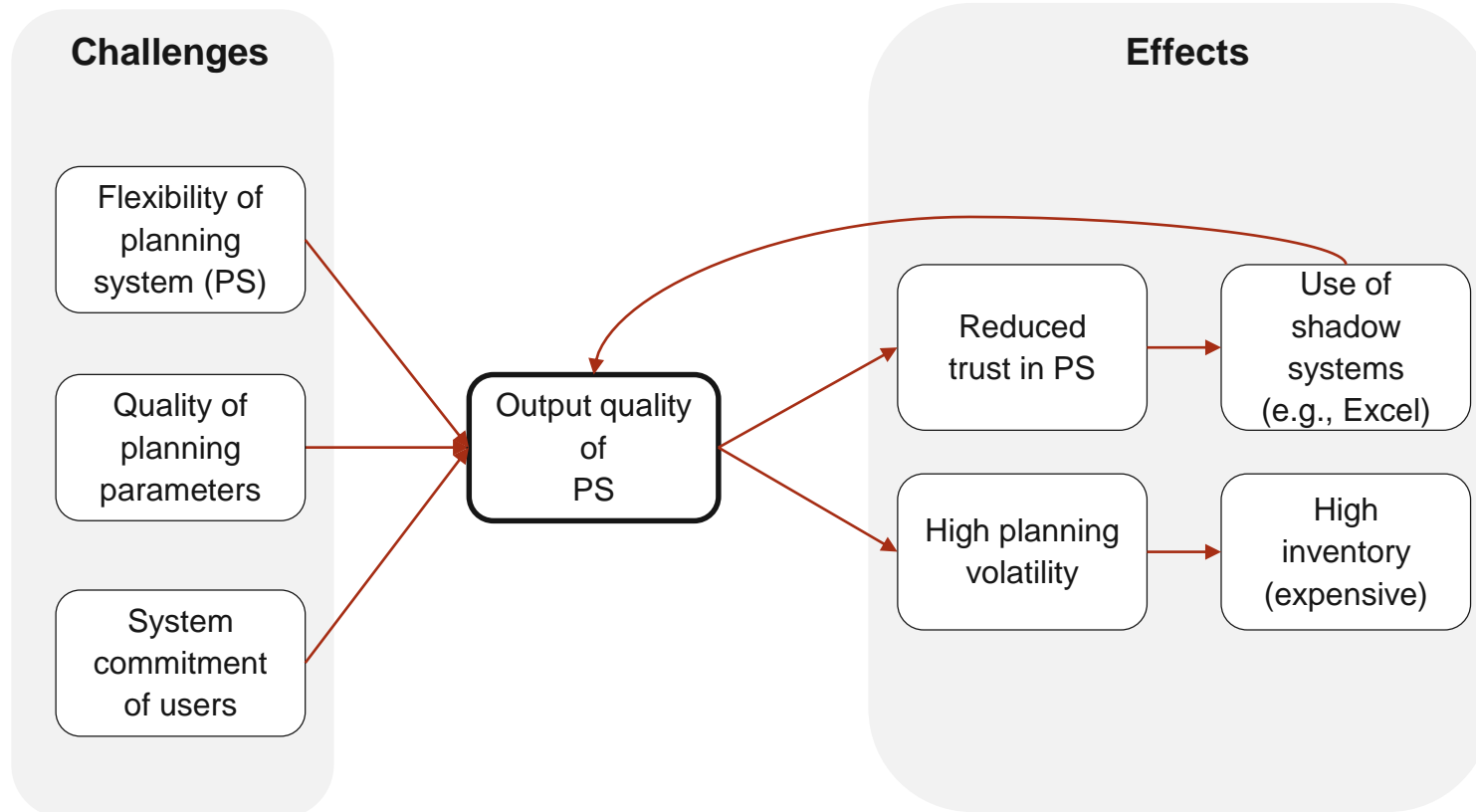
## Catalyze

- Expansion of chosen transformation throughout the organization
- Catalyzation additional people, processes, and technology

## Comments

- Process mining can **reveal relevant insights** about the companies' processes by analyzing process execution data
- The key question always are:
  - **How** is the process conducted?
  - **Where** and **why** in the process do behavior or outcomes differ from expectations?
- **Uncover the interaction and processes** between people and technology with the digital footprint within the organization
- **Determination of the right course of action** to improve processes based on the findings from process mining

# PROCESS MINING CAN BE USED TO SOLVE CURRENT PLANNING PROBLEMS



- ### Comments
- Existing data has to be better exploited
    - Process mining can be used to mine planning parameters
    - Automatically analyze / identify trends
  - Process mining can be used to understand in which cases APO output is not considered appropriately
    - Requires building up respective infrastructure since APO does not leave any traces
    - Conduct root-cause analysis (e.g., in which cases was the quantity / time incorrect?)
  - Process mining could be used to analyze the master data maintenance process: How well is the data maintained? Where are values missing? How often are certain parameters updated?

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## WHAT WE HEAR IN THE INTERVIEWS

” **Technology always functions as an enabler of business processes.**

Chief Information Officer

” Agile and flexible processes and people supported by technology **improve decision making and supply chain resilience.**

Director of SC Transformation

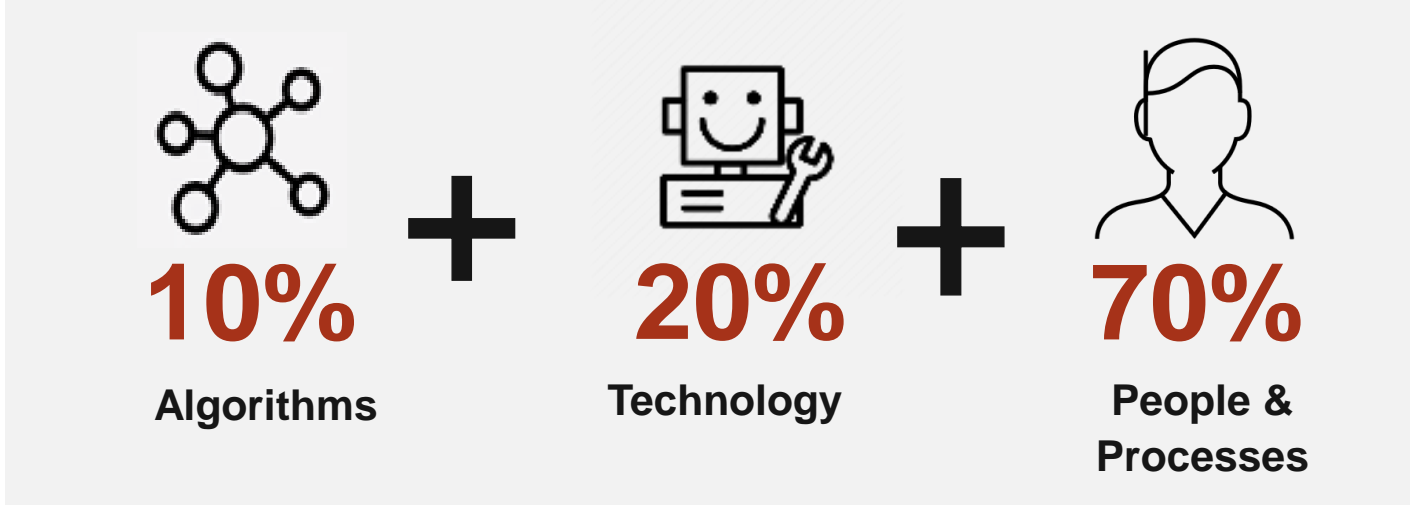
” Due to the fact that in most companies much of the heavy lifting of the demand planning processes is still done in spreadsheets, **demand planning systems can certainly improve forecasting capabilities tremendously.**

Executive Vice President

### Key Insight #6

The required **supply chain planning technologies mature** quickly and will support the new processes.

# TECHNOLOGIES MATURE QUICKLY – THE FOCUS MUST LIE IN PEOPLE AND PROCESSES



- **Technologies fail when falling short of the 70% part** (people & processes) because **humans have essential insights** that cannot be found in past data that can therefore cannot be analyzed by the technology
- **Human-AI** collaboration is a long process to establish, costly and difficult but leads to **long-term success**
- Importance to **invest in human knowledge to create experts**

## Comments

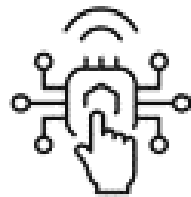
- **Technology** itself is – in the long run – **less relevant to consider** during the supply chain transformation and digitization process as people and processes because they mature quickly over time.
- At the end, **people make the change**, not the technology.
- More technologies develop in the market, but do not differ significantly from each other.
- Therefore, choosing a tool/technology becomes less important than **focusing on adjustment of processes or training of employees.**
- The **capability of people to optimally use technology for their purpose and to become more efficient**, at the end, really improves planning processes.

# HOW TO DEAL WITH SELF-HEALING PARAMETERS



## Self-healing parameters

The system detects inaccurate design assumptions and automatically adjust and monitor inputs based on historical data so you know where to focus your attention first.



## Interference of the human on the parameter

Adjustment of the parameters by the planner, as soon as differences occur. It is important to find a balance between manual adjustment and letting the system work independently.



## Overreaction

The system is reacting too sensitive on the input change for the parameter. Consequently, the system might not be able to distinguished between normal variation and structural changes (e.g. longer lead times)

## Comments

- Trade-off between automated parameter updating and adjustment of the update
- Updating the parameters manually, can lead to a **too nervous reaction of the parameter on the adjustment** – which in the future leads to wrong predictions
  - **Fear** of having self-healing parameters lies in the fact that **every outlier will have an impact**
  - Important to understand what is an exception
- It is hard for algorithms to distinguish between normal uncertainty, variation, and structural changes
- Parameters **such as yield and lead time** are most in focus when considering the self-healing ability → often don not reflect the actual reality, so **delay effects** have an impact



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## WHAT WE HEAR IN THE INTERVIEWS

- ” **The planners’ capabilities will change in the future**, so knowledge about the companies’ ecosystem, partnerships, strategy and market tactics will be required.   
Senior Director SCM
- ” AI will not take over all activities, **the focus of planners’ activities gradually shifts to more strategic tasks that need emotions or relationships.**   
B2B Technology Innovator
- ” **The right evaluation of the systems’ results and taking the further business decisions** is going to be another key task of the future planner.   
VP Industry Outreach & Thought Leadership
- ” **The separated supply chain planning functions will merge into one E2E planner.** So model supervision, leadership, workflow management, and collaboration will be in the focus.   
Director of SC Transformation

### Key Insight #7

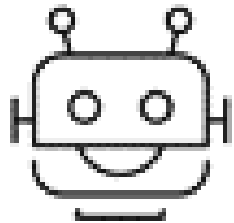
**More holistic, strategic roles will emerge** from the current supply chain planners’ job profiles.

# DISTRIBUTION OF ROLES BETWEEN THE MACHINE AND THE SYSTEM

## Capabilities



- Empathy & emotional intelligence
- Connection of unrelated areas
- Creativity & innovation
- Improvisation & abstraction
- Communication skills
- Relationships
- Cognition



- Big data processing capabilities
- Precision & accuracy
- Strength & speed
- Rational behavior

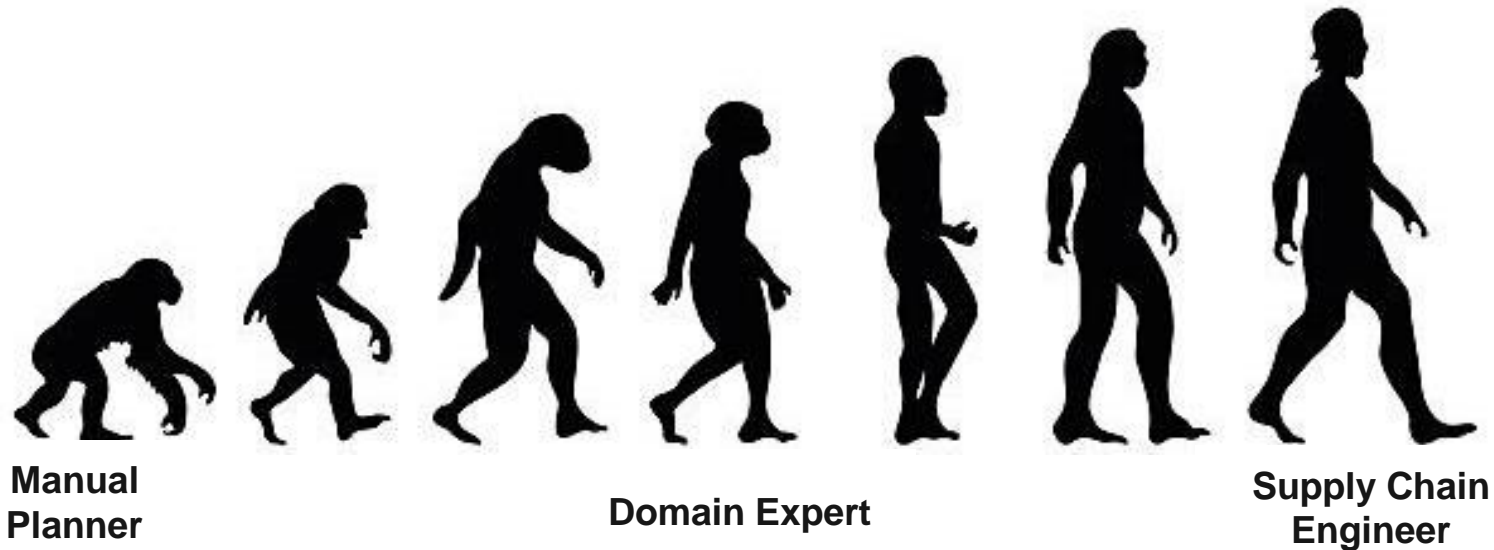
## Disabilities

- Processing limitations
- Subject to cognitive biases
- Inconsistency
- Physical limitations
  
- Performance limited to data quality
- Lack of creativity & innovation (self-optimization)
- No contextualization
- Lack of communication, emotions, empathy

## Comments

- The machine is effectively performing tasks that require a high computing power, a human can't do for analyzing big data sets
- The human should focus on tasks that can't be easily replaced by technology, that require capabilities like
  - **Contextualization** (understanding of cause & effect)
  - **Conscience** (managing unintended consequences)
  - **Collaboration** (understanding/Managing relationships)
- Humans should deal with **critical, unstable items, exceptions and unusual situations**

# THE EVOLUTION OF THE SUPPLY CHAIN PLANNER



## Evolution stage

- Purely reactive firefighting
- Repetitive demand planning activities
- No effective technological support, manual spreadsheet working

- Leverage advantage of big data
- Support by recommendations of an intelligent system
- Partially automated, autonomously working products
- Proactive supply chain management and planning

## Comments

- With inherent digitization in today's organizations, the planner will evolve from a manual, firefighting planner to a supply chain engineer
- In this regard the **function of the planner will change according to the degree of automation** realized for his activities
- By automating the repetitive, reactive, manual tasks the planner of the future concentrates on **strategic, predictive tasks that require human capabilities**
  - Decision-making based on recommendations by the system
  - Exception-focused planning and forecasting



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## WHAT WE HEAR IN THE INTERVIEWS

” **The planners’ tasks shift and become more data driven.** So they will focus on the optimization and the adjustment of the system.  
SVP Global Business Services

” **The traditional planner is going to be split into two planners** with different functions: The planner as data analyst and the planner as business partner.  
Head of SCM & Information Systems

” **New talents (data scientists) are going to be embedded in the teams** to pilot new use cases continually.  
Consultancy Partner Operations & SCM

### Key Insight #8

**New dedicated roles around data science and data stewardship** are required to augment supply chain planners.

# FUTURE ROLES EMERGING FROM DIGITAL TRANSFORMATION OF SUPPLY CHAIN PLANNING



TODAY

TOMORROW

Supply Chain Planner



Planner as an Analyst

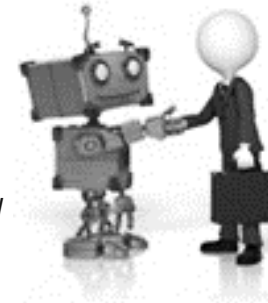
*Data Management*



EXAMPLE  
Beiersdorf

Data Science

*AI / ML  
Mathematical Optimization*



Planner as Business Partner

*Moderation & Communication*

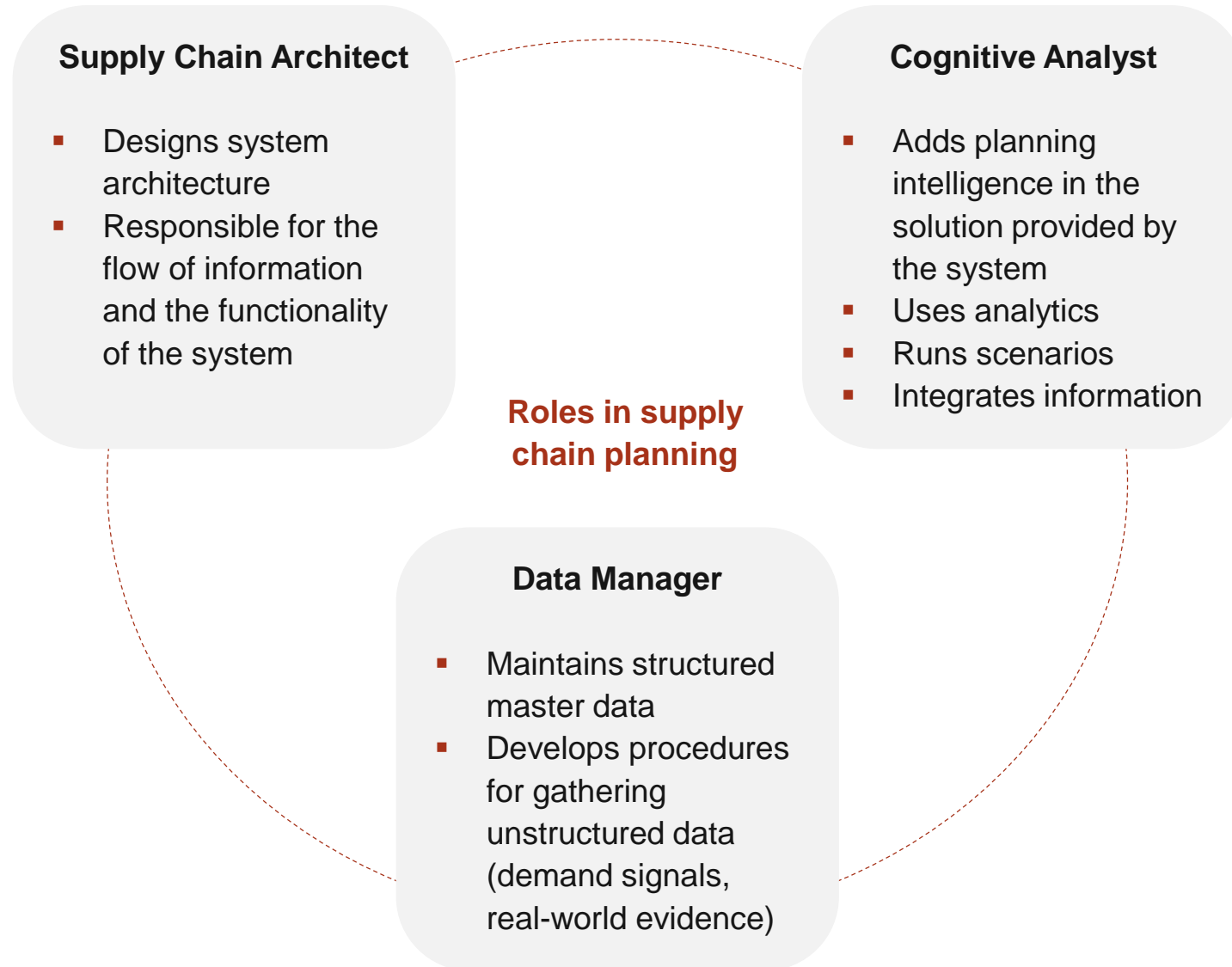


Digital Planning will require the „nerd“ and the business translator in the future

## Comments

- The traditional Supply Chain Planner will **split into two more separate functions in the near future** → prospectively the future planner works in cooperation with AI/ML
- Due to the immense amount of data that needs to be collected, maintained and used accordingly, a **planner as analyst is needed who focuses on data management**
- On the other hand, the planner of the future needs to have an overall understanding of the company's strategy and relationships, therefore a **planner as business partner, focusing on communication and networking is needed**

# THREE DIFFERENT PROFILES EMERGE IN THE FUTURE VISION OF PLANNING



Comments
<ul style="list-style-type: none"><li>▪ In line with the shifting tasks in future supply chain planning all three functions will evolve</li><li>▪ <b>Data managers will clearly separate from planning functions</b> and have strong data analytics and mastering skills</li><li>▪ The planner (Cognitive Analyst) should ideally plan business oriented, with a <b>E2E planning vision and cross-functional working</b></li><li>▪ For a successful change management, <b>employees have to be trained</b> accordingly<ul style="list-style-type: none"><li>– Re-skilling</li><li>– Up-skilling</li></ul></li></ul>



# AGENDA

#1 Supply chain planning workflows will become more automated

#2 Automation is driven by trust and incentives for the planners

#3 AI/rule based approaches play an important role but require experimentation

#4 Transactional master data quality is critical and requires continuous improvement

#5 Process mining is an essential tool to boost data quality and to create insights

#6 Supply chain planning technologies mature quickly and will support new processes

#7 More holistic, strategic roles will emerge from the planner's job profiles

#8 New dedicated roles around data science and data stewardship are required

**Conclusion and next steps**

## CONCLUSION AND NEXT STEPS

Based on the insights from our study, we identified the following recommendations:

- ▶ **Plan and prepare the transition to more automated supply chain workflows** from a technological as well as an organizational perspective.
- ▶ **Design new incentive models for planners** that appropriately consider the need for improving the system input.
- ▶ **Develop a strategy for AI adoption** by identifying relevant use cases and data sources.
- ▶ **Develop a master data management strategy** to continuously improve the increasing amount of master data.
- ▶ Move from using process mining to obtain insights to **using process mining to realize process improvement potentials.**
- ▶ **Invest in human knowledge** in order to prepare for an increasing level of interaction between AI and humans.
- ▶ **Prepare for a changing planner job profile** that concentrates on strategic, predictive tasks that require human capabilities.
- ▶ **Prepare for an increased need of data science competence** in the planning context.



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