McKinsey & Company

Managing uncertainty in animal planning

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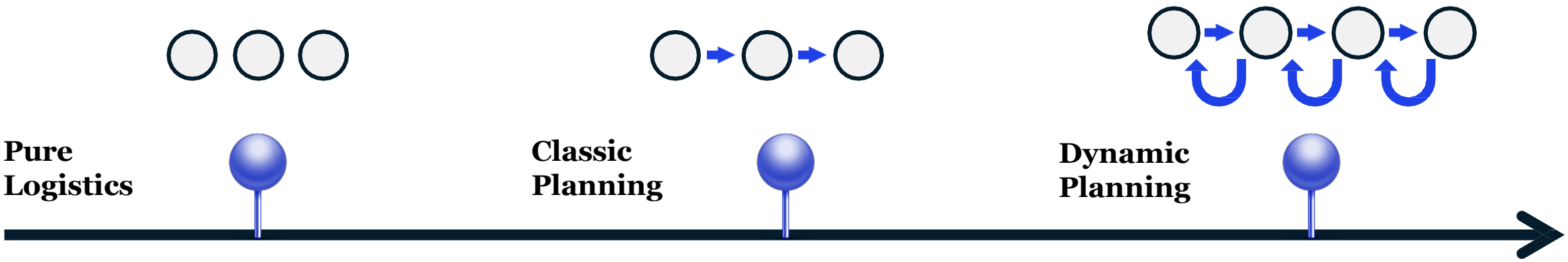
Over the years, Supply Chain management has evolved in depth and granularity to meet increased market and production complexity



Operational Execution up to 90´s

Operational logistics to ensure supply of production lines and delivery to customers

SC as function nonexistent, logistics reporting to sales and manufacturing

S&OP 90´s to early 2000´s

Adoption of S&OP - Integrated planning with M&S and supply

Limited planning interactions (monthly)

Single direction flow – ensure alignment

Low visibility and granularity

Control Tower until ~2015

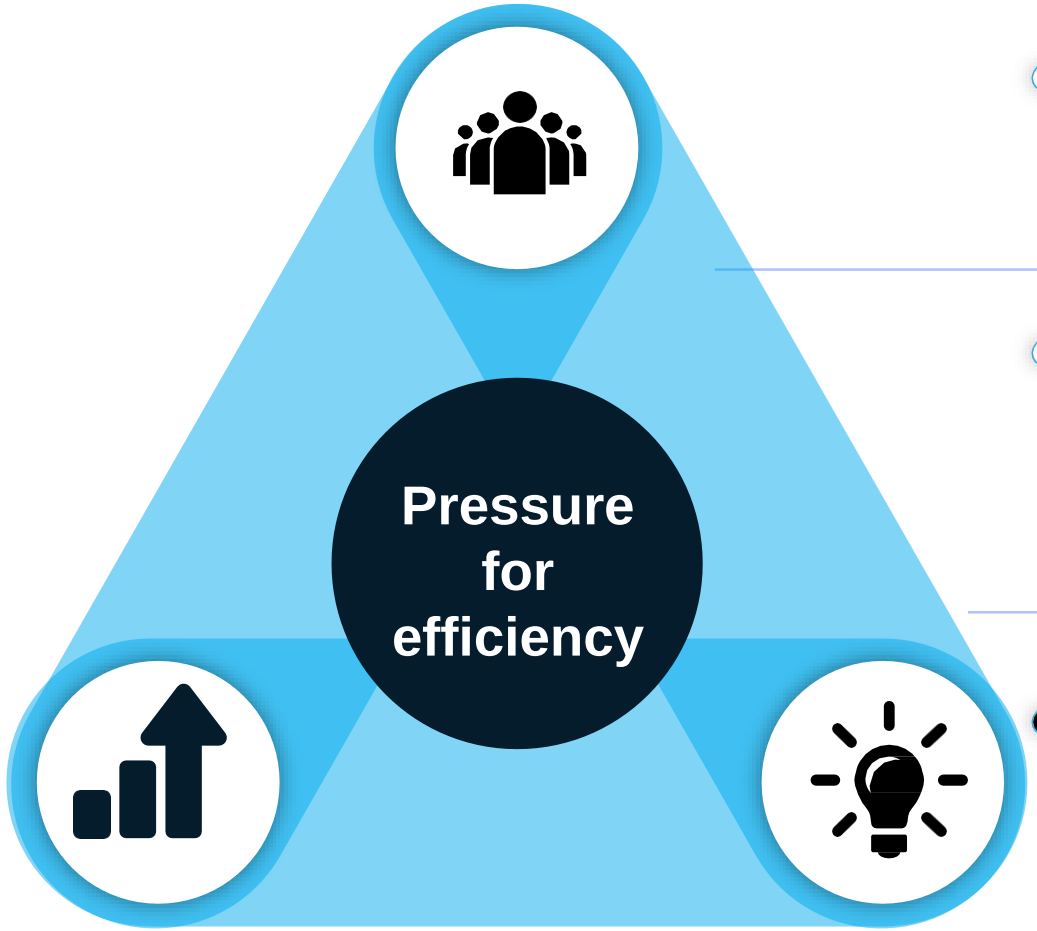
Creation of **Control Towers** – intra-month operational adjustments forums

Increased frequency of interactions ~weekly

Selected feedback loops

Increased visibility

But this journey is far from over, and three global megatrends are pushing that Supply Chains evolve to yet a new standard



I Rapidly changing of consumer demand and behaviors

Growing demand for individualization

Stronger focus on convenience

Higher price sensitivity

II Massive advancements in technology and innovation

Mobile world/social media

Advanced analytics and big data

Advanced robotics

3D printing

III Increasing pressure on cost and productivity

New market entries/business models

Increasing price transparency/consumer mobility

Environmental and socioeconomic pressure

Activist investors

Rapidly changing of consumer demand and behaviors are forcing deep revision of operations strategy and setup

Rural Growth

Wealth and growth moving to regions that have not been served in the past

Demanding customer expectations

Growing service expectations combined with shorter lead time to fulfill customer orders

Individualization

Large increase in SKU range due to ever growing customization driving complexity in supply chain

Multitude of options

Consumers have options to buy from **multiple channels** creating need for more granular demand and supply synchronism

In an environment of increasingly complexity, companies need to setup their supply chain to deliver

More granularity

Higher precision

Better integration

Massive advancements in technology and innovation are prime to enable the digitization of Operations

Data, computational power, and connectivity
Significantly reduced costs of computation, storage, and sensors
Reduced cost of small-scale hardware and connectivity (IoT)

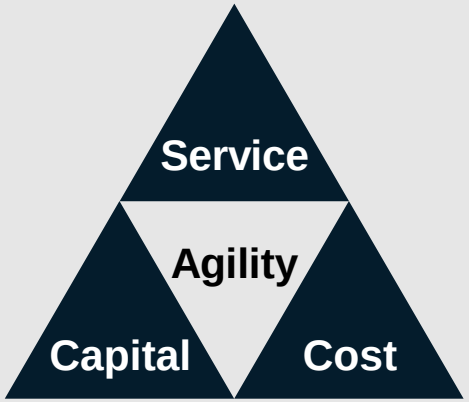
Analytics and intelligence
Breakthrough advances in artificial intelligence and machine learning
Improved algorithms and improved data availability

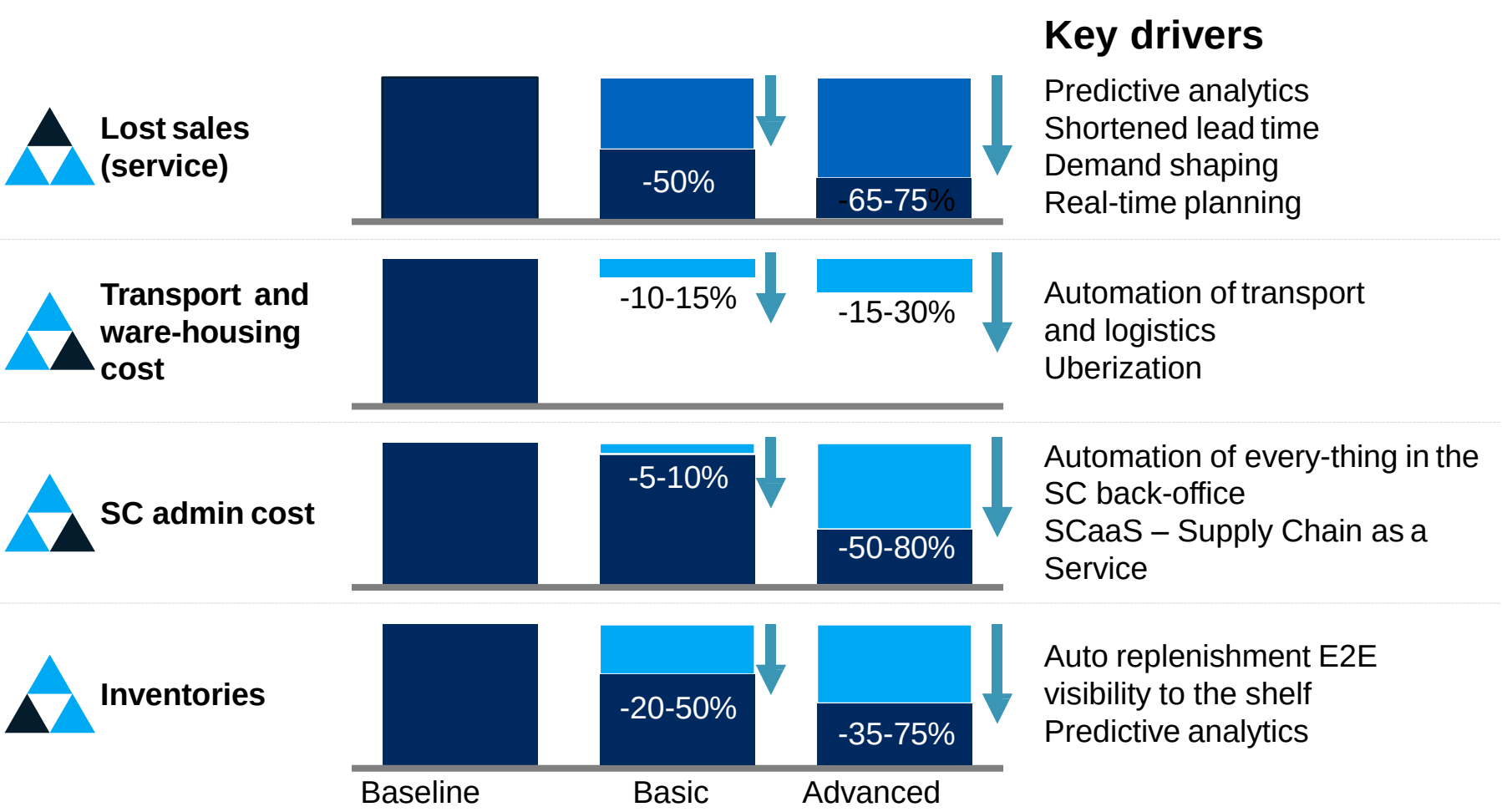
Human machine interaction
Quick proliferation via portable interfaces
Breakthrough of optical head-mounted displays

Digital-to-physical conversion
Advances in artificial intelligence, machine vision, M2M communication, and cheaper actuators
Expanding range of materials, rapidly declining prices for printers, increased precision/quality

Sensors in everything, networks everywhere automate anything, and analyze everything to significantly improve performance and customer satisfaction

The size of the prize – applying digital supply chain levers, huge potential can be unlocked in all supply chain categories





Key drivers

Predictive analytics
Shortened lead time
Demand shaping
Real-time planning

Automation of transport and logistics
Uberization

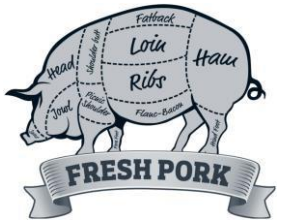
Automation of every-thing in the SC back-office
SCaaS – Supply Chain as a Service

Auto replenishment E2E visibility to the shelf
Predictive analytics

SOURCE: McKinsey

In addition to that, agricultural animal protein supply chain is even more complex due to three main challenges they have to deal with

1



Disassembly Trade-offs

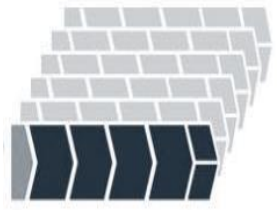
Once volume is locked, complexity is still high since all parts must be sold, and decisions of specific cuts will affect the availability of others

2

Demand volatility

Demand fluctuates in terms of product mix due to consumer preferences, and total volume due to events at the global economy level, such as trade wars and market openings and closures

3

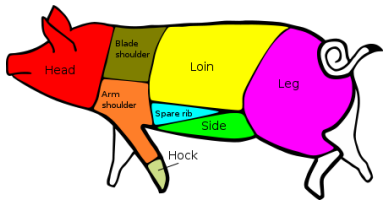


Long Supply Chain

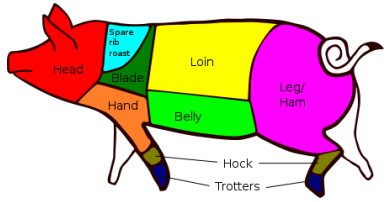
Having a long supply chain implies less flexibility and higher costs to adjust production throughout the process

1 There are key disassembly decisions to be made that makes it complex and requires analytics to maximize profits

American cuts



British Cuts



Key decisions involved

How to define the best volume-market mix

How to decide which plant will serve which market (some plants can only supply to specific markets due to sanitary restrictions)

How to cope with the cuts that are not so demanded and are perishable

How to maximize revenues and margins with all these constraints

How to optimize?

A Use analytics to maximize expected margin

- Historical data (internal)
- Internal plans and targets
- Production constraints (capacity, licenses, etc.)
- External data (competitors and market)
- Promotion/clearance effect (price elasticity)
- Cannibalization effect (internal)
- Etc.

B Map alternative solutions for output overflow

- Create new brands
- Expand to new markets (local and/or foreign)
- Create new products (i.e. fresh product line)

C Consider the cost and value added by each raw material to create each SKU

2 Changes in demand occur often not only in the product mix due to consumer preferences, but also due to events at the global economy

U.S.-China Trade War

2018: China imposed tariffs (25%) on pork imported from the U.S.

Sep/2019: China rolling back tariffs on pork imports from the U.S. (limited to a certain amount)

Market opening/closure

Barriers

- Tariff quotes
- Allowances
- Import Tax
- Technical
- Sanitary
- Non-automatic import license

European Union
- No imports of cheese bread
- No imports of porks

Germany
- Taxes over paint imports

Nigeria
- No beef imports

South Africa
- Higher taxes over bread, cookies and pasta

Opportunities

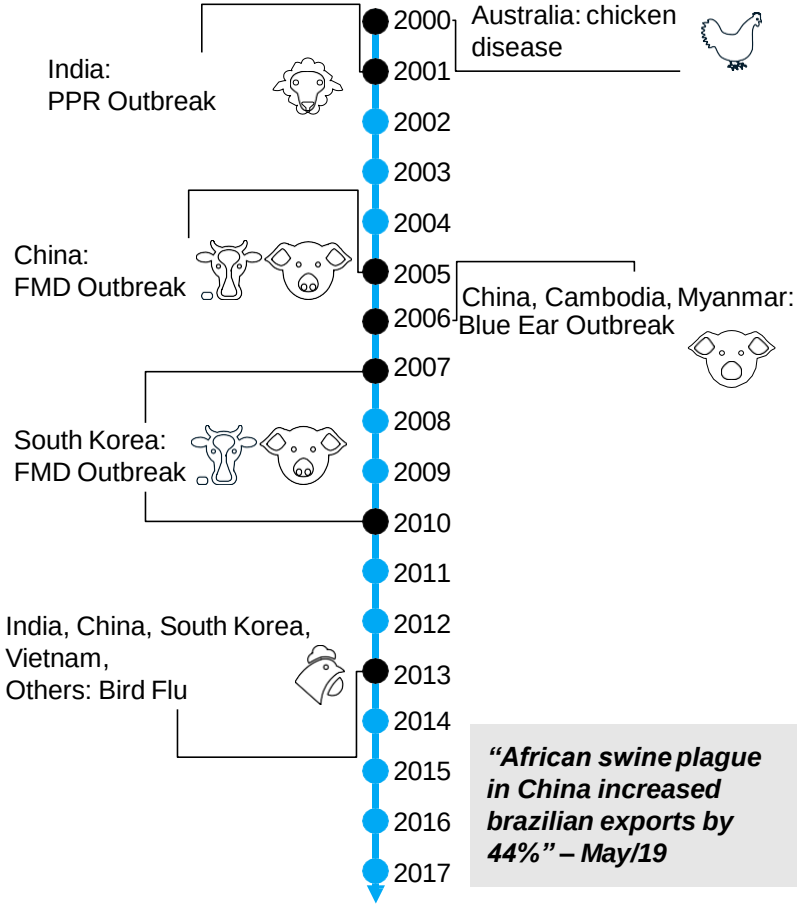
New markets

"India opened its market to brazilian pork in 2018"

New licenses for slaughters

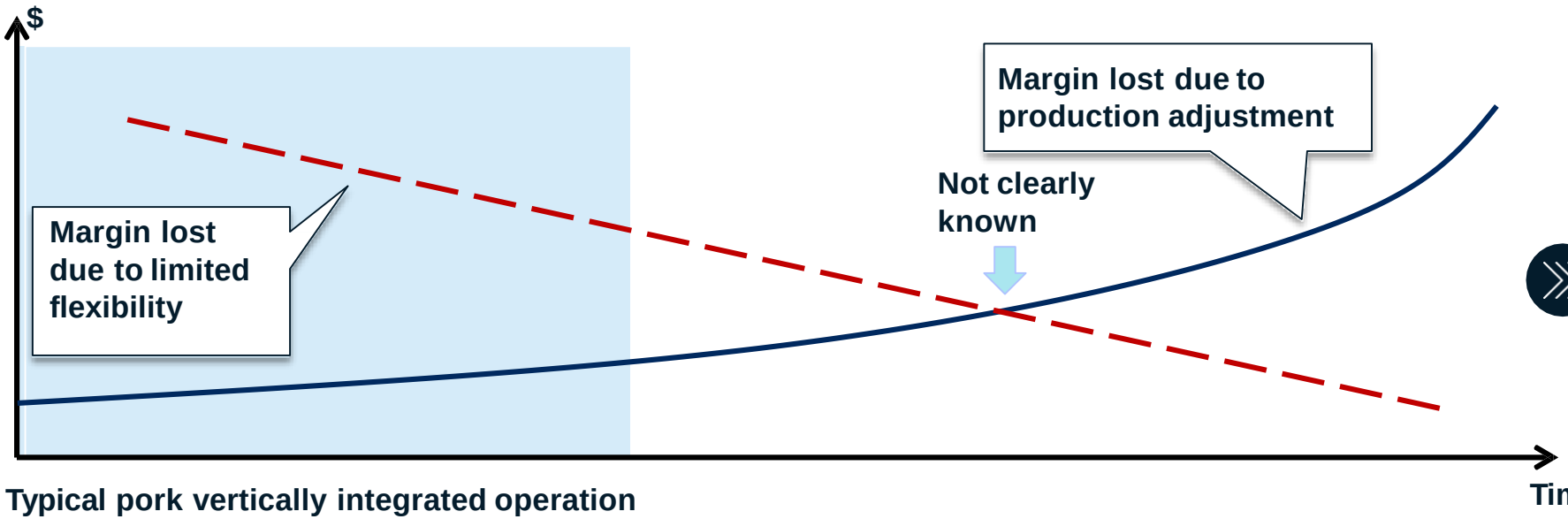
"China visited some brazilian slaugthers and plan to provide new licenses" May/2019

Diseases



"African swine plague in China increased brazilian exports by 44%" – May/19

3 In long supply chains, continuous investment progressively increase the cost of changing volume, eventually locking-in total production levels



Typical pork vertically integrated operation

Pre-Primary breeder Purchasing → Pre-Primary breeder mating → Primary breeder birth → Primary breeder selection & growth → Primary breeder mating → Breeder Birth → Breeder selection & growth → Breeder mating → Pig growth → Processing

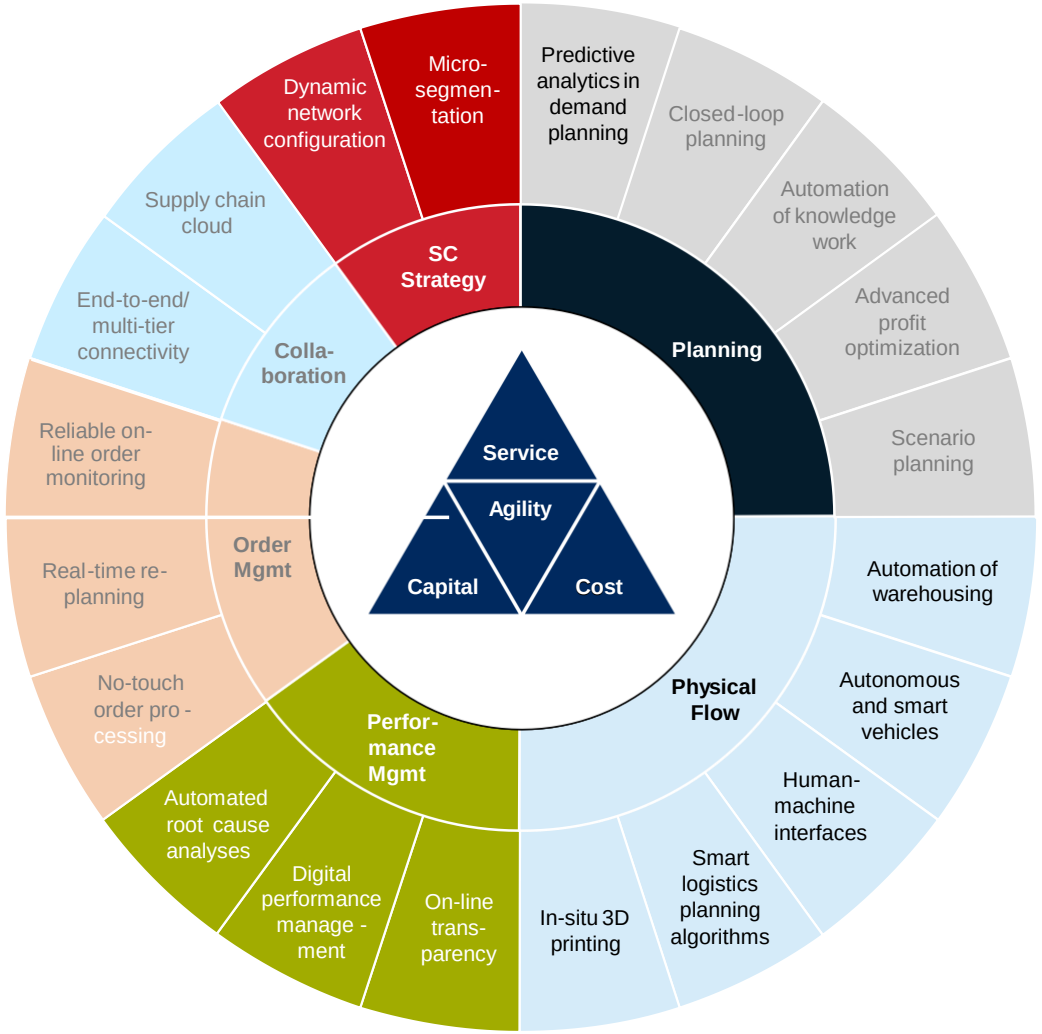


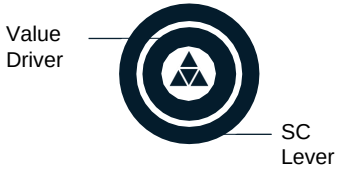


- Not having flexibility to adjust production volumes will affect margins of the final product
- The cost breakeven point between adjusting production and flexibility is not clear
- Usually adjusting production anticipates recognizing losses

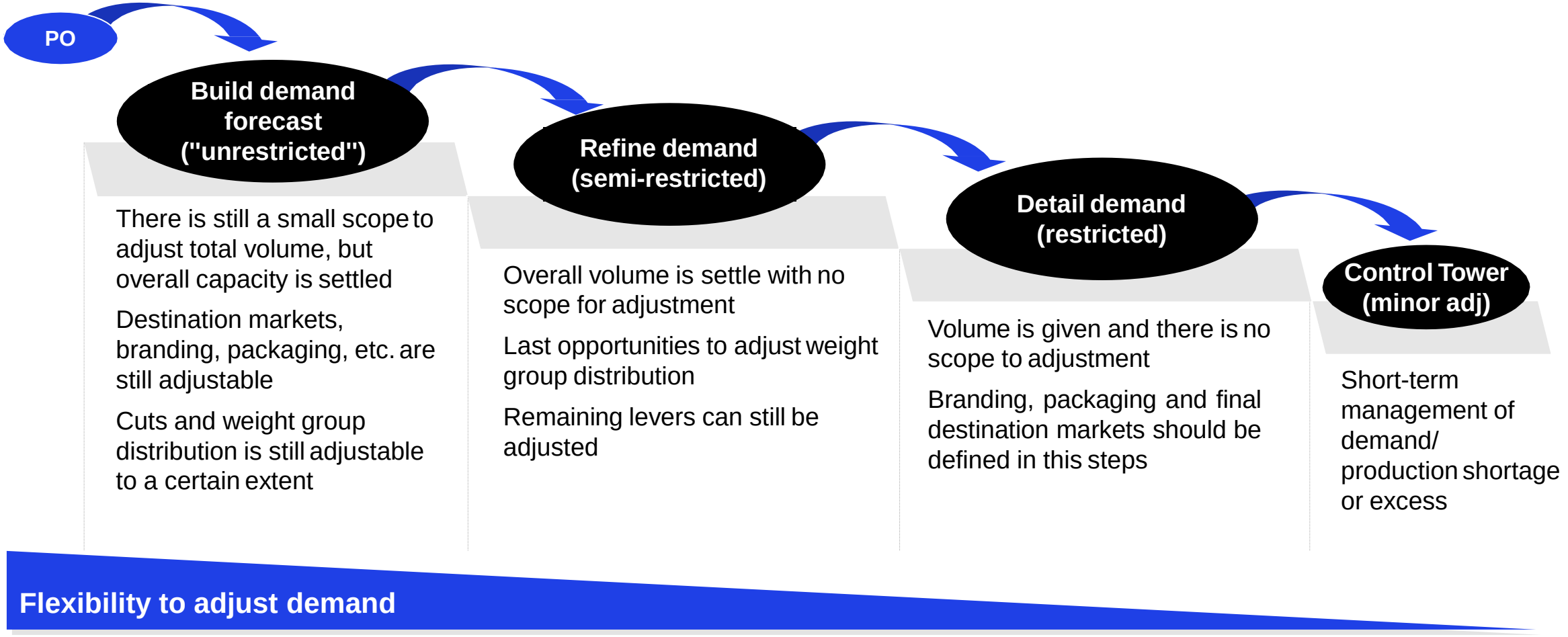
The complete cycle from beginning until first processed animal ~ 940 days

There is a large spectrum of digital drivers and levers that help companies deal with these challenges and evolve to a new standard





One approach is to adopt an ongoing demand refinement process, with the support of a control tower for short-term adjustments



For demand forecasting, machine learning led to 40% decrease in stockout, 35% less inventory and 13pp better forecast accuracy

Case 1

Context

Personal care direct selling company in LatAm facing pressure to increase EBITDA

Inaccuracy on forecast as the **root-cause for more than two-thirds of shortages**

High complexity driven by:

Frequent promotions and high depth of discounts

Large and discontinuous portfolio (~40% of portfolio removed and re-introduced every month**)**

Constant innovation

Many **qualitative factors driving demand not codified in databases**; planners manually identify and evaluate those factors to estimate demand

Approach

End-to-end planning program including:

- Product segmentation and strategy
- Inventory optimization
- S&OP review and Control tower implementation
- Demand forecasting solution

In Demand forecasting, we have created a **hybrid solution combining machine learning and human judgement to achieve the best estimate, using…**

- **External data** (macroeconomic indicators) and internal data (historical demand, regular and discounted prices, promotion types, product exposure in ads, among others)
- Demand forecasting unit (DFU):
  - SKU group (one level above SKU)
  - Promotion type (e.g., straight discount, bundle)
  - Sales period
- **Features to deal with demand behaviors**:
  - Client's purchase behavior
  - Cannibalization
  - Pantry loading

Results

Shortage savings:

Full potential estimated to decrease stockout in 40% (30% already captured in 6 months)

Accuracy improvements:

Monthly forecast accuracy in DFU: +13pp better than baseline (forecast error -32%)

Inventory reduction of 35%

A hybrid solution combined the best of human emotional judgement with advanced analytics' empirical approach…

How the hybrid solution is structured

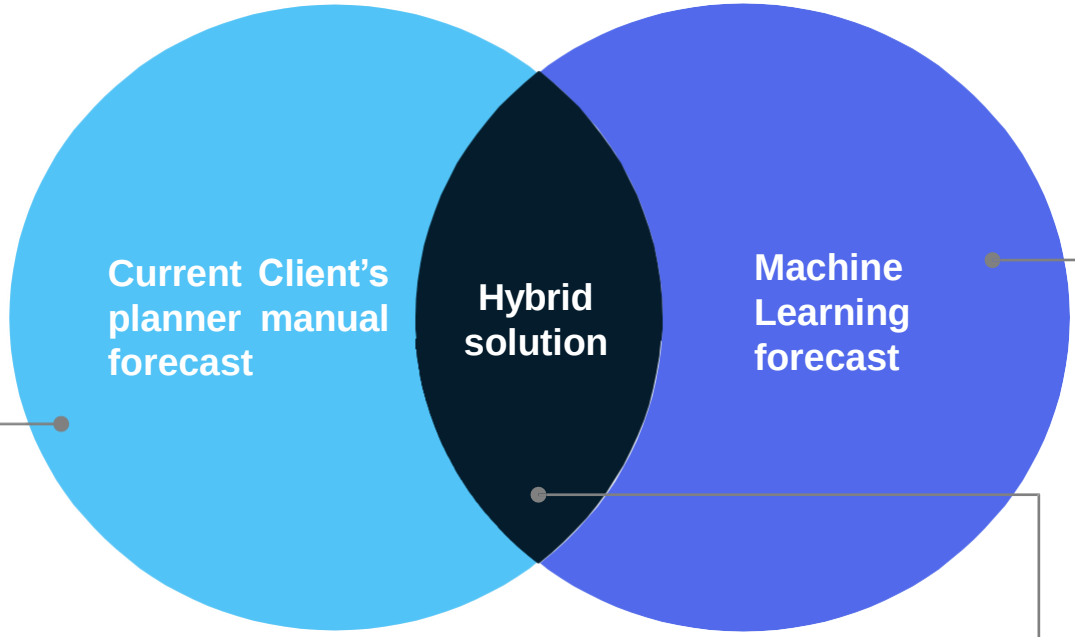
Company: human emotional solution produced by planners

PROS

- Uses different sources of **qualitative information**
- Able to adjust forecast based on qualitative **non-codified information**
- More updated on **recent trends**
- Sees **intangible features** on sales vehicles

CONS

- **Depends on different experiences of multiple people**
- Uses **non-standard criteria** to perform same task



MACHINE LEARNING: structured, mathematical solution

PROS

- Able to **"see" nuances of dozens of variables** based on thousands of past experiences
- Follows a **clear logic**
- Able to adjust based on every new datapoint included every campaign
- Able to **learn "demand behavior" from other products**

CONS

- Based uniquely on what is available on databases

HYBRID: symbiotic solution

PROS

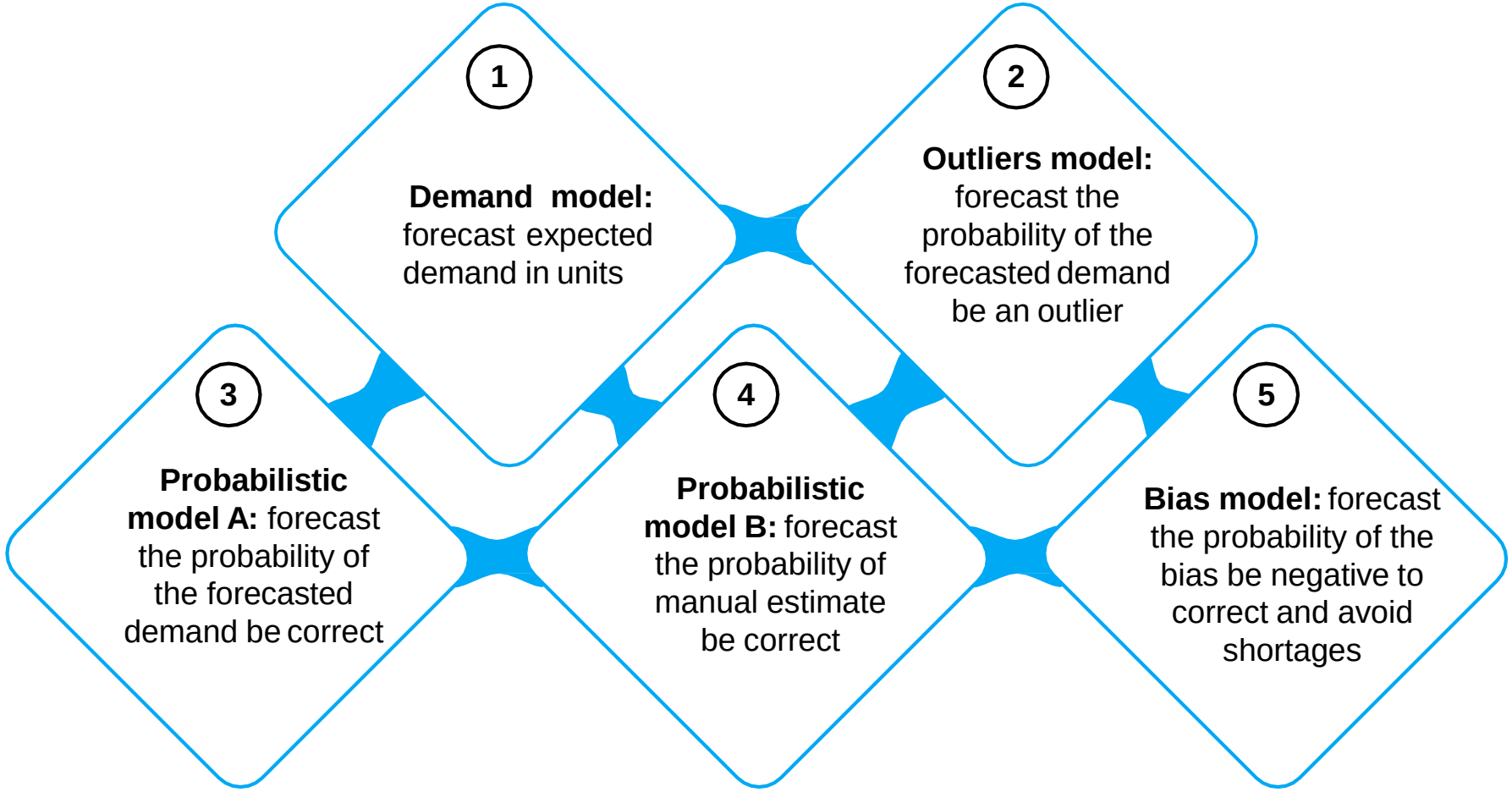
More robust to inaccuracies on either side (lower variance in error)
Higher accuracy

CONS

Depends on the maintenance of current process with additional steps

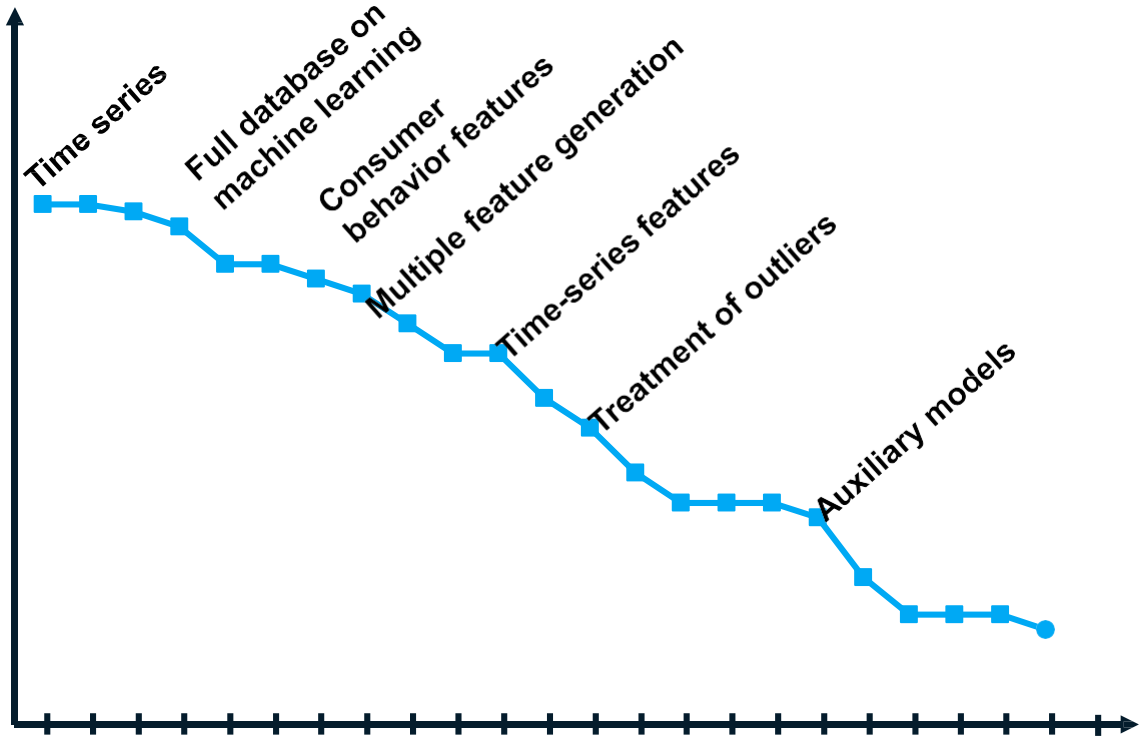
…and uses 5 models to: predict demand, decide how to blend it w/ human's manual prediction, and correct outliers and negative bias

How the multiple models in the hybrid solution are structured

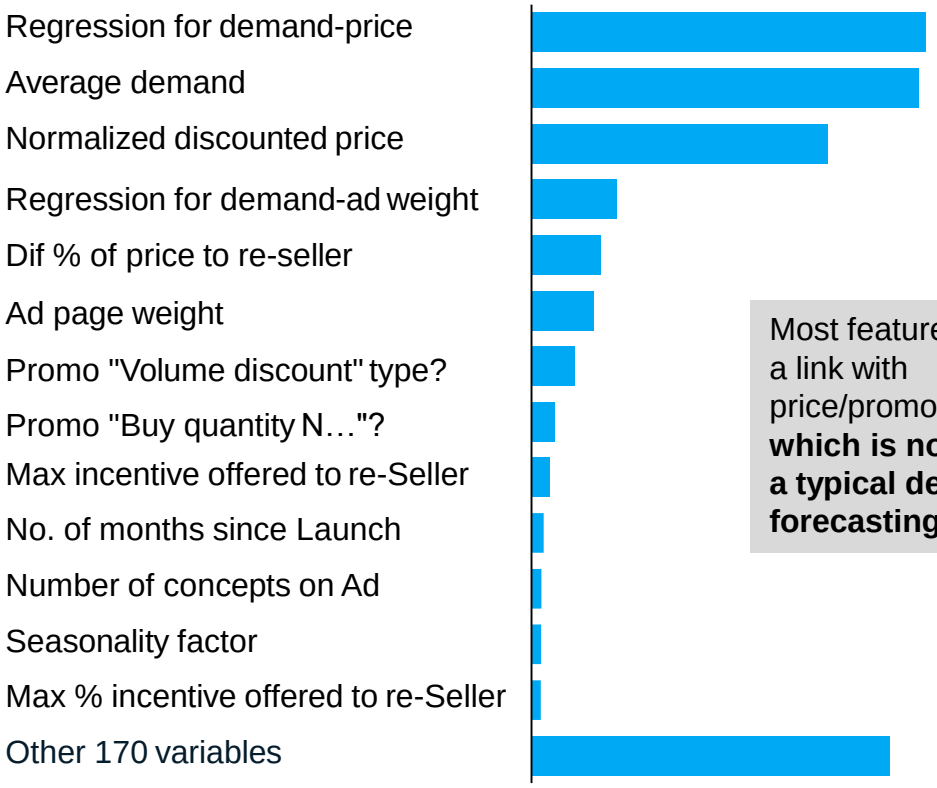


Improvements were created by the understanding of outliers and creation of multiple models and multiple features

History of the development



Importance of features in the model



Most features contain a link with price/promo elasticity, **which is not seen in a typical demand forecasting problem**

An optimization of the planning process using Llamasoft Supply Chain Guru for Logistics Footprint can reduce shipping cost by more than 5%

Case 2

Context

Client in the agribusiness sector, operating seasonal harvesting products with highly complex chain with more than 200 storage facilities, processing units and ports. Serving customers in the domestic and international market

Lack of a structured planning process that allows adjustments to occur frequently in a centralized manner

Inability to see all bottlenecks at local levels of the system due to lack of granularity and integration of inputs

Decision to allocate logistics flows not optimally due to absence of analytical support

Approach

Designed and implement end-to-end planning process with multiple horizons

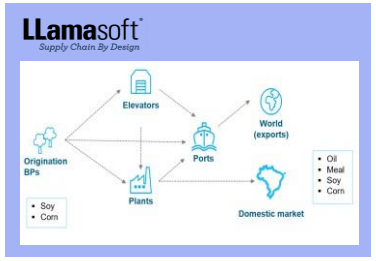
Developed analytical tool using the Llamasoft Supply Chain Guru software to optimize volume allocation in the footprint physical and temporal flow of products

Optimization has the objective function to maximize product prices and minimize costs incurred in the chain (origination, processing, storage, transportation)

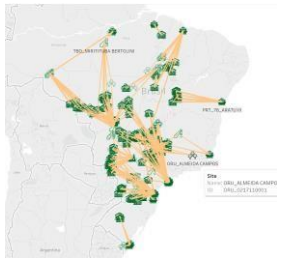
The tool also includes constraints such as asset capacity (processing, receiving and dispatch), origination volumes, market demand, modal transport contracts more than 750 restrictions

A customized set of dashboards was developed to evaluate results and drive decisions

Inputs



Front End (preview)



Results

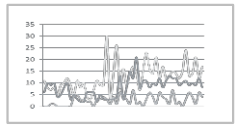
Optimization model implementation that translates the complexity of the footprint and granularity required for decision making

Optimization of 500,000 decision points through 1.2 million of variables, for example:

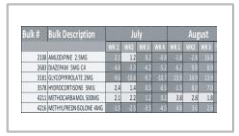
- Unbalance of bottlenecks in origination
- Need for new investments in assets
- Market to be served
- Transport contracts and ports

Ongoing to deliver more than 5% reduction in shipping costs

Many organizations are shifting to a digital management of their Supply Chains through intelligent dashboards and predictive analytics to accelerate decision making

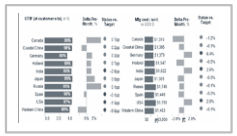


Statistical forecasting

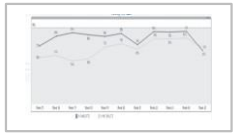


Inventory needs & actuals

Sales performance



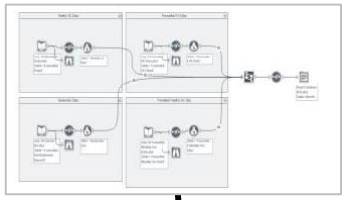
Production plan& Actuals



Financial targets

Others – DC utilization, costs, raw materials etc.

Big data processing



Performance outlook **based on current performance, automated root cause and predictive analyses** allows anticipation of decisions, minimizing costs and disruptions

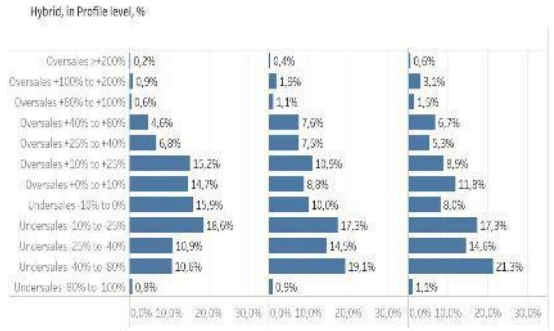
Always On brings **full Supply Chain transparency** and enables immediate **fact based decision**

To quickly and easily analyze all results generated by the Solution, McKinsey created its Always On Control Tower solution

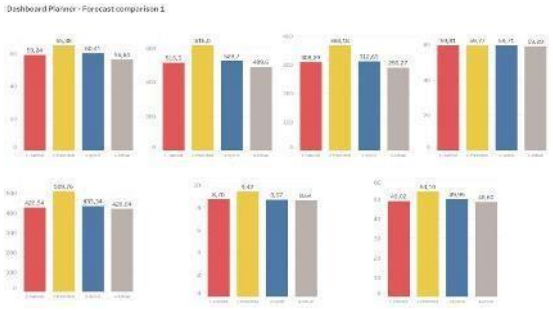
Accuracy in SKU level, per month

Accuracy in family level, per month

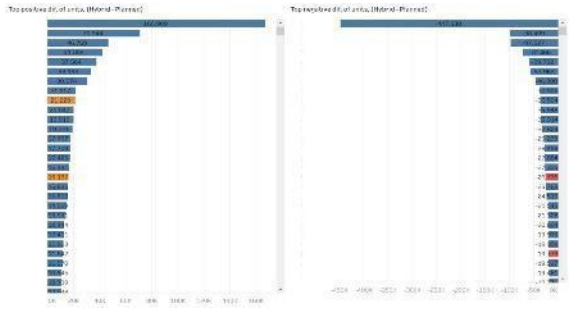
Distribution of error



Financial KPIs



Top dif. from Manual to Hybrid forecast



KPIs per type of Ad / Media offering

Using Always On can increase significantly the quality analysis on forecast

Summary of how to transform into a digital supply chain

1 Define your digital supply chain journey

Define the baseline of your starting point

Understand digital waste, e.g. by conducting a digital walkthrough

Layout future state, but be flexible in execution

2 Get the right digital talent, integrate and nurture

Develop talent internally or hire externally

Install creativity processes – e.g. hack week, hackathon

Understand and communicate changes in the organizational setup

3 Create the right environment for your digital transformation journey

Allow to fail and ensure the right to stop and reprioritize

Provide the right flexibility – e.g., via Amazon Web Services

2-speed architecture to conserve legacy and push agility

Foster start-up to push innovative topics and re-integrated

Start small, test fast and scale up

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Thank you