MBD | Analytics for Retail & Consumer

Supply-chain system optimization leveraging demand forecasting

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Today, we will demonstrate how AFR can leverage on demand forecasting to improve its operational efficiency and boost the company's profitability

AFR active in kids fashion market with production facilities in CN, TR & PT – increasing competition leading to significant price pressure

Background

Client snapshot

Chic-style kids fashion

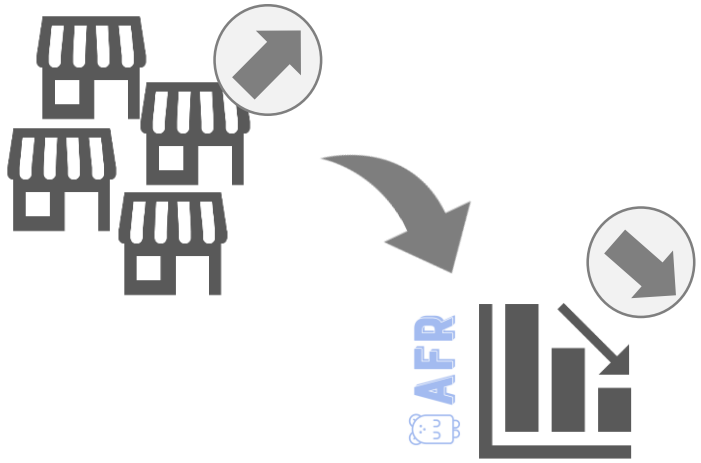
Design | Distribution | Sale

- Portfolio of **>1000 different products** per season – wide selection of products to specifically meet demands of each addressed age group
- **100 stores** in Spain (ca. 70% of sales), multi-brand stores and online (ca. 30%)[1)]
- Historically **high-margin** business **currently bruised** – sales stable

Operations overview

Design	▪ Centralized fashion design in Spain
Production (*outsourced*)	▪ Production facilities in CN, TR and PT with varying lead times / variable prod. costs
Warehouse storage	▪ Centralized storage of all produced items in ES before distribution
Distribution	▪ External company distributes items to stores
Sale	▪ Online[1)] and POS sale in 100+ stores

Environment



- **Increasing competition** imitating AFR's strategy and product – mostly at lower prices
- With sales down, AFR was forced to reduce prices, **resulting in significantly lower margins** – sales stabilized

1) Assumption

AFR's operational inefficiencies and margin pressure require quick and decisive counteraction with regard to improved demand forecasting

Project scope

EXTERNAL	SCOPE
Increasing competitive environment	✗
Fast changing trends in fashion industry	(✓)
INTERNAL	
Mismatch of supply and demand	✓
Margin pressure due to high operational cost	✓

KEY CHALLENGES

PROJECT SCOPE

WHAT

Supply-chain and production optimization through improved demand forecasting

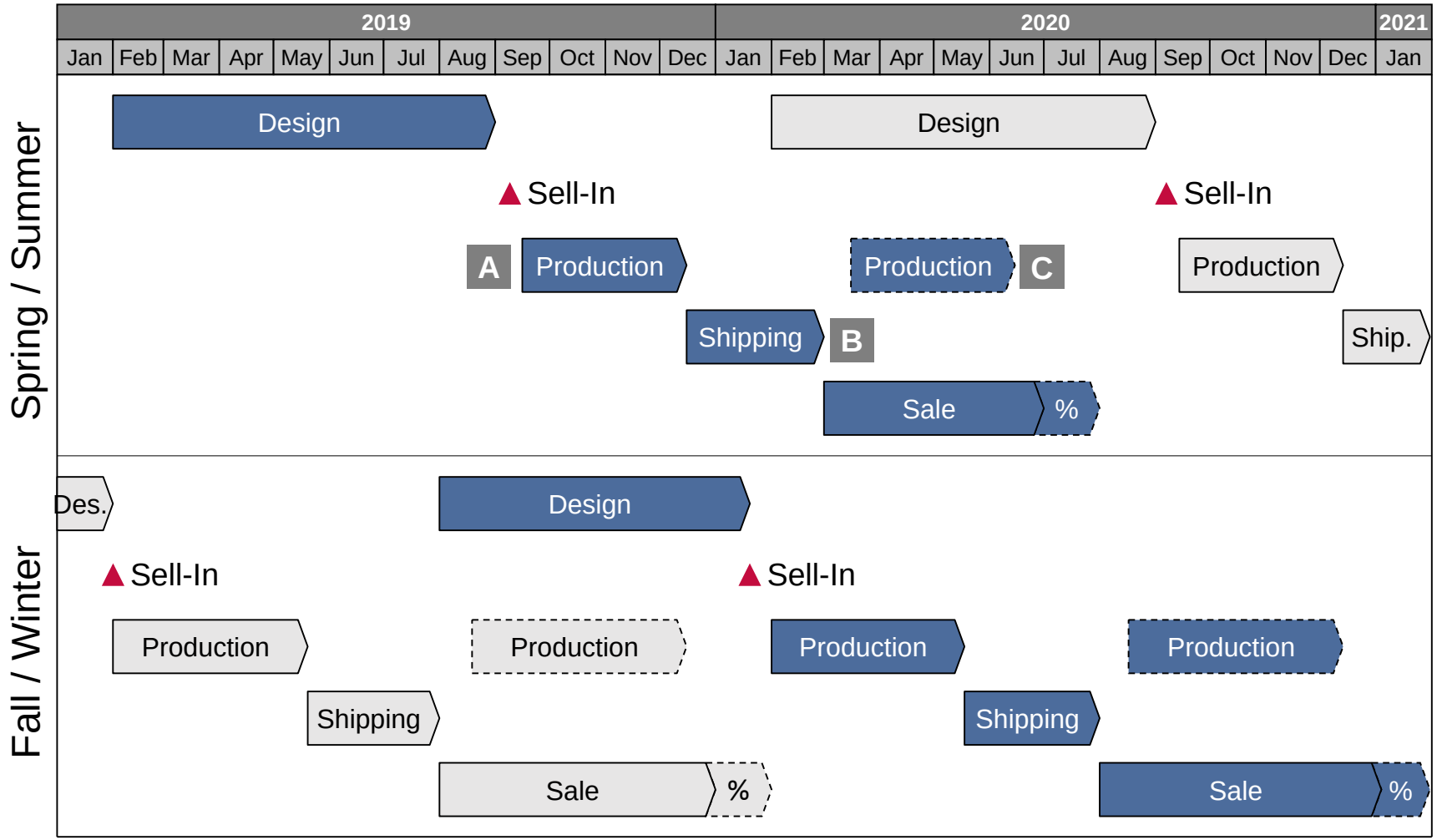
HOW

Enhanced prediction methodology leveraging AFR's data and production systems

To assess relevant levers for AFR's operational efficiency, a clear understanding of the company's supply and value chain is essential

Supply chain, exemplary seasonal planning

Illustrative



Pain Points

A Pre season production starts before any sale has occurred

B Produced clothes from China need to be stored until sold

C In-season production can only be delivered with time lag

Challenge

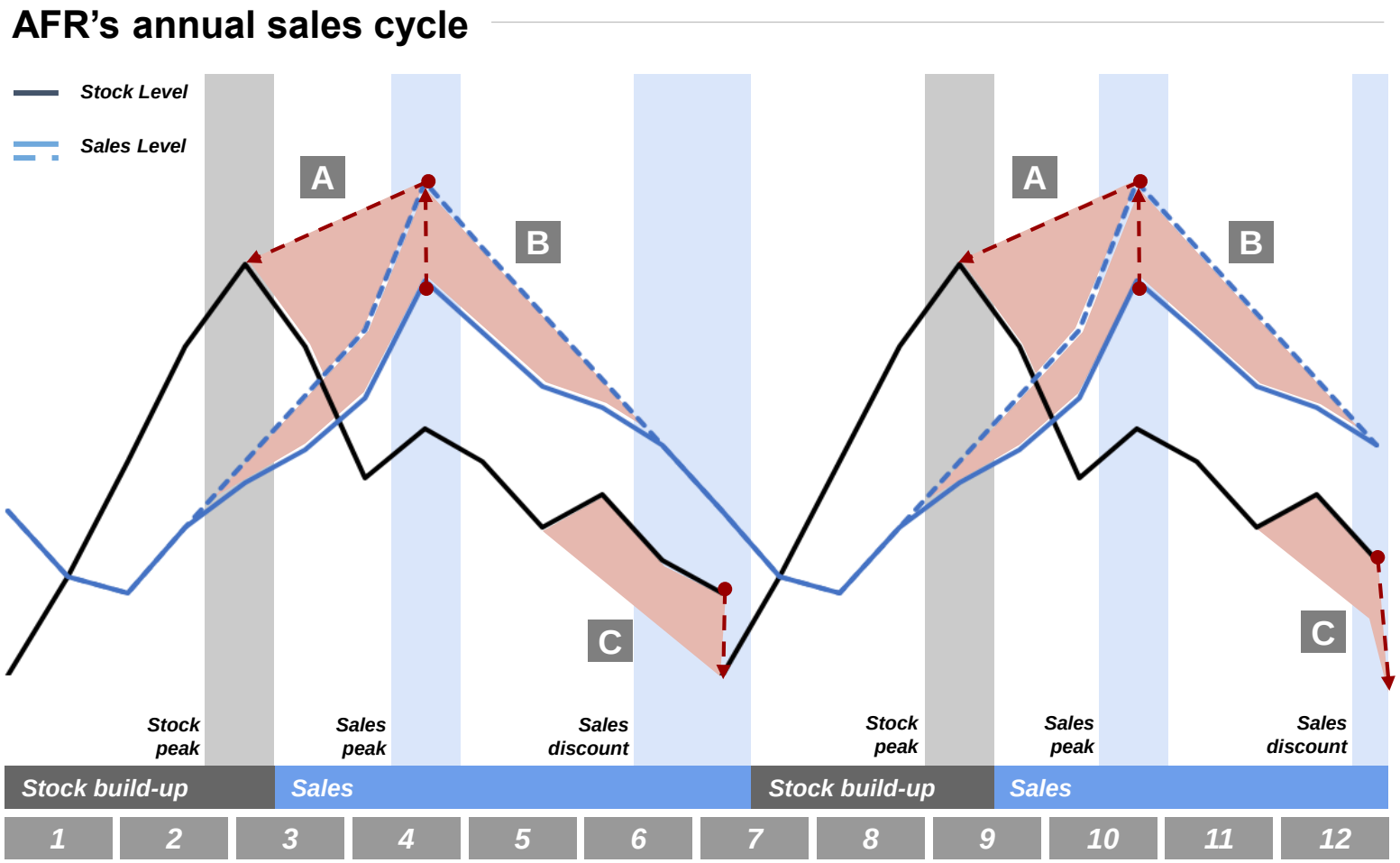
- Long product lead times meeting very short product life cycles – high demand uncertainty

Source: McKinsey & Company, AFR as European hybrid fashion brand

Through long lead times combined with short product life cycles there is a constant mismatch of product supply and demand

Supply and demand mismatch

Illustrative



Pain Points

- **A** Forecast errors leading to supply mismatches
- **B** Stock-outs happen and cannibalize potential sales
- **C** Unsold stock deteriorates company profitability

Affected KPIs

- Forecast error
- Stock to sales
- Perfect order performance
- Contribution margin

Forecast accuracy directly and indirectly impacts several KPIs – improving it could lead to significant positive business development for AFR

KPI landscape

Forecast accuracy

- Measures deviation of actual to planned sales by SKU, tracked daily/ weekly
- Key indicator of inventory management effectiveness
- Basis of demand prediction KPI landscape

Direct impact

Stock to sales

- Measures the ratio of inventory available versus quantity actually sold
- Indicates stocking effectiveness and should be kept as low as possible

Perfect order performance

- POP = % delivered on time *
  % complete *
  % damage free *
  % accurate doc.
- Key indicator measuring delivery effectiveness

Avg. contribution margin

- Measuring profitability per product group
- Indicating production / assortment cost management effectiveness

Indirect impact

Net promoter score

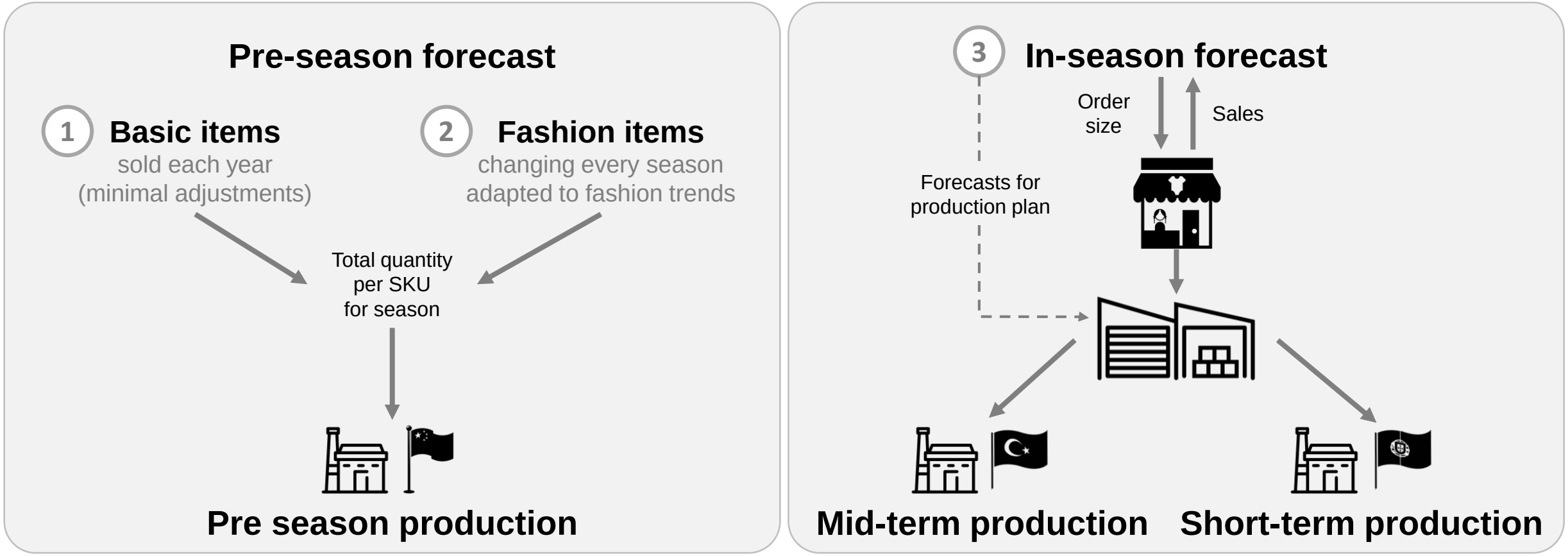
- Measures customer satisfaction / referral likelihood

Others

- Customer retention
- Service level

Due to varying data availability and differing production cycles, three different forecasting models are suggested to optimize supply chain management

Methodology overview



Pre-season basics forecasting model will leverage historic sales data and provide demand prediction on SKU level

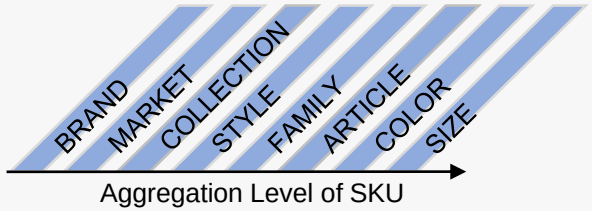
Pre-Season

Basics

1 Pre-season, basics demand forecasting methodology

Input

- Historic Sales



- Demographics

Model

Linear Regression

with Lagged Time Variable

Output

SKU Demand

for entire season

Illustrative Output:

SKU1 (Girls, Casual, Jeans, id1, Red, M): 5.000 units

Consecutive steps

Output → **Business approval** → PUSH → **Production Order** for China

Due to lack of historic sales data, forecasts can be only on family level but combined with business expert evaluation for final order

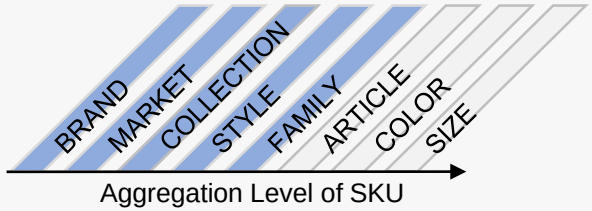
Pre-Season

Fashion

2 Pre-season, fashion demand forecasting methodology

Input

- Historic Sales



- Marketing Activities

Model

Linear Regression

with Lagged Time Variable

Output

Family level forecast

for entire season

Illustrative Output:

Family 1 (Girls, Casual, Jeans): 20.000 units

Consecutive steps

Output
Family level

→

Article level
fashion expert Evaluation & 3rd party orders

→

Size
demographic distribution

→

SKU level
Order based on forecast and eval.

PUSH →

Production order
for China

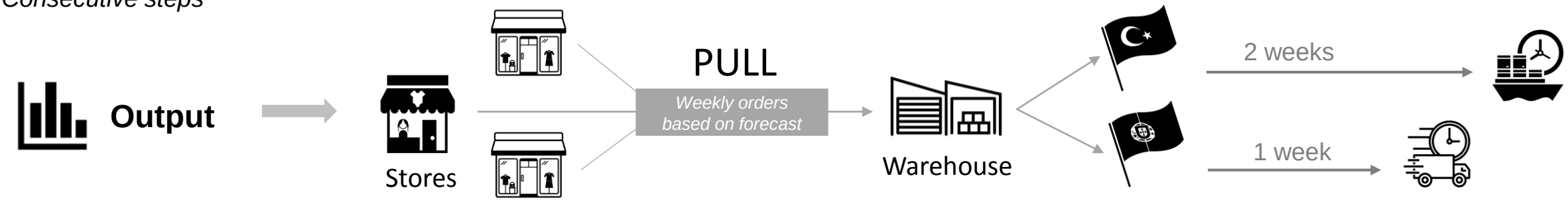
Replenishment based on in-season forecast leveraging sales information on single-store basis

In-Season

3 In-season forecast methodology – Store specific models

Input	Model	Output
▪ Pre sales ▪ In season store sales ▪ Weather forecast ▪ Upcoming marketing activities ▪ Calendar data ▪ Avg last year family sales ▪ Influencer coverage	Neural Network	Daily and weekly quantity *per SKU* *per store*

Consecutive steps



Our proposed forecasting methodology will result in strong, positive changes for all focus KPIs

Incremental benefits on focus KPIs

KPI	Change	Description	Example
Forecast accuracy		▪ Leveraging internal and external data using adv. analytics techniques with direct impact on forecast accuracy	▪ Overall deviation between actual and planned demand will decrease both pre- and in-season
Stock to sales		▪ Optimizing inventory levels will ensure minimizing days of under- and overstocking in stores	▪ Especially in more 'difficult' planning periods for non-basic products, stocking based on sophisticated planning and not on sporadic purchases is crucial for AFR
Perfect order performance		▪ Improved on-time delivery both in warehouse and in stores will boost perfect order performance	▪ Knowing precisely when and where which items are needed, accurate on-time deliveries to warehouse and stores increase
Contribution margin		▪ Optimizing balanced supply from CN, TR and PT lowers assortment costs ▪ In-store storing costs lower due to increasing just-in-time delivery	▪ Produced and stored at lower cost, each item contributes now more positively to AFRs business result
Net promoter score		▪ Increased customer satisfaction ensured due to better product availability, i.e. less stockouts	▪ Customers are more likely to give positive feedback or referrals about AFR having experienced a positive (e.g. non-stockout) AFR-experience

In the long run AFR will unlock further potential by implementing a more efficient supply chain through data driven automation and decision making

Supply chain optimization

Fully connected supply chain trough information sharing

Digitized value chain	*Integrated data streams*	*Real-time Analytics*

Design

- *On-the-fly prototyping based on direct feedback from in-shop buying patterns*

Production

- *Forecast based raw material sourcing*
- *Pull-based in-season production adjustments*

Order Fulfilment

- *Automized emergency response tool for improved crisis management*
- *Season start stocking based on pre-sales data*

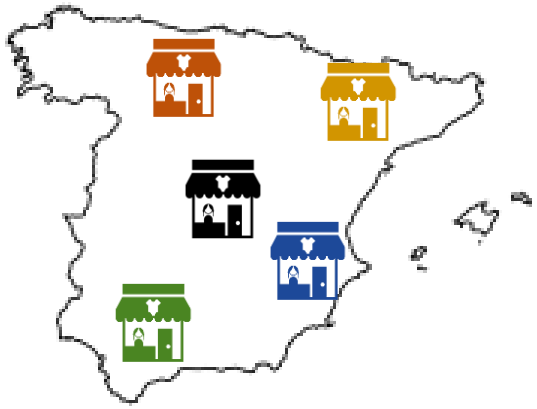
Store

- *Automized ordering process*
- *Adaptive discounting policy*

Decision making based on advanced analytics creates value across the supply chain but is only successful if operations adopts accordingly

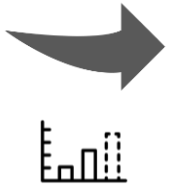
Example: Leveraging pre-sales data

Pre season sales in selected stores



Stores are clustered and for each cluster a store is selected

Cluster specific forecasts

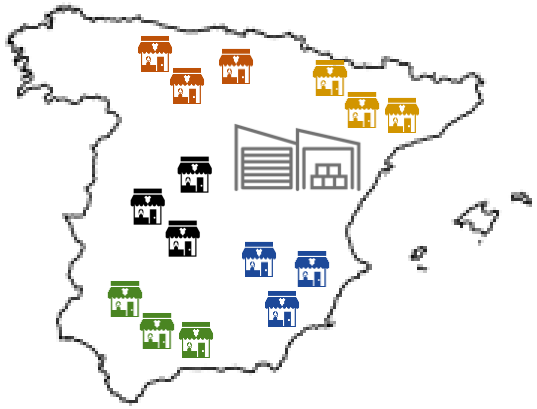


Warehouse optimizes distribution for season start

Pre season sales help to estimate regional specific sales

Distribution plan

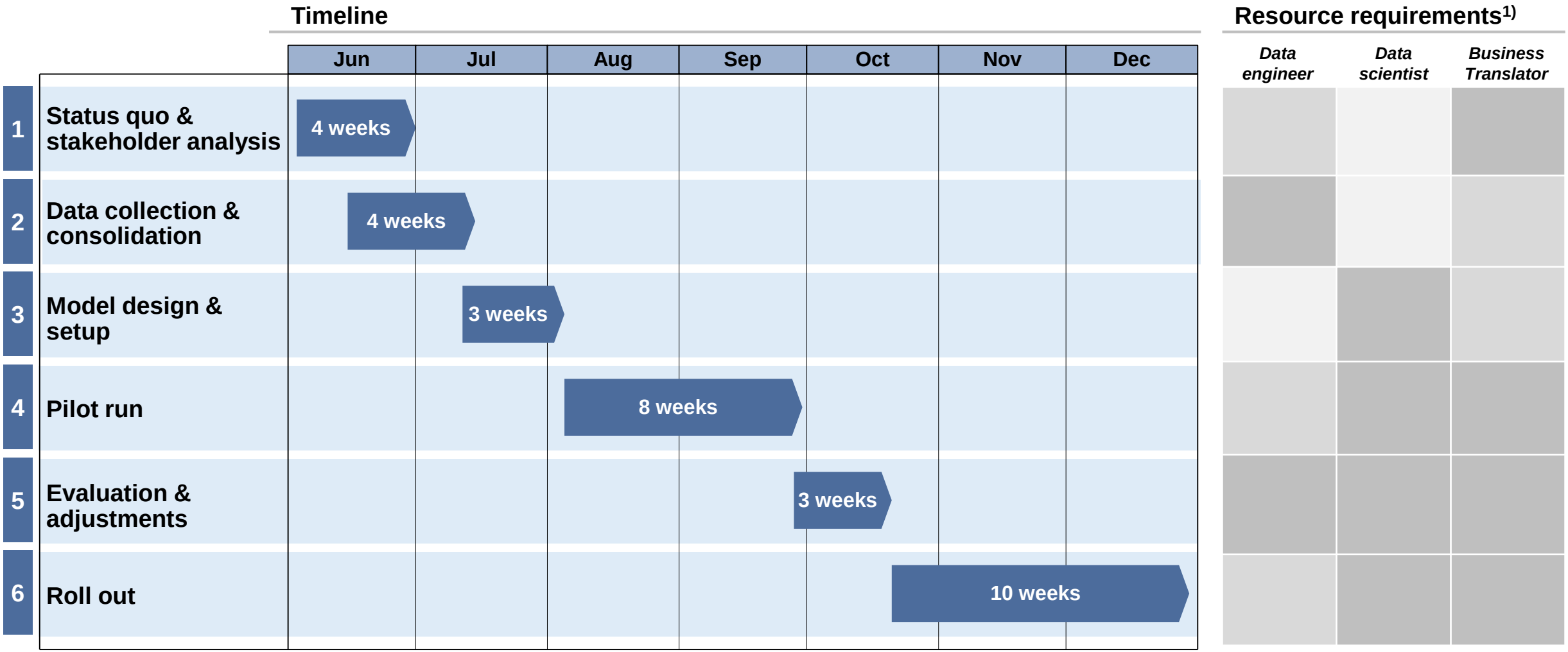
Cluster specific stock for season start



Warehouse can send out initial stock based on pre sales experience

Due to the high complexity of a fashion retailer supply chain the adoption of the new forecasting models should be based on experiences from pilot runs

Action Plan

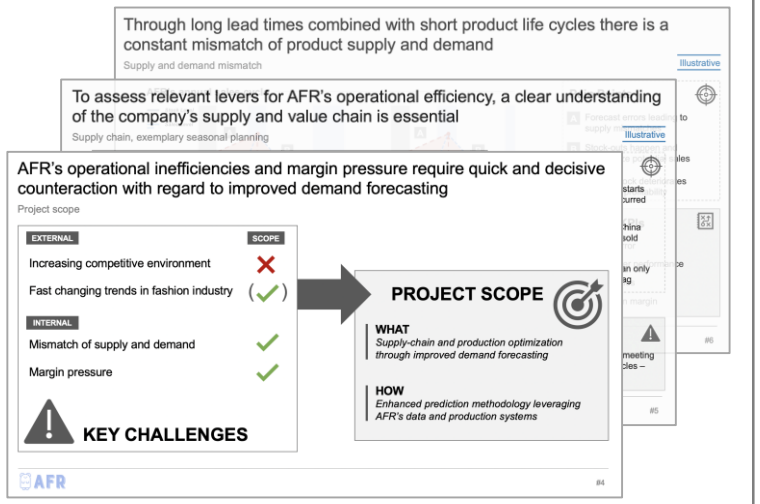


1) Workload: High Mid Low

SCM based on advanced analytics does not only provide incremental benefits but also helps to cope the high demand uncertainty within the fashion industry

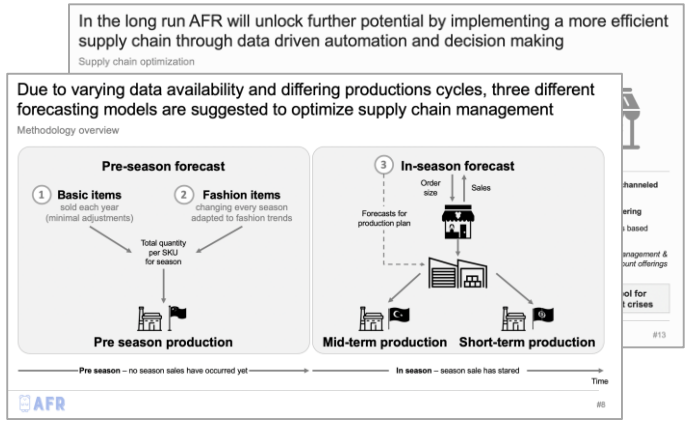
Conclusion

Status Quo



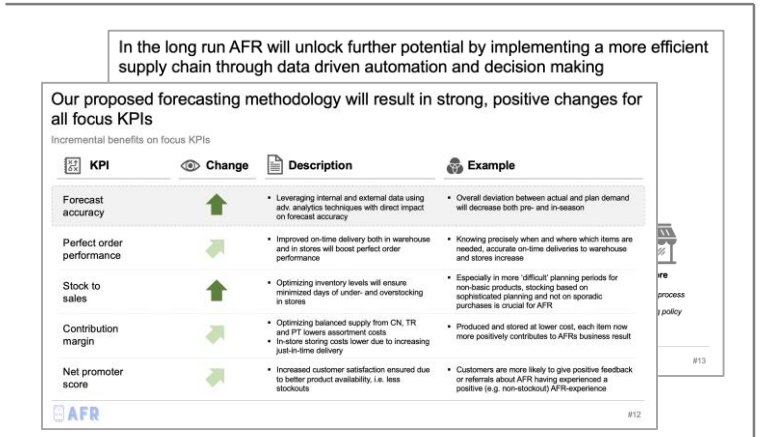
- Insufficient SCM resulting in **constant mismatch of supply and demand**, leading to an increasing supply chain cost and margin pressure

Proposed Methodology



- **Reducing forecast error** and thus optimizing replenishment management, reducing operational cost through a more efficient supply chain

Expected results



- Proposed forecasting methodology will result in **strong, positive changes for all focus KPIs** – additional SCM innovations will further boost AFR's long-term business performance

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Thank you for your attention.

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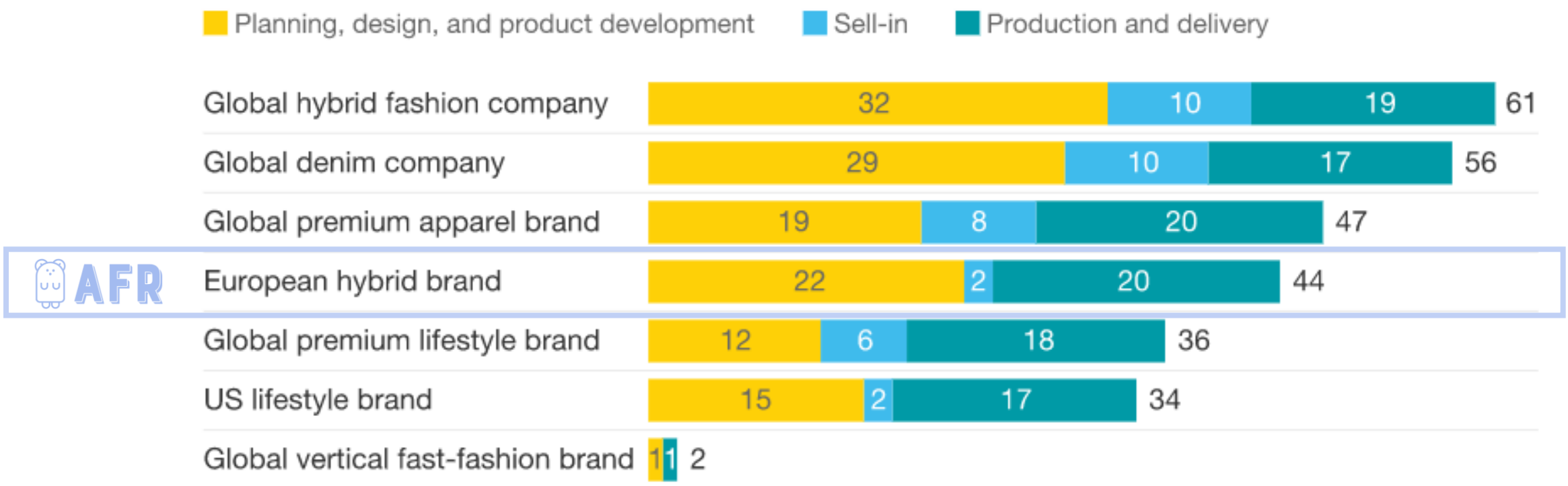
Tuesday, June 4th 2019

Fashion cycle duration varies across industry due to different company profiles and production line set-ups

Overview pre season planning (in weeks)



Source: McKinsey and Company

AFR three different production sites in China, Turkey and Portugal differ in production cost and delivery times

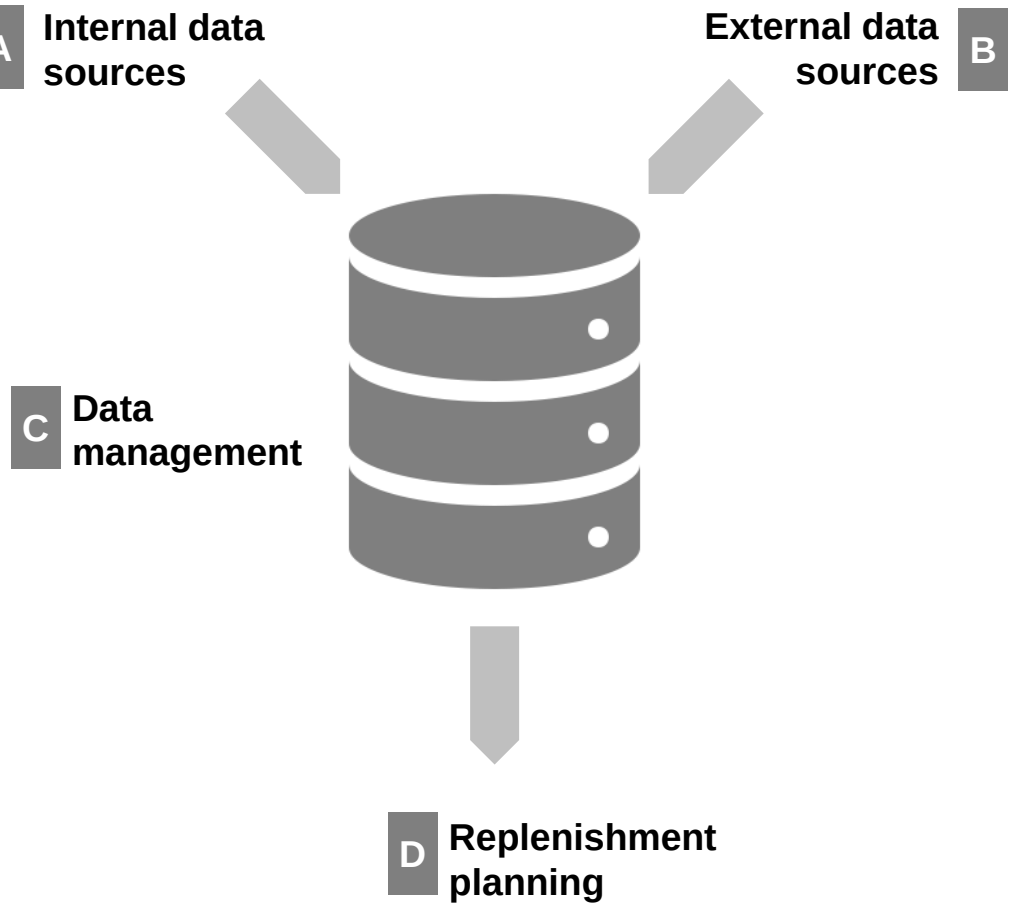
Production site overview

	Average production cost	Arrival time
CN	8 USD	36 days shipping + 4 days customs
TK	16 USD	12 – 28 days shipping 6 – 8 days plane
PT	24 USD	6 days road delivery

Source: Made in China, DSV logistics, Me360, Freigthos

AFR builds on a sophisticated operational data management system but is not yet leveraging on its full potential

Data management



Description

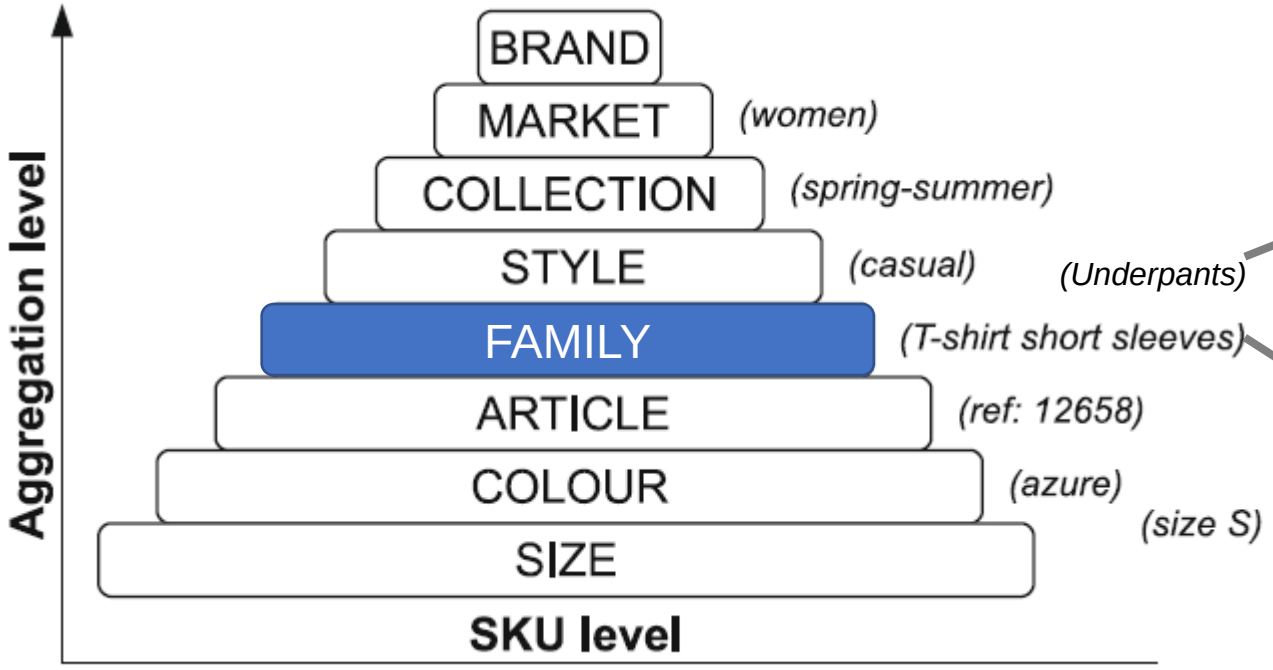
- **A** Historical sales and stock data, promotional data
- **B** E.g. weather, holiday, competitor data, social media data
- **C** Data aggregation and flow between central and decentral stakeholders
- **D** Replenishment planning based on steps A-C

Pain Points

- Sole data source for replenishment planning
- External data not at all leveraged
- Infrequent communication between warehouse & stores
- No algorithmic replenishment planning in place

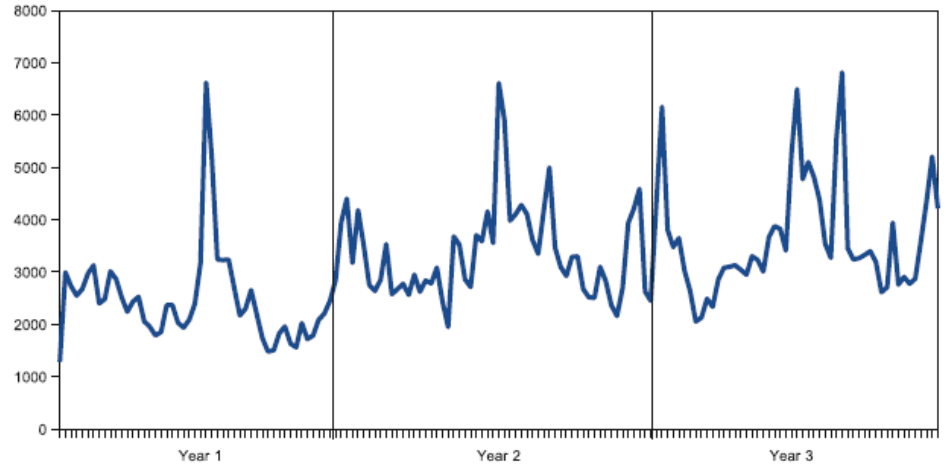
Among fashion item groups differing seasonal variation levels due to group specific sensitivities and sales patterns

Aggregation levels of fashion products

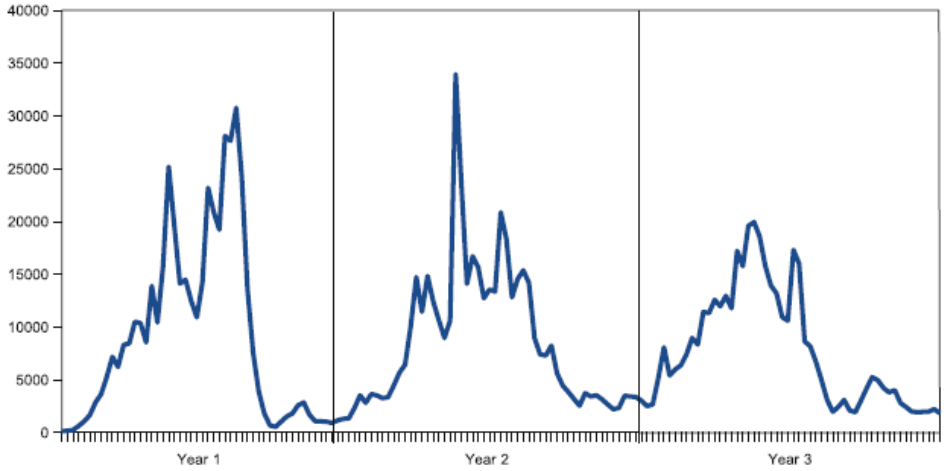


(Underpants)

Underpants sales



Short sleeves t-shirts sales



Source: Sebastian Thomassey

Fashion demand is influenced by several different factors – some of them can be influenced by the retailer while others cannot and are also difficult to predict

Demand influence factors

Under control

- **Item features** *(size, colour, style,…)*
- **Retailing strategy** *(number of stores, location,…)*
- **Marketing strategy** *(advertising,…)*

Uncontrolled

- **Weather data** *(temp, rainfall,…)* ✗
- **Competition** *(offer, promos,…)* ✗
- **Calendar data** *(holidays,…)* ✓
- **Economic trends** *(purchasing power,…)* (✓)

Source: Sebastian Thomassey

✓ Observable ✗ Not observable

Machine learning model with lagged time variables takes advantage of historic sales data as well as demographic trends among Spain

Linear model with lagged time variables – Pre season Basics

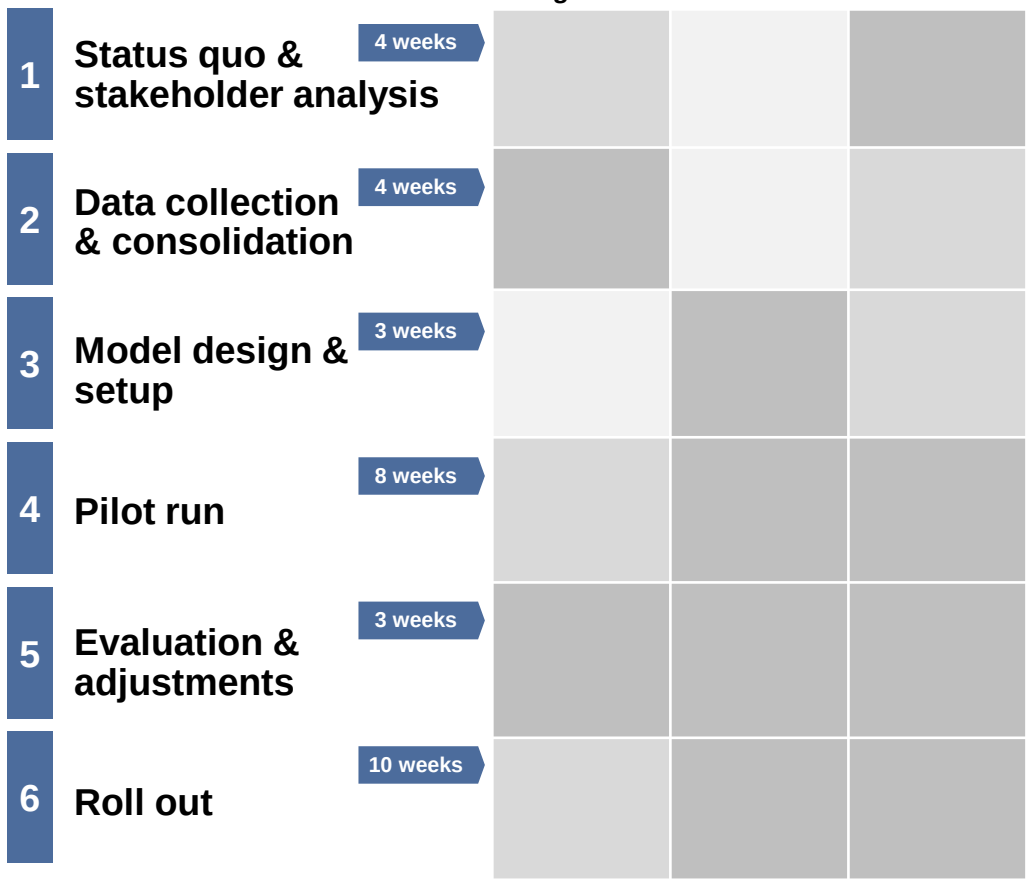
Illustrative

	Historical Data		Demographics					Target
	Total qty sold Y-1	Total qty sold Y-2	# of children 0-3 mnths Y-1	#of children 0-3 mnths Y-2	…	# of children 11-12 yrs Y-1	# of children 11-12 yrs Y-2	Total quantity
SKU 1-2011	23 500	26 000	#	#	…	#	#	25 000
SKU 1-2012	25 000	23 500	#	#	…	#	#	23 500
SKU 1-2013	23 500	25 000	#	#	…	#	#	24 500
SKU 1-2014	24 500	23 500	#	#	…	#	#	25 500
SKU 1-2015	25 500	24 500	#	#	…	#	#	24 000
…	…	…	…	…	…	…	…	…
SKU 1-2018	25 200	24 700	#	#	…	#	#	26 000
SKU 1-2019	26 000	25 300	#	#	…	#	#	?

Clarifications:
- Values displayed in this tables need to be processed before inputting them in the model
- Depicted values represent aggregated data from previous seasons, not full years' data
- Demographics features presented above are for a generic case. For a specific SKU ONLY certain age ranges will apply, since a specific SKU by definition will suit to certain ages

We will implement our solution in less then 8 mo. with skill sets comprising Data Engineering & Science and Business Translator capabilities for less than 600k

Commercial proposal



Commercial Proposal (k EUR)

	Data engineer	Data scientist	Business Translator	TOTAL
1	12	8	30	50
2	20	8	6	34
3	3	30	4.5	37.5
4	24	80	60	164
5	15	30	22.5	67.5
6	30	100	75	205

Workload

Low	*0-1 FTE*
Mid	*1-2 FTE*
High	*2-3 FTE*

Rates

Data Engineer	*2000 EUR*
Data Scientist	*4000 EUR*
Business Translator	*3000 EUR*

TOTAL (k EUR)

Full-fledged project **558.000**

Academic resources as well as operational experts are constantly discussing how to optimize supply chains in the fashion industry

Sources (1/2)

Berg, A.; Heyn, M.; Rölkens, F.; Simon, P. (2019, May 23). *Faster fashion: How to shorten the apparel calendar*. Retrieved from https://www.mckinsey.com/industries/retail/our-insights/faster-fashion-how-to-shorten-the-apparel-calendar

Choi, T. M.; Hui, C. L.; Yong, Y. (2014). *Intelligent fashion forecasting systems : models and applications*. Heidelberg New York: Springer.

Digital Supply Networks (2019, May23). *D!gitalist Magazine*. Retrieved from https://www.digitalistmag.com/digital-supply-networks/2016/03/30/zaras-agile-supply-chain-is-source-of-competitive-advantage-04083335

DSV (2019, May 17). *Global Transport and Logistics*. Retrieved from http://www.es.dsv.com/transporte-mercancias-ferrocarril/importacion-exportacion-china/tiempos-transito

Freightos.com (2019, May 15). *Freight Shipping and Transit Calculator*. Retrieved from https://www.freightos.com/freight-resources/transit-time-calculator-for-international-freight-free/

Gorrepati, K. (2019, May 23). *D!gitalist Magazine*. Retrieved from https://www.digitalistmag.com/digital-supply-networks/2016/03/30/zaras-agile-supply-chain-is-source-of-competitive-advantage-04083335

Academic resources as well as operational experts are constantly discussing how to optimize supply chains in the fashion industry

Sources (2/2)

Made-in-China.com (2019, May 10*). Connecting Buyers with Chinese Suppliers*. Retrieved from https://www.made-in-china.com/productdirectory.do?word=clothes&subaction=hunt&style=b&mode=and&code=0&comProvince=nolimit&order=0&isOpenCorrection=1

Me360.com (2019, May 15). ***土耳其纺织行业概况***. Retrieved from http://www.me360.com/article/330433

Peneházi, G. (2019). *Recurrent Neural Network for Time Series Forecasting.* University of Debrecen, Doctoral School of Mathematical and Computational Sciences

tradegecko.com (2019, May 18). *Zara supply chain analysis*. Retrieved from https://www.tradegecko.com/blog/zara-supply-chain-its-secret-to-retail-success

TrendReports (2019, May 25). *Kids Fashion Trend Report*. Retrieved from https://www.trendreports.com/research/kids-fashion-trend-report