

Today's Business Challenges



FORECASTING BASED ON EXPERT ASSESSMENT

The lack of intelligent tools for sales forecasting makes business decisions dependent only on the available analytics.



USING MANUAL DATA ANALYSIS

Summarizing data from various sources into spreadsheets comes with manual modifications by employees, as well as the risk of analyzing out-of-date information.



DATA STORAGE FRAGMENTATION

The presence of various information and analytical systems complicates the comprehensive analysis and obtaining valuable business information.



LACK OF EFFICIENCY IN MAKING BUSINESS DECISIONS

Businesses are not able to quickly respond to changes in demand due to external and internal factors of influence.

Solving business tasks with Demand Forecast



FORECASTING WITH ML

Machine learning algorithms predict demand, ensure optimal stock levels, and prevent lost sales.



USING POWER BI ANALYTICS

The use of intelligent data processing algorithms makes it possible to analyze large amounts of information and display requests in a few clicks.



UNIVERSAL DATA STORAGE

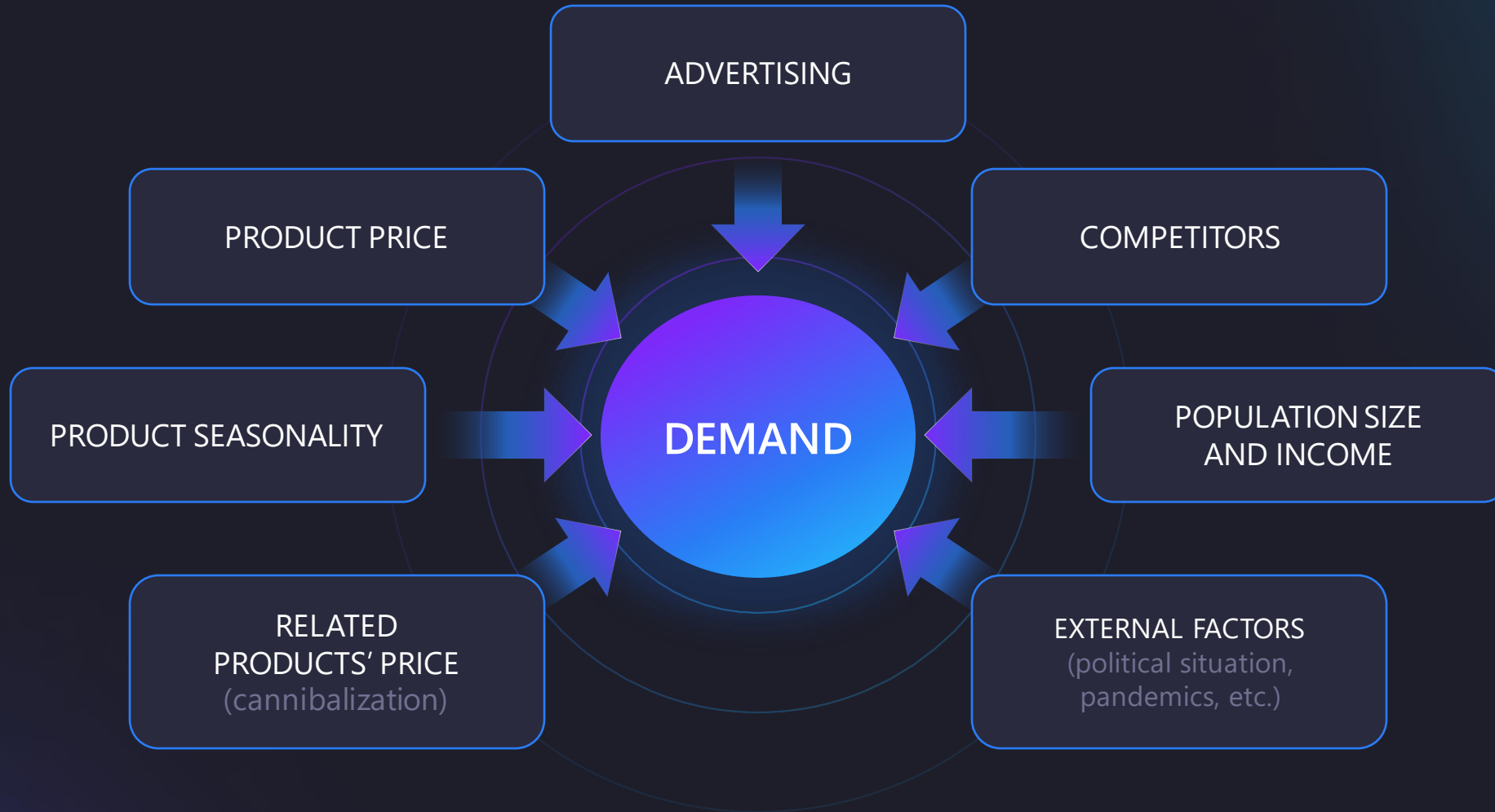
A universal data structure makes it possible to store disparate information in a single format and space.



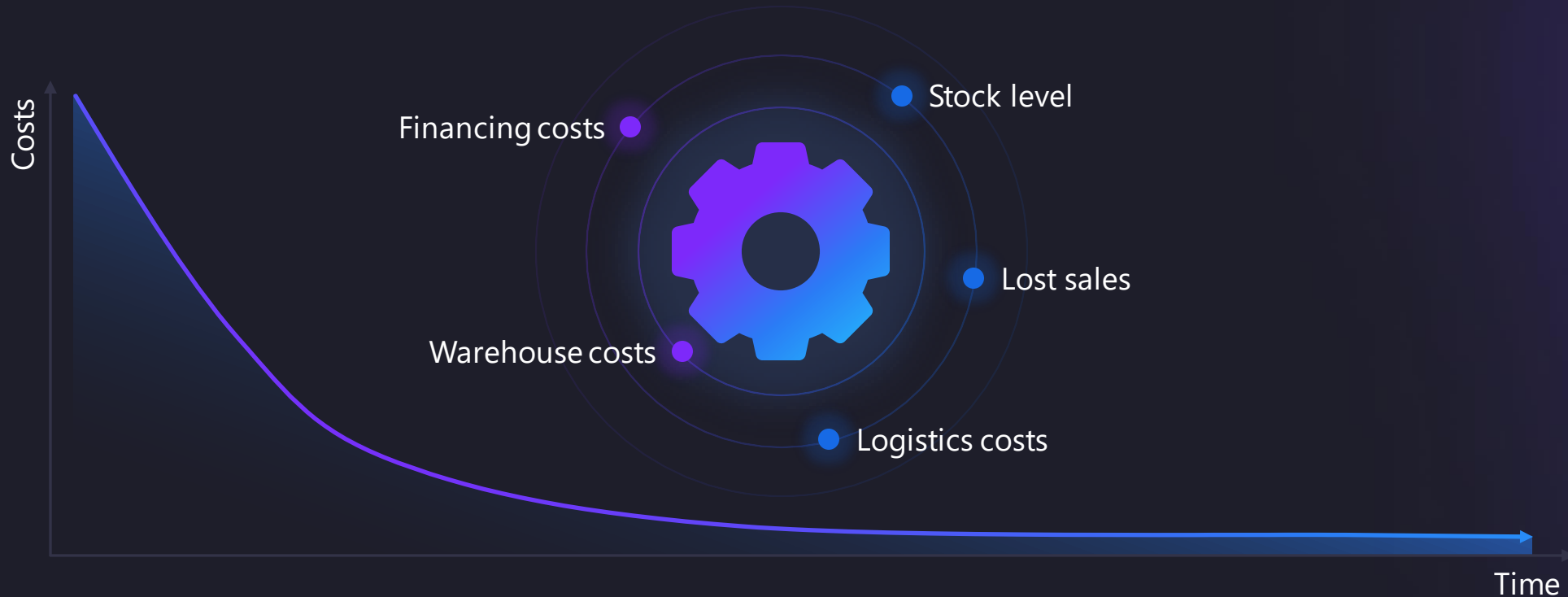
INFORMED DECISION MAKING

Data integration allows you to quickly analyze the level of forecast fulfillment, which lets you make management decisions.

Key factors affecting demand

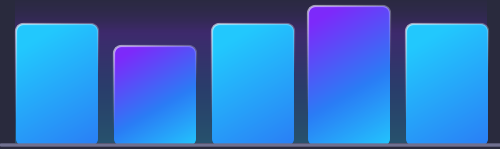


What's affected by forecast quality?



Poor forecasting quality is one of the most common unrecognized reasons of major losses in many companies: decreased level of service, lost sales, etc.

Types of demand and their impact on forecasting



Timescale

SMOOTH DEMAND

Is constant in time and quantitative characteristics.

Forecasting accuracy

HIGH



Timescale

INTERMITTENT DEMAND

No big volatility in quantitative characteristics, large intervals between neighboring points.

Forecasting accuracy

LOW



Timescale

ERRATIC DEMAND

Regular in time, large volatility in quantitative characteristics.

Forecasting accuracy

UNSTABLE



Timescale

LUMPY DEMAND

Large volatility both in time and in quantitative characteristics.

Forecasting accuracy

LOW

Determining the level of target demand

TO DETERMINE THE TYPE OF DEMAND, IT IS NECESSARY TO CALCULATE TWO MAIN COEFFICIENTS:

$$ADI = \frac{\text{Total number of periods}}{\text{Number of demand buckets}} = \frac{12}{8} = 1,5$$

Average demand interval (ADI) shows regularity over time by calculating the average interval between two sales.

$$CV^2 = \left(\frac{\text{Standard deviation}}{\text{Average value}} \right)^2 = \left(\frac{7,12}{13} \right)^2 = 0,3$$

The square of the coefficient of variation in demand CV^2 shows the change in quantitative characteristics.

PERIOD	1	2	3	4	5	6	7	8	9	10	11	12
SALES (DEMAND)	11	-	15	5	-	1	19	-	16	-	12	25



Smooth demand

$ADI < 1.32$ and $CV^2 < 0.49$



Intermittent demand

$ADI \geq 1.32$ and $CV^2 < 0.49$



Erratic demand

$ADI < 1.32$ and $CV^2 \geq 0.49$



Lumpy demand

$ADI \geq 1.32$ and $CV^2 \geq 0.49$

Forecast quality assessment

High forecast accuracy ensures the necessary availability of goods at the right time.

FORECAST BIAS

$$FB = \frac{\text{Sales}}{\text{Forecast}} - 1$$

FORECAST ACCURACY

$$FA = 1 - WMAPE$$

WEIGHED MEAN ABSOLUTE PERCENTAGE ERROR

$$WMAPE = \frac{\sum |\text{Sales} - \text{Forecast}|}{\sum \text{Sales}}$$

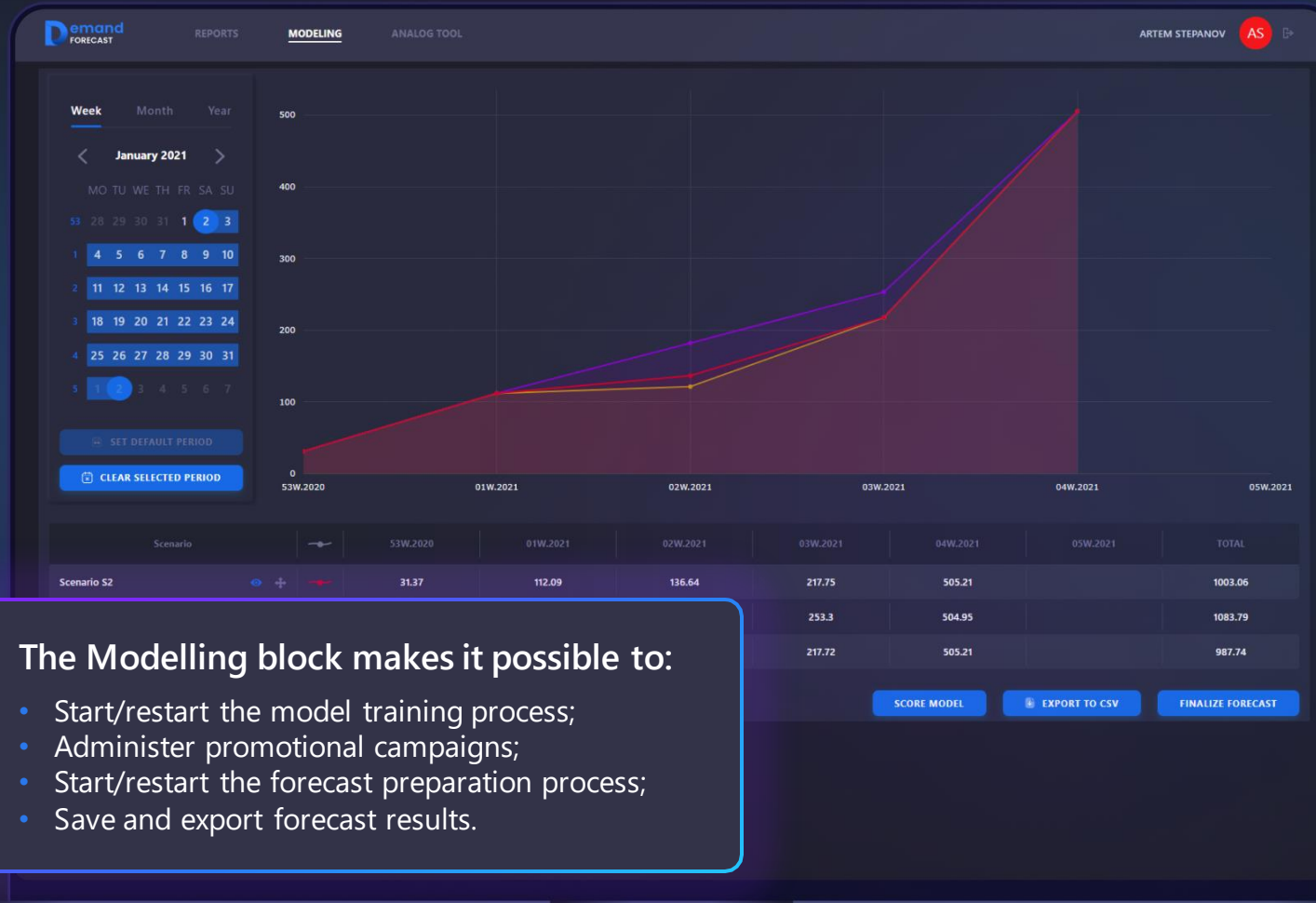


Correlation between forecast accuracy and bias indicators

PRODUCT	SALES	FORECAST	ABSOLUTE DEVIATION	WEIGHED MEAN ABSOLUTE PERCENTAGE ERROR	FORECAST ACCURACY	FORECAST BIAS
PRODUCT 1	50	150	100	200%	0%	- 67%
PRODUCT 2	300	210	90	30%	70%	43%
PRODUCT 3	500	340	160	32%	68%	47%
PRODUCT 4	150	300	150	100%	0%	- 50%
TOTAL	1000	1000	500	50%	50%	0%

It can be seen from the calculations that forecast bias is 0% despite the 50% accuracy. This may indicate a shortage of goods in the right quantity and time.

Demand Forecast | Modelling



The Modelling block makes it possible to:

- Start/restart the model training process;
- Administer promotional campaigns;
- Start/restart the forecast preparation process;
- Save and export forecast results.

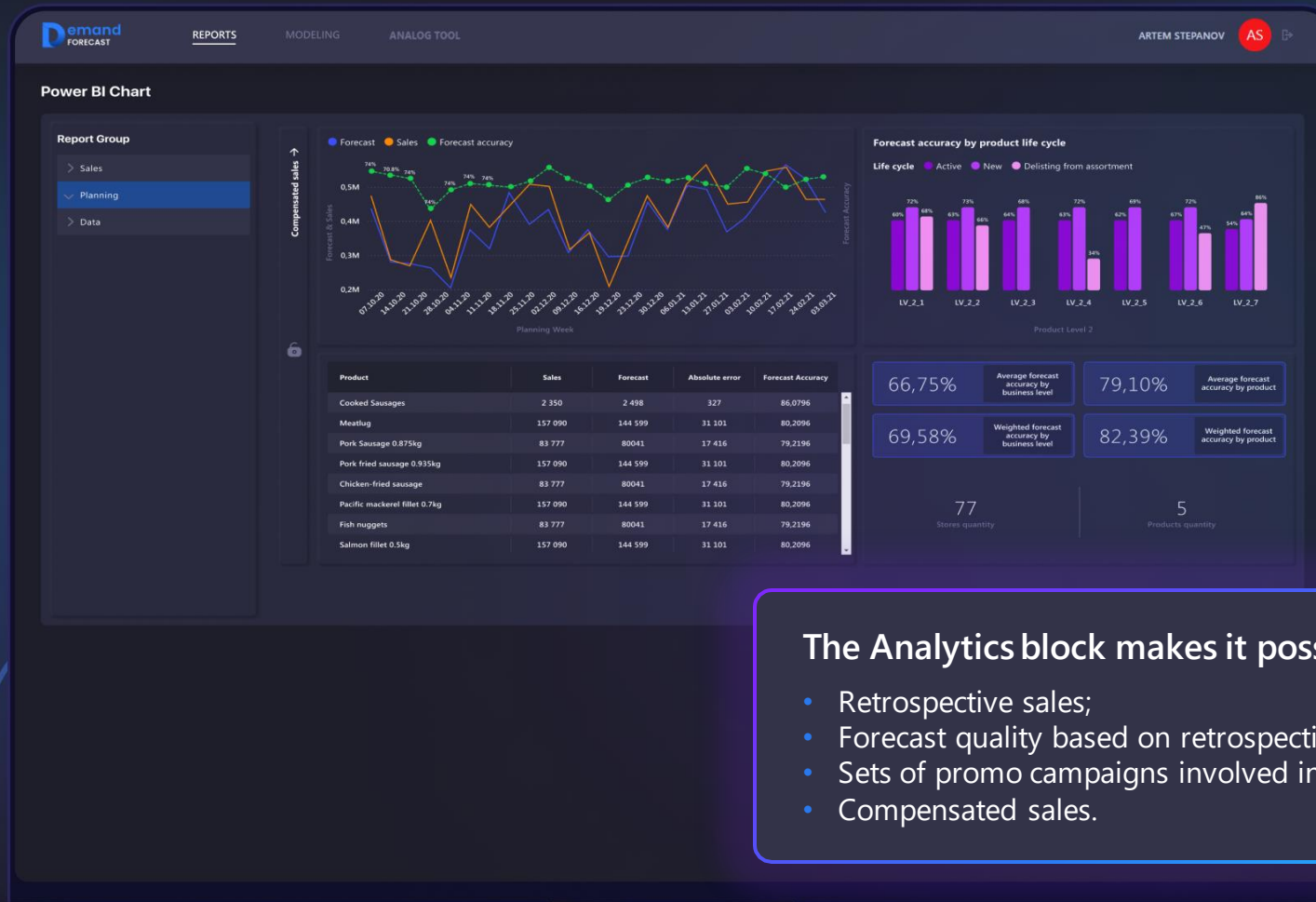
Demand Forecast | Analog processing

The screenshot displays the 'ANALOG TOOL' interface. At the top, there are navigation tabs for 'REPORTS', 'MODELING', and 'ANALOG TOOL'. The user 'ARTEM STEPANOV' is logged in. The main section is titled 'SKUs with insufficient history' and contains a table with columns: Product, Description, Analog description, Base unit of measurement, Planning unit of measurement, Level 1, Level 2, Level 3, Level 4, and Level 5. Three rows are visible, with the third row (SKU 36115) highlighted in blue. Below this is the 'SKU analog selection' section, which includes dropdown menus for 'Level 1' (MEATS), 'Level 2' (SEMI-SMOKED SAU...), and 'Level 3' (SAUSAGE). An 'All analogs' toggle is turned on. A table below shows the selected analog for product 20472, with columns: Active analog, Product, Description, Base unit of measurement, Planning unit of measurement, and Level 1.

The Analog processing block makes it possible to:

- Check for products/stores that do not have enough actual sales data to predict;
- Analyze the list of proposed analogs of goods / stores;
- Choose a relevant product / store as a benchmark.

Demand Forecast | Analytics



The Analytics block makes it possible to analyze:

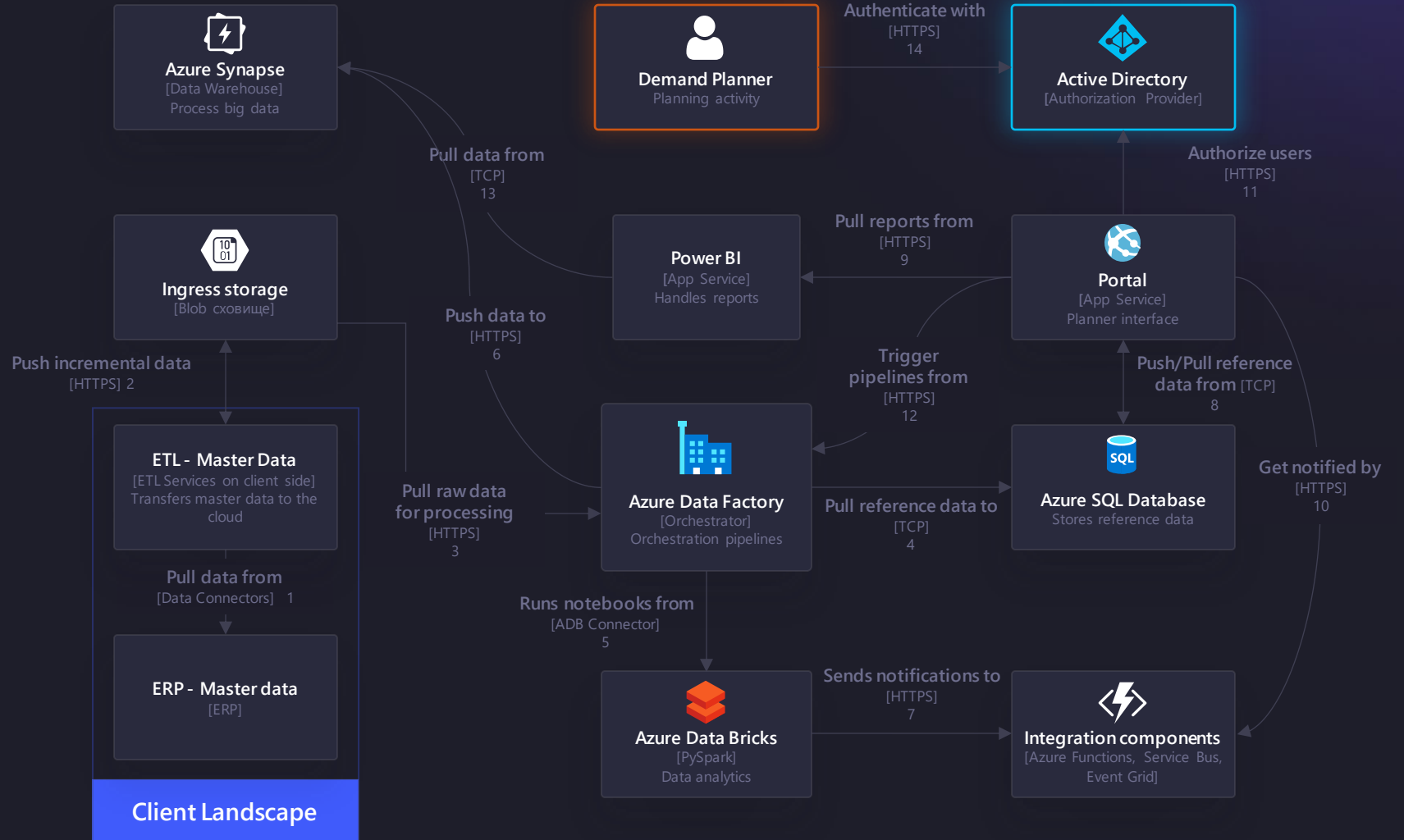
- Retrospective sales;
- Forecast quality based on retrospective data;
- Sets of promo campaigns involved in forecasting;
- Compensated sales.

SMART DEMAND FORECAST ARCHITECTURE

Опис

1. Retrieve historical data from master data ERP
2. Push historical incremental data to the cloud storage for further processing
3. Azure Data Factory gets data on schedule and process it from raw to prepared for planned
4. Transformed raw data incrementally stored in Azure SQL Database
5. Azure Data Factory triggers Azure Data Bricks to run notebooks during modeling, training and data health check process
6. Azure Data Factory triggers Azure Synapse to process big data
7. Azure Data Bricks notifies integration components while long-running operations
8. Portal works with data in Azure SQL Database
9. Portal gets reports from Power BI based on data in Azure Synapse
10. Portal use integration components for long-running operations
11. Portal uses Azure AD B2C to authenticate users
12. Portal triggers Azure Data Factory to run pipelines
13. Power BI gets data from Azure Synapse
14. Demand Planner uses Azure AD B2C to authenticate

Azure Subscription



Pilot Project Results

Retail chain of stores in Ukraine.



Challenges:

Forecasting weekly promotions for one of the high-turnover product categories with a short shelf life (2-6 weeks):

- Assortment list: 150+ SKUs
- Number of points of sale: 700+
- Planning horizon: 8 weeks

Forecast detail level:

- Promo Week
- Point of sale
- Product



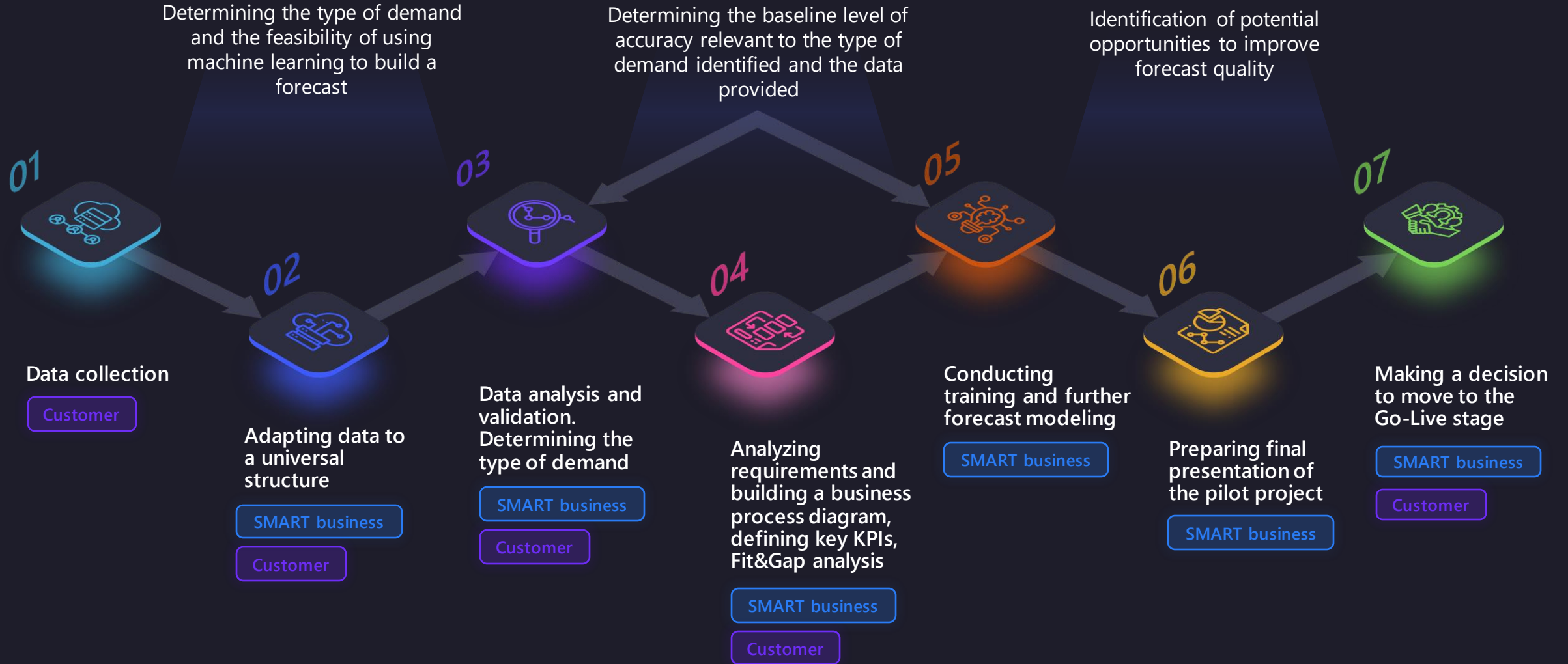
Results:

Accuracy indicators at the product and point-of-sale levels in the promo week during the validation period (6 months) were as follows:

- Weighed mean accuracy – **69%**
- Mean accuracy – **67,5%**



Pilot Project Stages



Solution Benefits

STOCK REDUCTION

The more accurate the forecast, the more availability can be provided at the right time with less inventory.

SAVING LABOR COSTS

Optimization of the planning and analytics process to avoid the workload of teams and reduce the human error factor.

REDUCED NUMBER OF WRITE-OFFS

Forecasting accuracy has direct impact on the number of products written off.

AVAILABILITY LEVEL OPTIMIZATION

The high availability of products has a positive impact on the reputation of the business as a whole and contributes to an increase in the level of service.

EFFICIENCY IN BUSINESS DECISION MAKING

Powerful Power BI analytics will allow you to quickly make management decisions based on up-to-date data.





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