Identify Hidden Patterns and create Demand Forecasting in Supply Chain using MS Azure AI

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Agenda

- Data as a Strategic Asset (DaaSA)
- Understanding Hidden Patterns in Data
- MS Azure AI Stack
- Digitalization & Automation of Supply Chain
- Creating Demand Forecast
- Veraqor Offers

Supply Chain Management

- Interconnected supplies of hardware, services, operations and technology in such coordinated way that a task could not be completed unless previous task in the chain is finished.
- There are many intermediaries involved to facilitate
- Businesses demand data-centric 360-degree omnichannel view
- Data & Cloud growth and adoption rate Y-o-Y grown ~29%

~$15 **trillion**

CAGR of 16% (2020 – 2030) projection

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DaaSA: Data as a Strategic Asset

- Data is not just info anymore – its an asset
- Create enterprise level data strategy and framework
- Make CyberPhysical system more resilient and responsive
- It helps create 360 degree omnichannel view for customer churn
- Using advanced analytics get key insights from enterprise data

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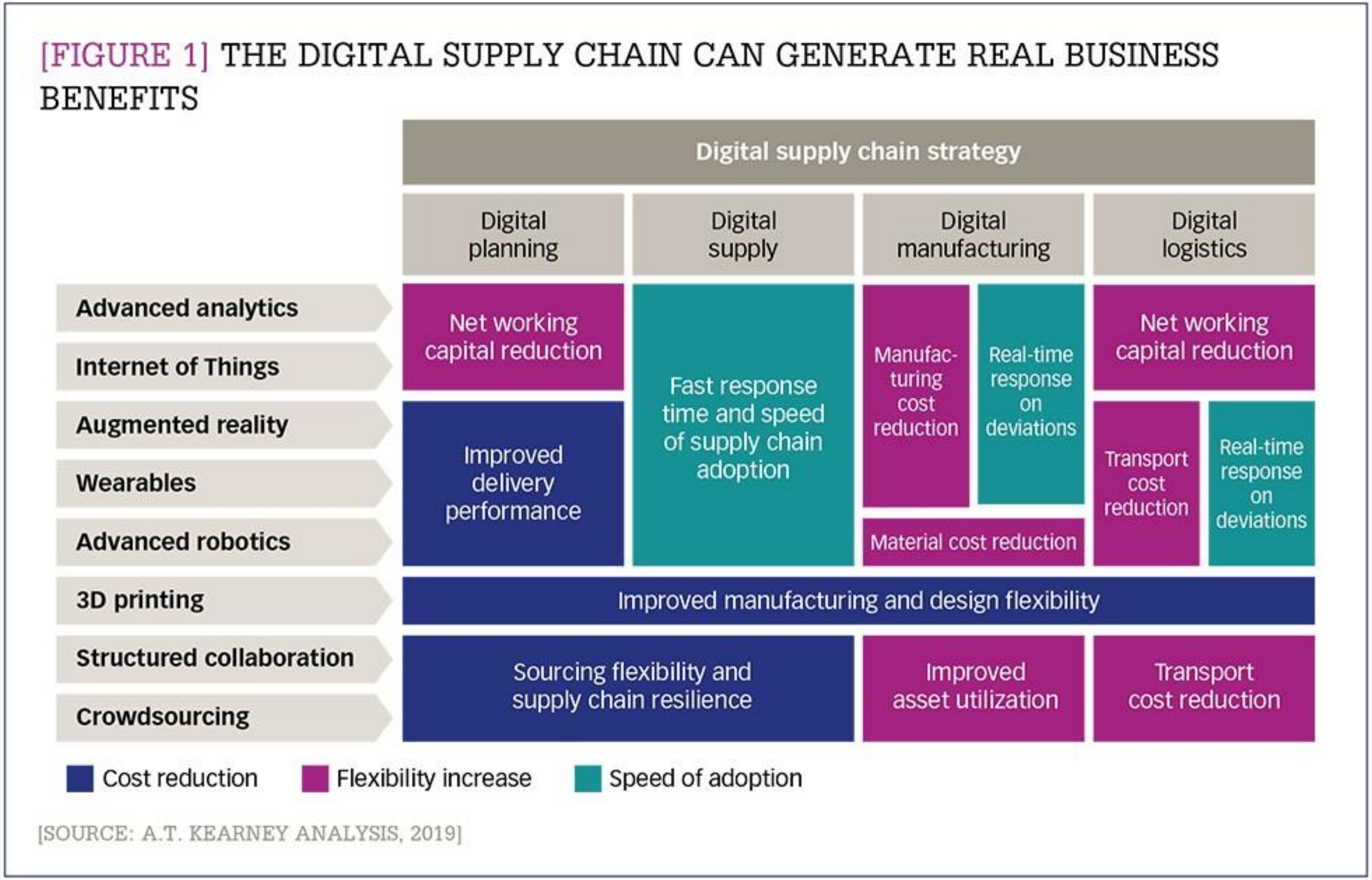
Digitization & Automation of Supply Chain

- Better control over supply chain
- Tendency for forward-planning
- Ability to connect and relate data
- Using analytics generate insights for key decision
- Improved collaboration across the board
- Improved cash flow & management
- Satisfied customer



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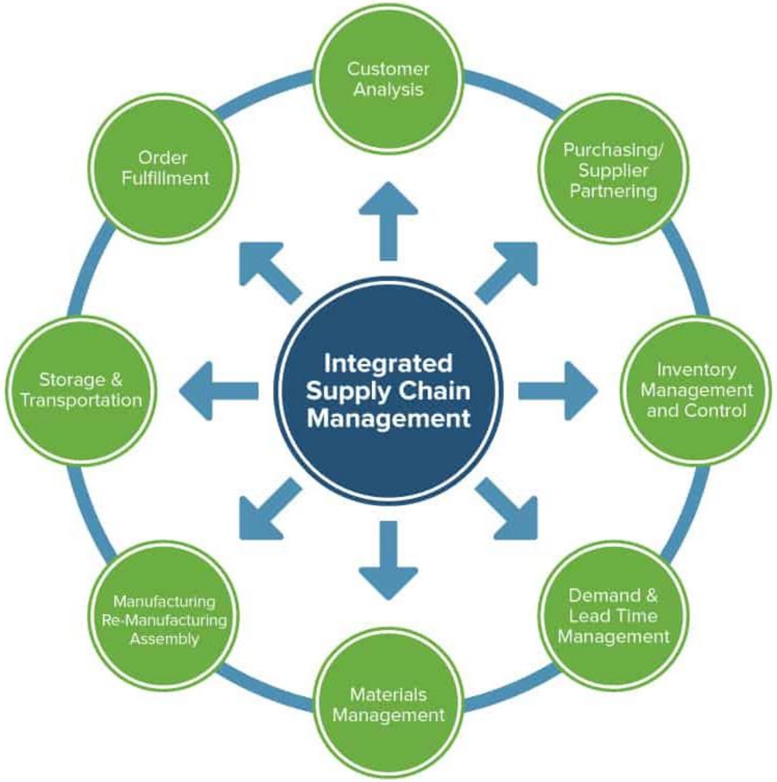
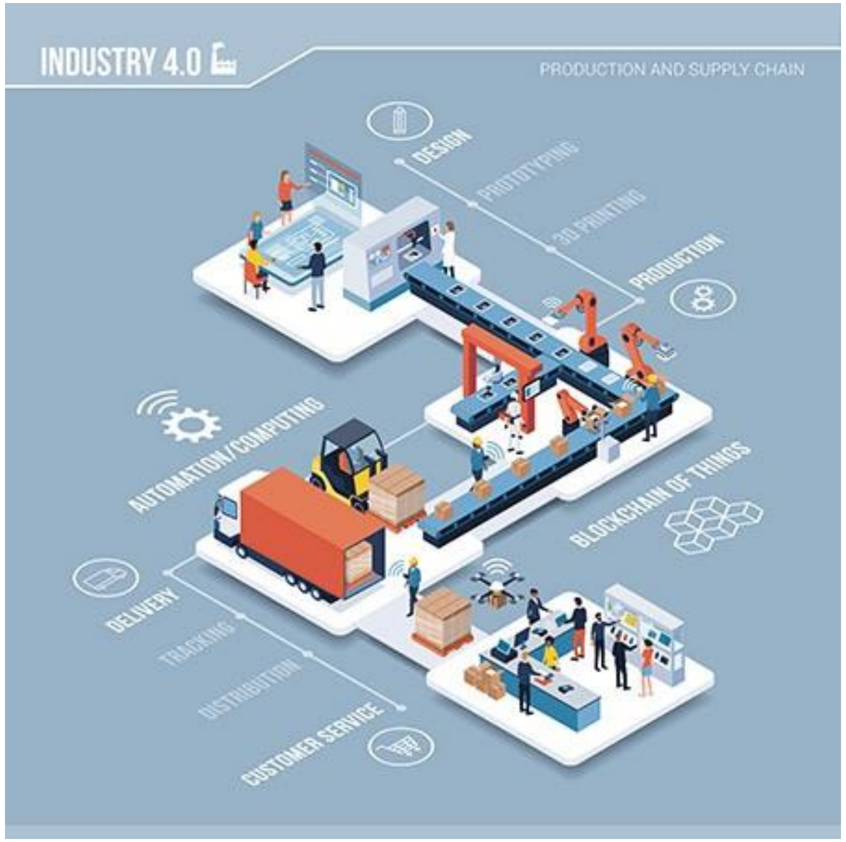

Integrated Supply Chain Management
Customer Analysis
Purchasing/ Supplier Partnering
Inventory Management and Control
Demand & Lead Time Management
Materials Management
Manufacturing Re-Manufacturing Assembly
Storage & Transportation
Order Fulfillment


INDUSTRY 4.0
PRODUCTION AND SUPPLY CHAIN
DESIGN
PROTOTYPING
3D PRINTING
PRODUCTION
AUTOMATION/COMPUTING
BLOCKCHAIN OF THINGS
DELIVERY
TRACKING
DISTRIBUTION
CUSTOMER SERVICE

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Hidden Patterns within Data

Periodic Patterns

These are patterns that are seen repeating themselves after a certain lapse of time. This type of pattern is frequently encountered in time series data, biological sequences, spatiotemporal (has both time + space dimensions) data, etc.

Associative Patterns

These are like Bread and Butter/Knife and Fork, i.e., co-occurring groups of things that make more sense with each other. The members of this pattern are complementary to each other.

Abnormal Patterns

This kind of pattern occurs when the data has a clear deviation from normal behavior, an unexpected pattern appears between expected patterns and its appearance is not periodic.

Structural Patterns

Like path finding in graphs or cluster identification > An example would be low-cost residences tend to occur in suburbs whereas downtown has higher costing apartments.

Chaotic Patterns

Here the patterns appear but have no definitive characteristic related to time/space/frequency.

Graph Analytics

- Graph databases are those that use graph structures for semantic queries with nodes, edges, and properties as representations of the data and also to store data
- Graph analytics is the process of analyzing graph data to uncover hidden patterns and relationships.
- Graph databases are well-suited for applications that require the analysis of complex relationships between data elements

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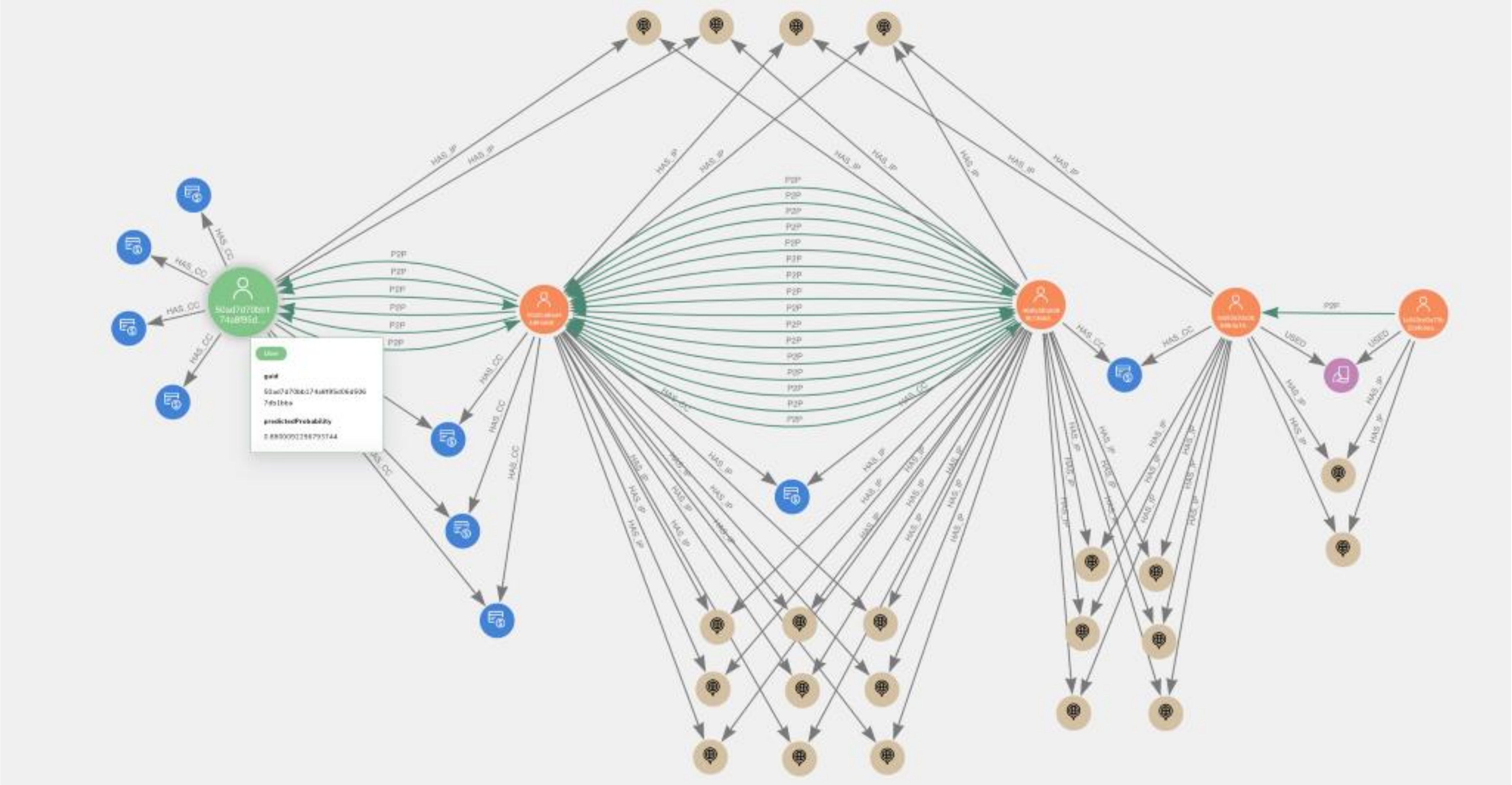
P2P
HAS_IP
HAS_CC
USED
guid
predictedProbability

Types of Graph Analytics

- Pathfinding: to find the shortest path between two nodes in a graph. This is useful for tasks such as routing and task planning.
- Centrality measures: to determine the importance of nodes in a graph. This information can be used to determine which nodes should be priority targets for optimization.
- Community detection: to find clusters of nodes in a graph. This information can be used to identify relationships between nodes and to make decisions based on those relationships.

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Graph Analytics & Hidden Patterns in Data

- Graph analytics is a powerful tool that can help you uncover hidden patterns and relationships in your data.

- Gain insights that would be difficult to find using other methods.

- Use graph analytics to find communities of users with similar interests or to identify potential fraudsters by looking for unusual patterns of behavior.

- Can be used on any type of data, including social media data, financial data, and web data.

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Graph Analytics: Case Study

- Retailer Uses To Detect Fraud:
- A major retailer used graph analytics to detect fraudulent activity. By analyzing the connections between data points, the retailer was able to identify patterns of behavior that suggested fraud. For example, the retailer was able to detect unusual patterns of purchase activity, which suggested that someone was trying to defraud the company. By using graph analytics, the retailer was able to prevent a large financial loss and prevent fraud from occurring in the future.

Bank Account
Credit Card
HAS_BANKACCOUNT
Unsecured Loan
HAS_CREDITCARD
HAS_UNSECUREDLOAN
Phone Number
SSN
HAS_PHONENUMBER
HAS_SSN
SSN
Account Holder
HAS_SSN
HAS_PHONENUMBER
HAS_ADDRESS
HAS_SSN
Credit Card
HAS_CREDITCARD
Account Holder
HAS_ADDRESS
Address
HAS_BANKACCOUNT
Account Holder
HAS_UNSECUREDLOAN
Unsecured Loan
HAS_BANKACCOUNT
HAS_BANKACCOUNT
Bank Account
HAS_PHONENUMBER
Bank Account
Phone Number

Graph Analytics: Case Study

- Food Company Uses To Improve Product Taste:
- A food company used graph analytics to improve product taste. By analyzing the connections between data points, the food company was able to identify which ingredients were most responsible for flavor and texture. This information was then used to reformulate products to improve the taste. By using graph analytics, the food company was able to improve the overall quality of its products and increase sales.

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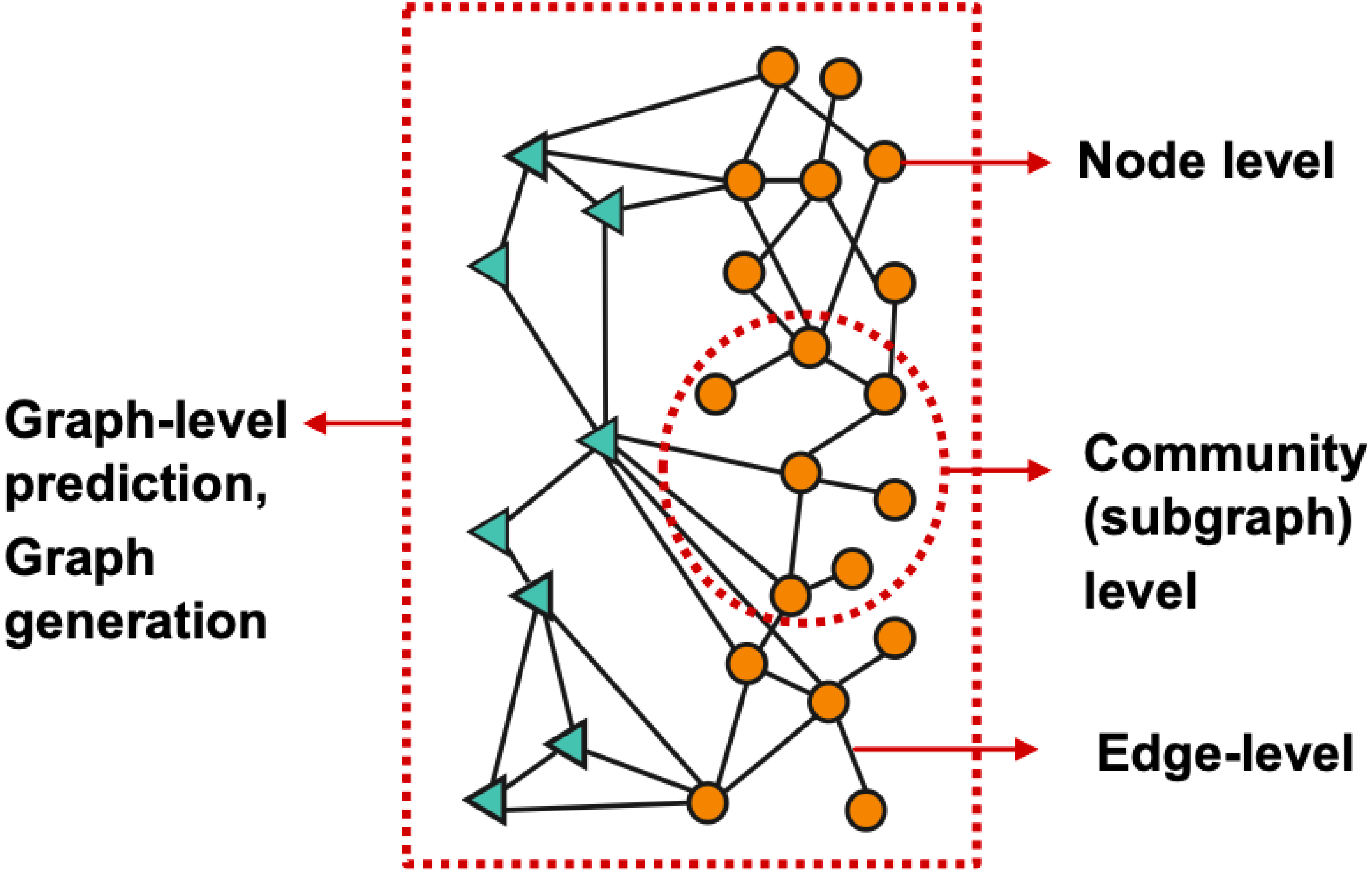
Graph-level prediction, Graph generation
Node level
Community (subgraph) level
Edge-level

Applications

- Sentiments & Trends Analysis
- Image Analysis & Computer Vision
- Forecasting & Probabilistic Estimation
- Speech Recognition

Making Demand Forecasting

- Moving Average Forecasting
- Exponential Smoothing
- Auto-regressive Integrated Moving Average
- Multiple Aggregation Prediction Algorithm
- Bottom-Up Forecasting

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Moving Average Forecasting

- The moving average is a statistical method used for forecasting long-term trends. The technique represents taking an average of a set of numbers in a given range while moving the range.
- Simple moving average (SMA): Simple moving average (SMA) is a form of moving average (MA) that is used in time series forecasting. It is calculated by taking the arithmetic mean of a given set of data over a certain period of time.
- Exponential moving average (EMA): Exponential moving average (EMA) is a type of moving average that places more weight on recent data points and helps smooth out the data points in a time series. Unlike simple moving averages, which give equal weight to all data points, EMAs give more weight to recent data points. This makes it more responsive to new information than a simple moving average.

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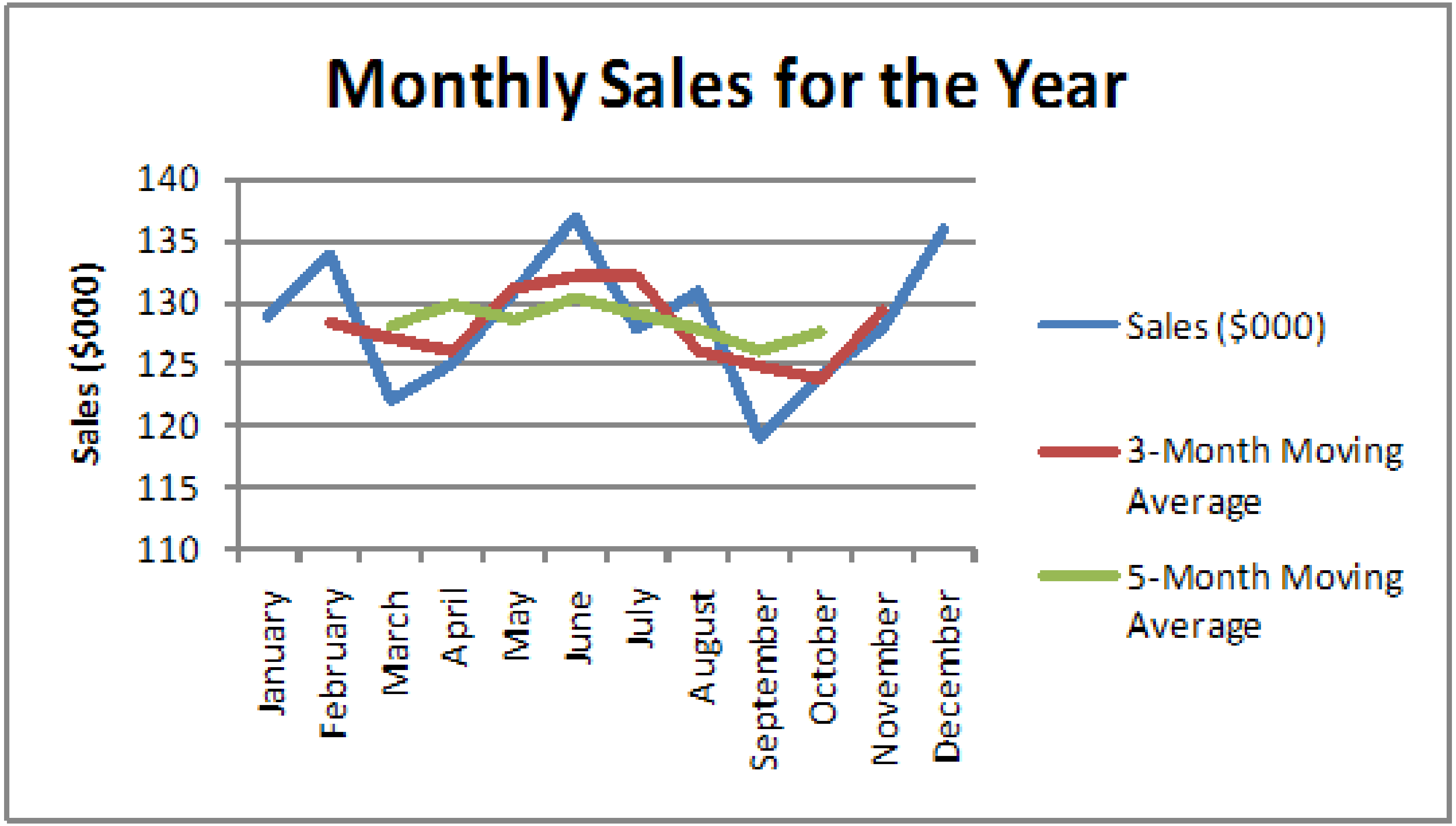
Monthly Sales for the Year
Sales ($000)
140
135
130
125
120
115
110
January
February
March
April
May
June
July
August
September
October
November
December
Sales ($000)
3-Month Moving Average
5-Month Moving Average

Exponential Smoothing

- Exponential smoothing forecasting methods are similar in that a prediction is a weighted sum of past observations, but the model explicitly uses an exponentially decreasing weight for past observations.
- Single, double and triple exponential smoothing
- Additive Seasonality: Triple Exponential Smoothing with a linear seasonality.
- Multiplicative Seasonality: Triple Exponential Smoothing with an exponential seasonality.

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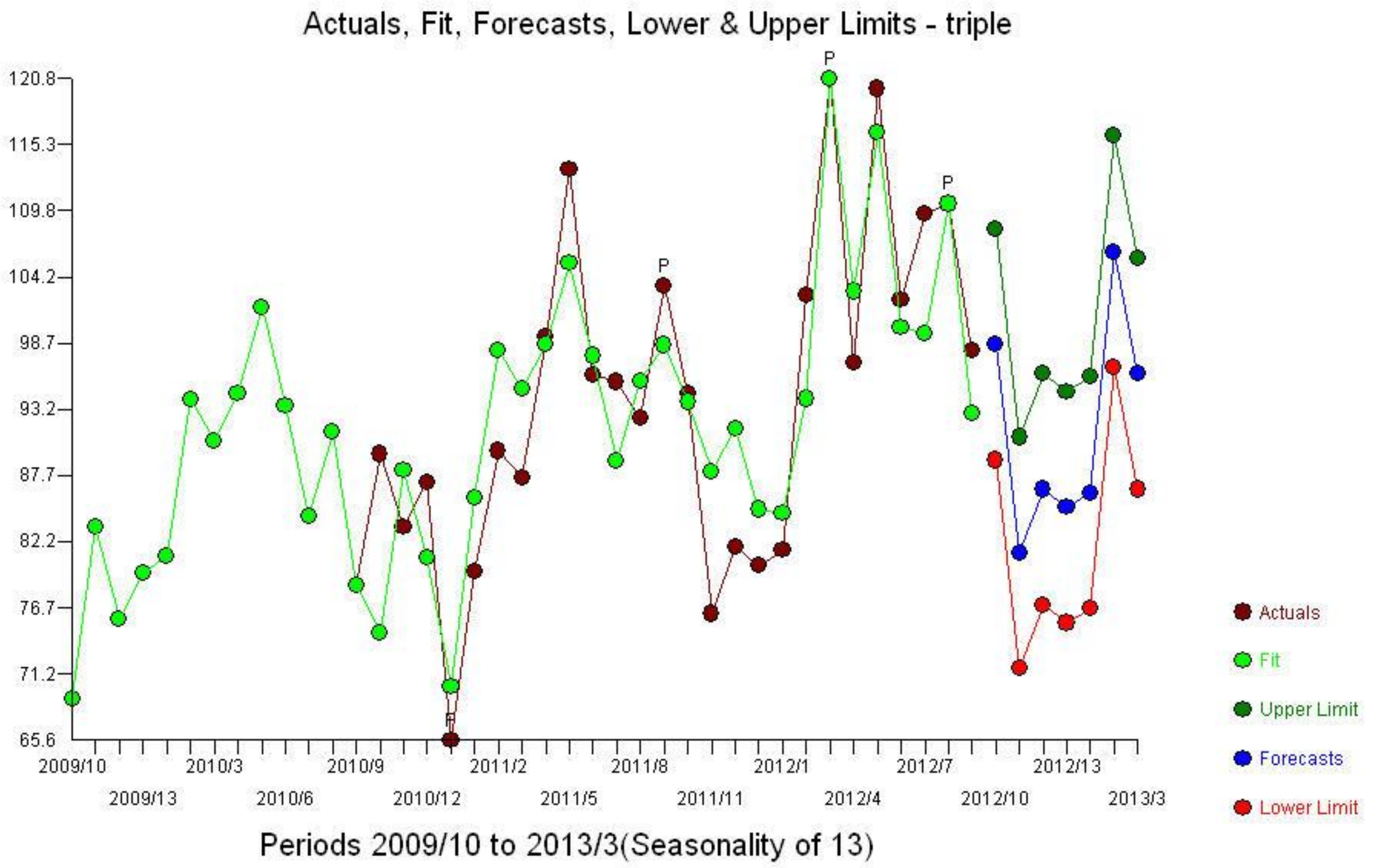
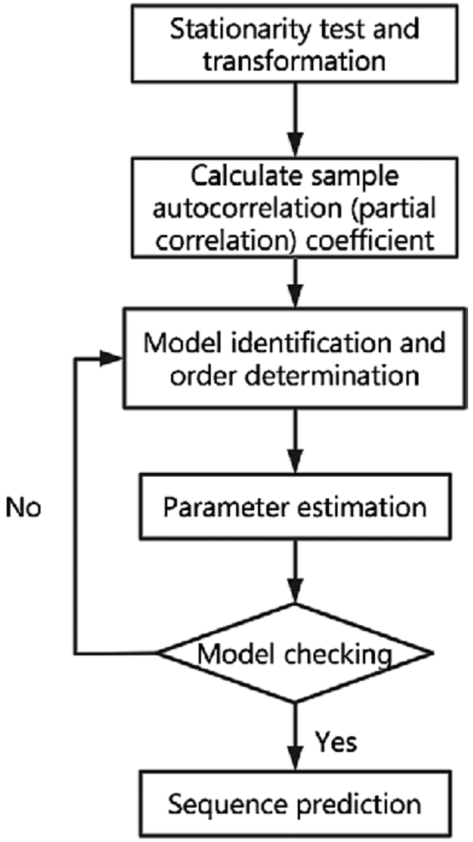


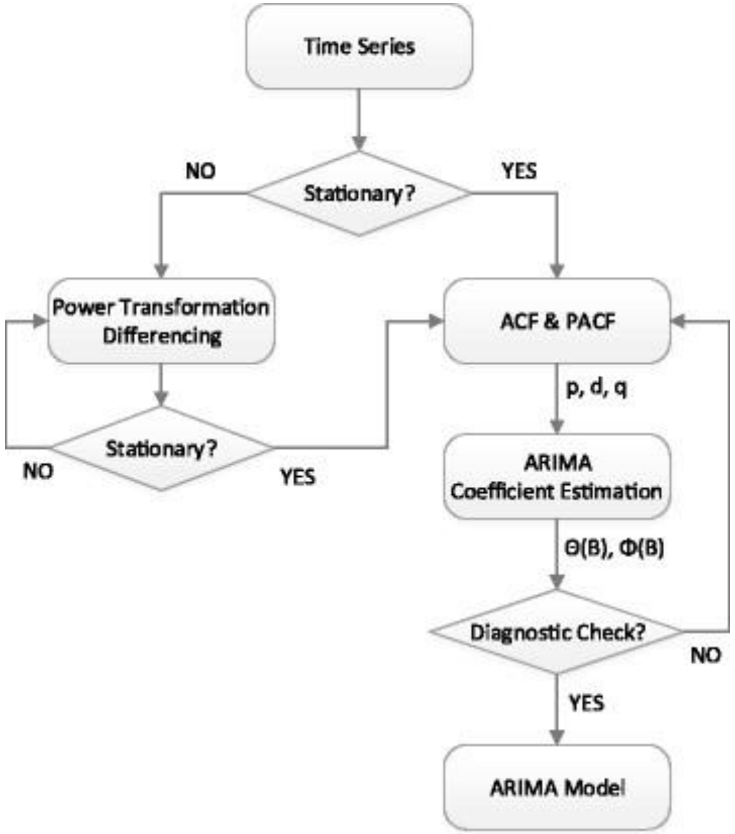
Actuals, Fit, Forecasts, Lower & Upper Limits - triple
120.8
115.3
109.8
104.2
98.7
93.2
87.7
82.2
76.7
71.2
65.6
P
P
P
P
2009/10
2009/13
2010/3
2010/6
2010/9
2010/12
2011/2
2011/5
2011/8
2011/11
2012/1
2012/4
2012/7
2012/10
2012/13
2013/3
Periods 2009/10 to 2013/3(Seasonality of 13)
Actuals
Fit
Upper Limit
Forecasts
Lower Limit

Auto-Regressive Integrated Moving Average

- An auto-regressive integrated moving average, or ARIMA, is a statistical analysis model that uses time series data to either better understand the data set or to predict future trends
- They are widely used in technical analysis to forecast future security prices.
- Therefore, they can prove inaccurate under certain market conditions, such as financial crises or periods of rapid technological change.



Stationarity test and transformation
Calculate sample autocorrelation (partial correlation) coefficient
Model identification and order determination
Parameter estimation
Model checking
No
Yes
Sequence prediction



Time Series
Stationary?
NO
YES
Power Transformation Differencing
ACF & PACF
p, d, q
Stationary?
NO
YES
ARIMA Coefficient Estimation
Θ(B), Φ(B)
Diagnostic Check?
NO
YES
ARIMA Model

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Multiple Aggregation Prediction Algorithm

Step 1

given time series is aggregated into multiple levels using consecutive non-overlapping temporal aggregation

Step 2

An independent ETS model is fitted to each temporal level

Step 3

The components of individual ETS models are extracted and combined to produce the final forecast

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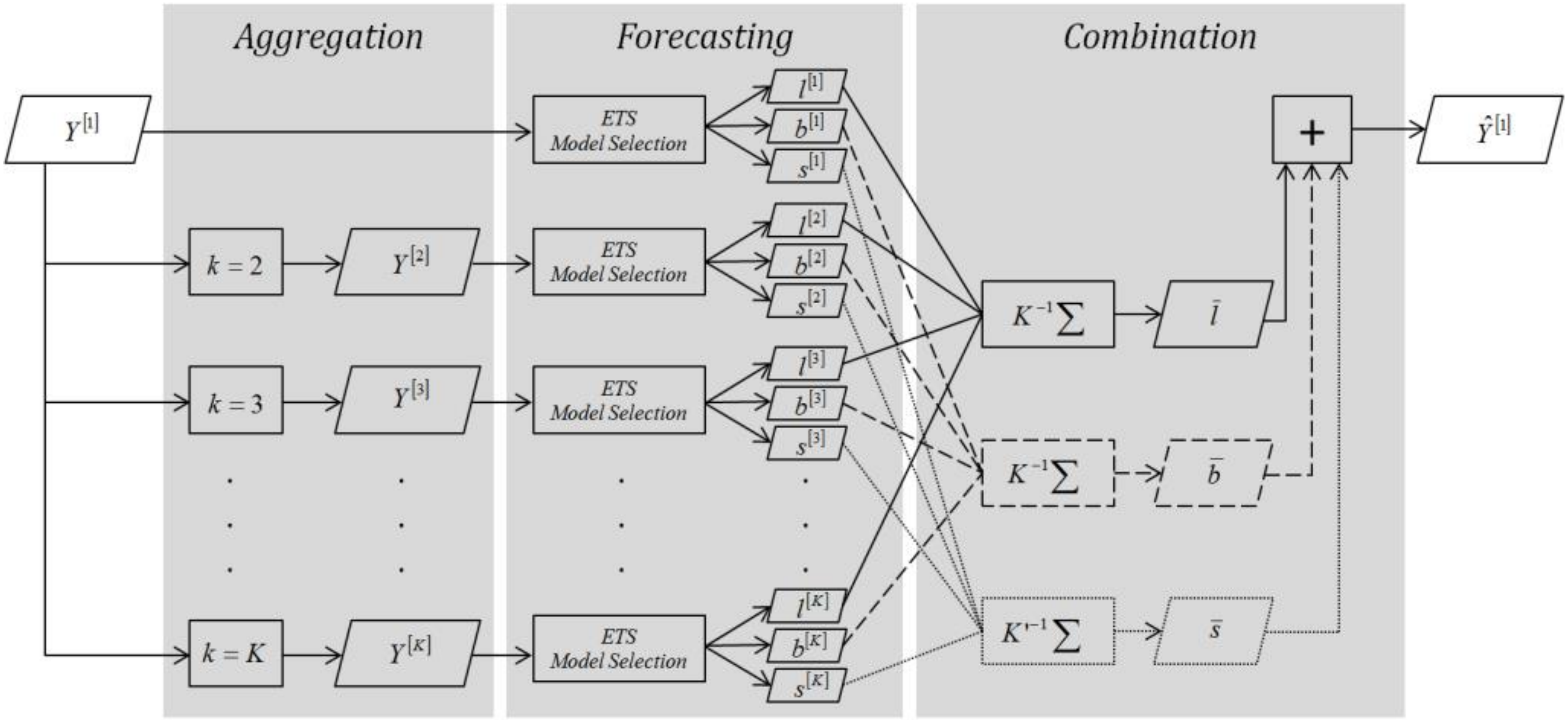

The algorithm is split into 3 distinct steps. The aggregation, the forecasting, and the combination step. In the aggregation step, non-overlapping temporal aggregations are used to construct each hierarchical level. Then in the Forecasting step, a separate ETS model is fitted on every constructed level to produce a forecast. Finally, in the last step, the state space components of the ETS models are combined to produce the final forecast.

Bottom-Up Forecasting

- How much inventory to buy and when
- Customer behavior for specific product service
- Incentivize and attract target audience
- Estimating demand for a new product launch
- Forecasting a demand during a promotion

Bottom-up forecasting is a projection of micro-level inputs to assess revenue for a given year or set of years. For example, revenue teams often use this method to estimate the business's future performance based on individual sales or rep performance.

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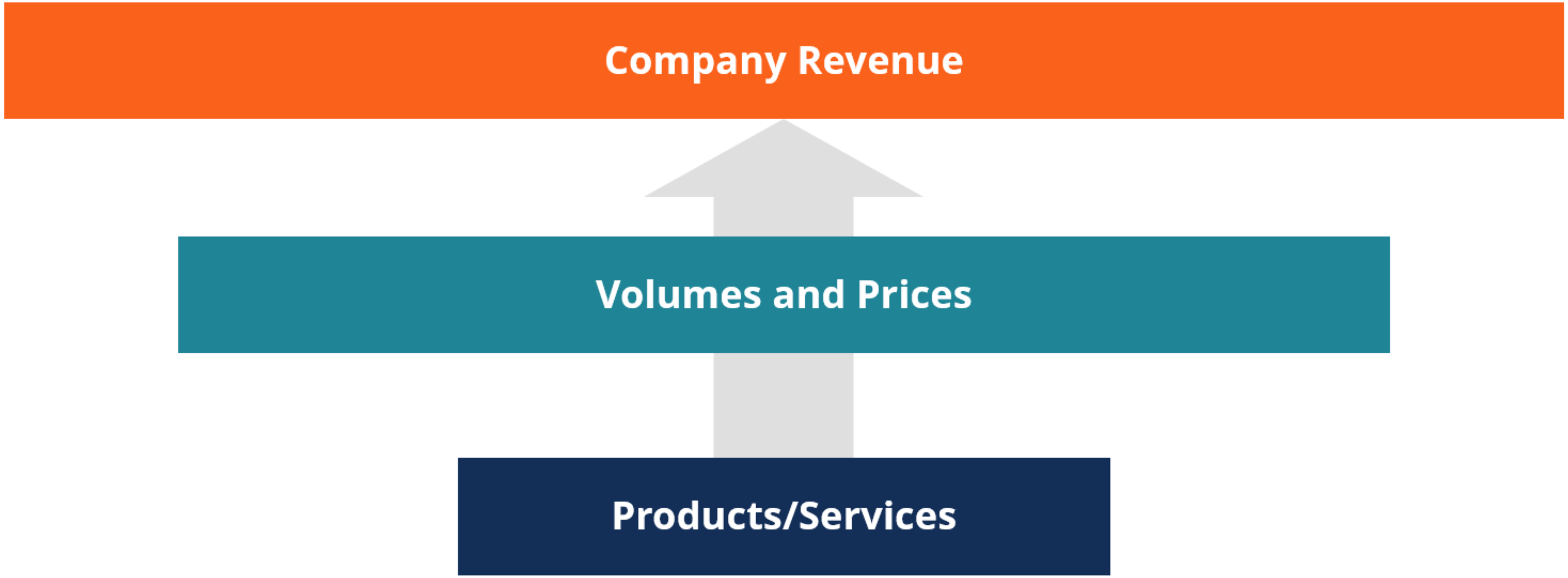
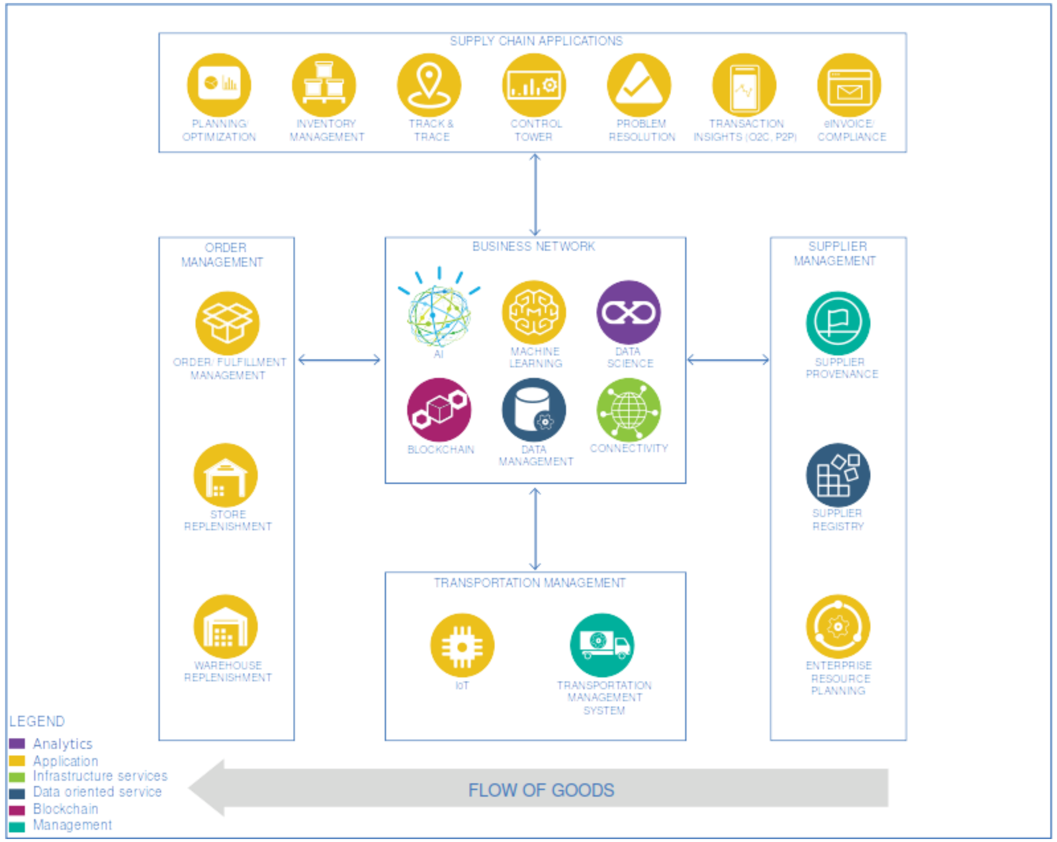
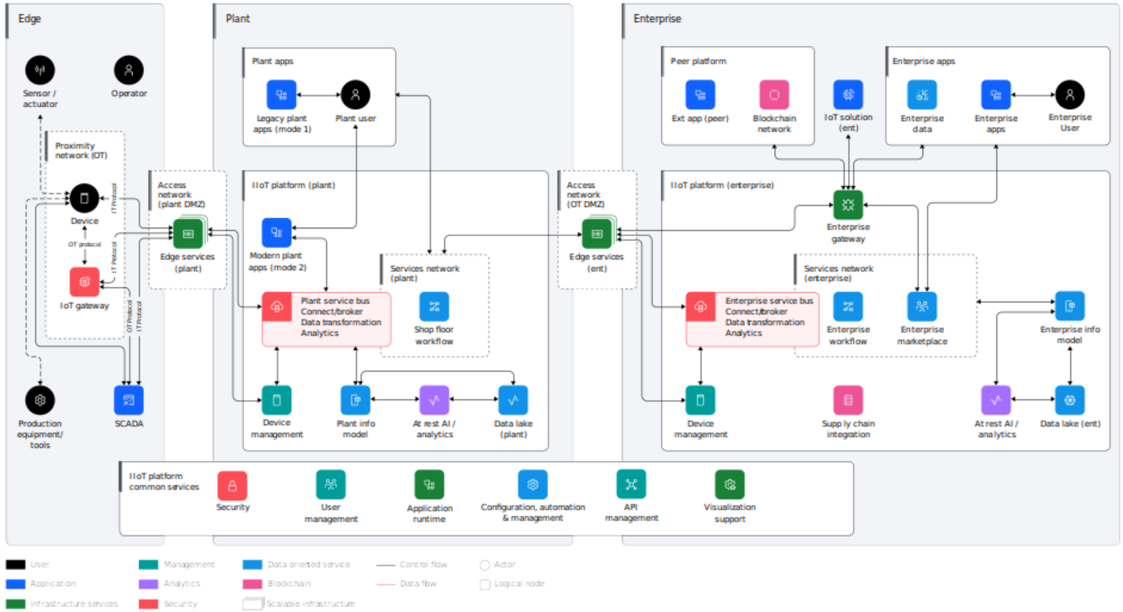

Company Revenue
Volumes and Prices
Products/Services

Technical Reference Architecture





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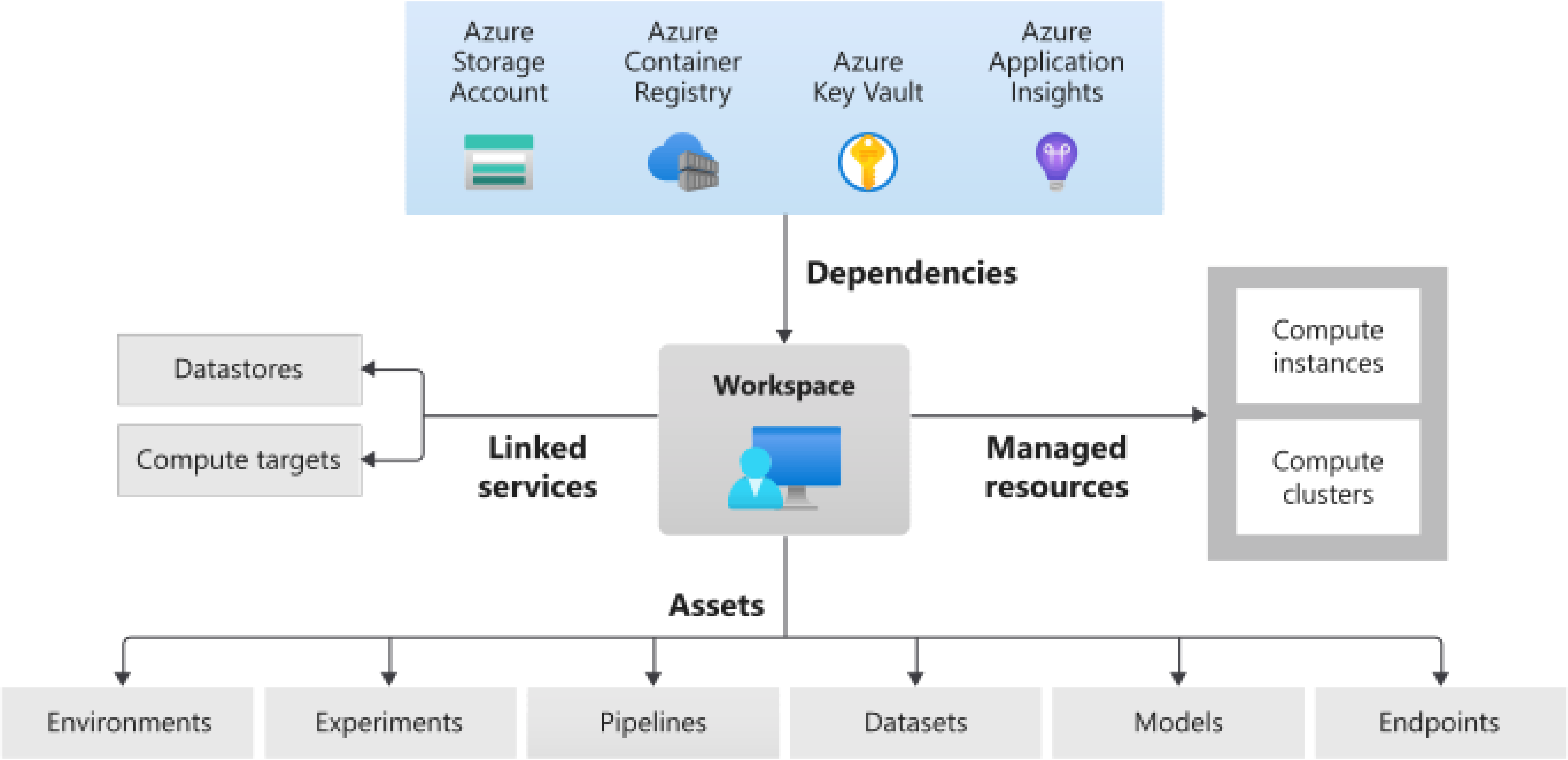
Azure Storage Account
Azure Container Registry
Azure Key Vault
Azure Application Insights
Dependencies
Datastores
Compute targets
Linked services
Workspace
Managed resources
Compute instances
Compute clusters
Assets
Environments
Experiments
Pipelines
Datasets
Models
Endpoints

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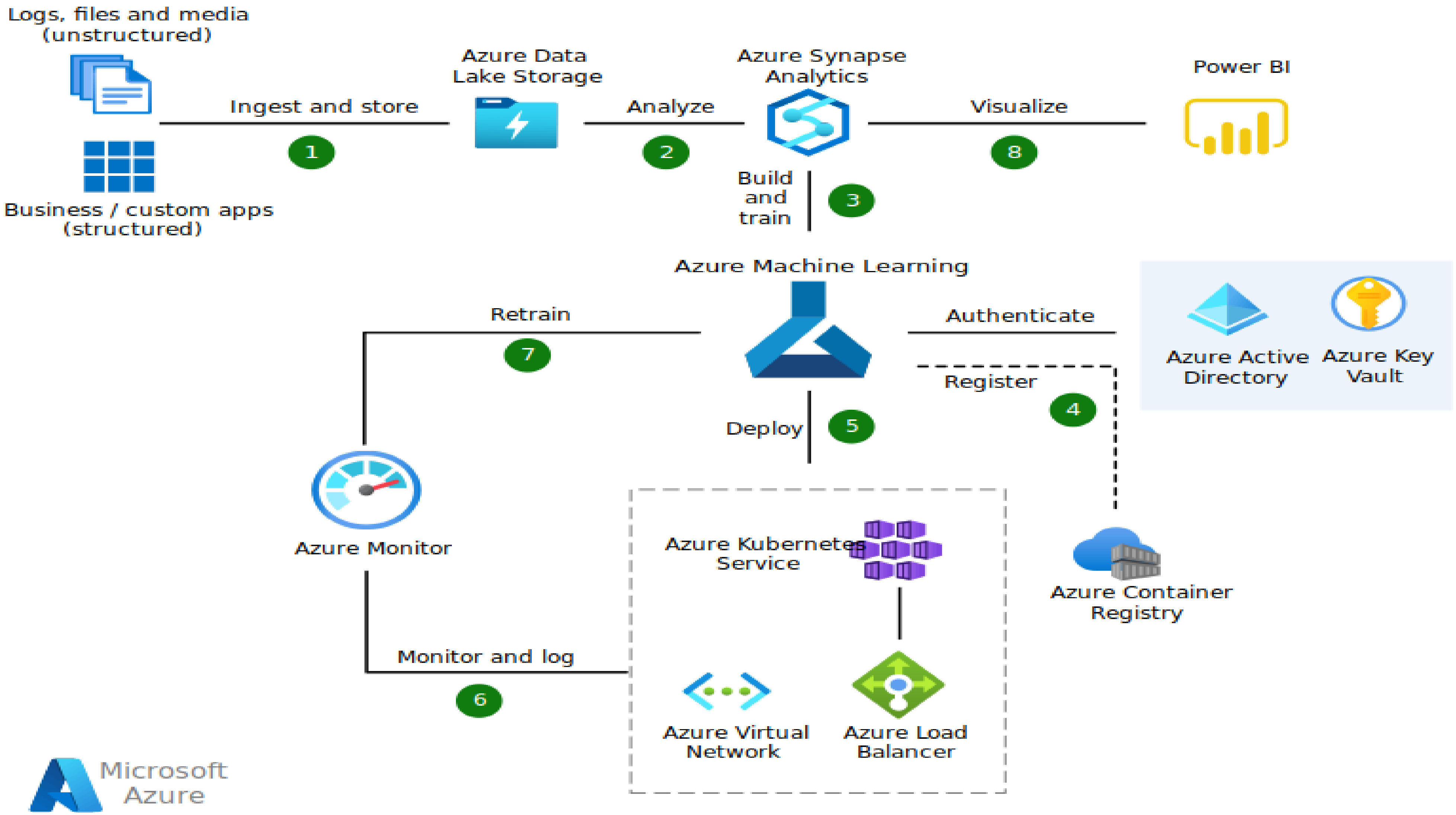
Microsoft Azure AI & Stack



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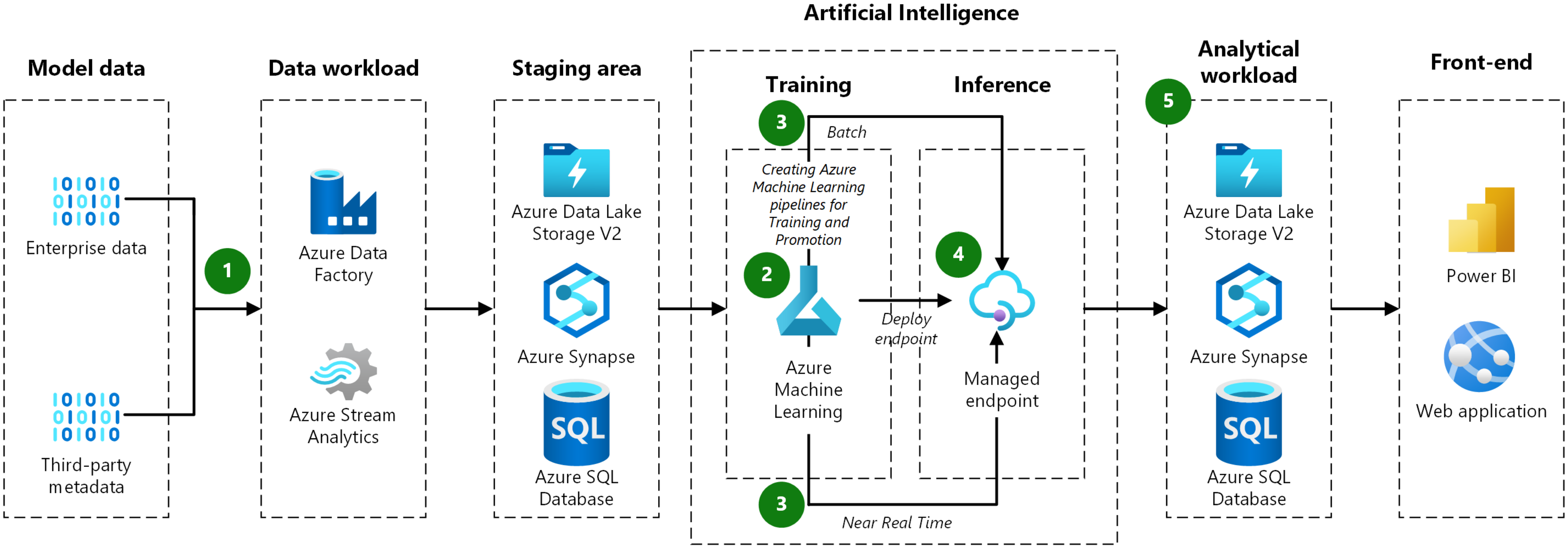

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How Can Veraqor Help?

Briefing	Assessment	Proof of Concept	Implementation
Understand mathematical methods used for pattern analysis, techniques and models used in making demand forecasting	**Receive** an end-to-end analysis and mapping of their IT infrastructure (both physical and virtual), taking into consideration customer plans, current deployment, usage, processes, and data	**POC provides** a test bed where we can migrate your workloads and applications to a cloud environment	**Working Solution** that includes Cloud environment, and suitable Azure destination for customer workload
Briefly discuss methods, techniques, models, components and applications of demand forecasting	**Evaluate** your overall infrastructure in relation to your on-premises and Microsoft Azure cloud strategy	**Azure high level design**, Analysis and Planning report, Pre-Engagement Questionnaire	**Implementation of Lift and Shift**, Migrated and deployed solution, Landing zone, Application artifacts and its configurations.
Duration: 3 Hours Investment: **FREE**	**Identify** migration opportunities in Windows Server and SQL environments.	**It makes your business** more efficient and saves time and money	**Faster time to market**, Business Continuity, Application Innovation, Digital transformation, Cost optimization, Security.
	Duration: 3 Weeks Investment: **$8,000**	Duration: 3 Weeks Investment: **$6,000**	Duration: 4 Weeks Investment: **$16,000**

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Microsoft Azure

Thank you!

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