# NVIDIA's AI Forecasting & Planning Improvement Journey with SAP IBP & NVIDIA AI

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SAPinsider
Las Vegas

2023

SAPinsider

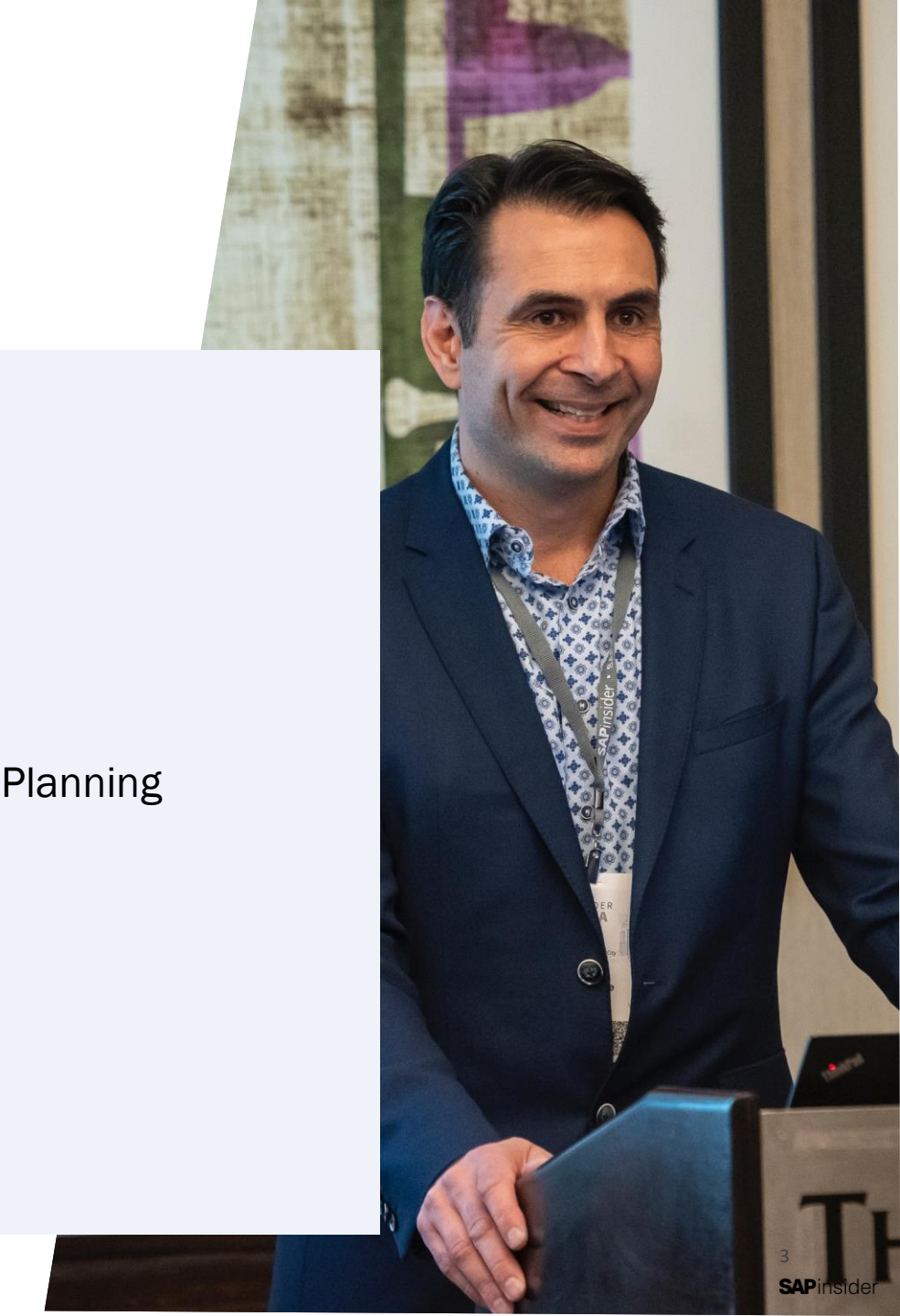
# In This Session

Is your organization needing to improve forecasting capability via use of AI and external factors with SAP IBP?

This session will present NVIDIA's journey on how they are leveraging AI, external factors, and the NVIDIA AI platform with SAP IBP to improve forecasting and planning

# What We'll Cover

- NVIDIA Overview
- CloudPaths Overview
- NVIDIA's Supply Chain Challenges
- The Need for AI to Improve Forecasting & Planning  Capabilities
- Incorporating AI into NVIDIA's Forecasting & Planning Processes
- Key Points
- Q&A



# NVIDIA Overview

# Accelerated Computing Across the Full-Stack and at Data Center Scale


NVIDIA is built like a computing stack or neural network—in four layers: hardware, system software, platform software, and applications. Each layer is open to computer makers, service providers, and developers to integrate into their offerings however best for them.

# CloudPaths Introduction

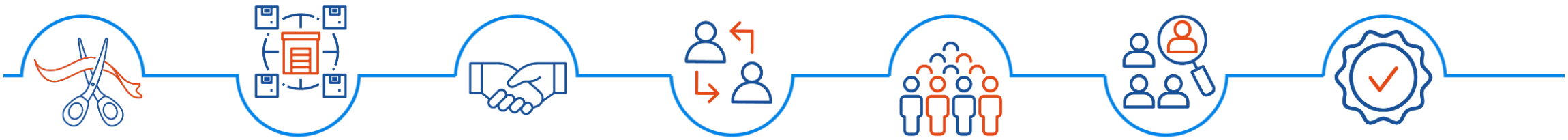
# CloudPaths Overview

CloudPaths

HQ in Newark, CA and Delivery centers in Toronto, Canada & Chennai, India

Engagements with direct clients and leading SIs

Quality team of SME's, Leads & Account managers & Governance



Established in 2017

Investments and partnerships in SAP Supply Chain, NetSuite, SFDC, Mulesoft, Java, .NET and Pega

150 Unique candidates across various skill sets

CloudPaths is MBE Certified

## Our Customers

CISCO
BEHR
NVIDIA
CORNING
Entegris
Blue Diamond Almonds
E&J Gallo Winery
ORACLE NETSUITE
infinera
Shaklee

## Partnerships

SAP
noodle.ai
salesforce
celonis
ORACLE NETSUITE
CONFLUENT
QPR

# Our Supply Chain Practice

CloudPaths

**50+**
IBP/CPI Professionals

**6 Yrs**
In Services Business

**3 Yrs**
SAP IBP Services

**1st**
Partner to Provide API based Integration to Sales Force

**200 Yrs**
Total SAP IBP Experience

**8**
Customers for SAP IBP

**3**
Apps on BTP

## Partnered with SAP

SAP Integrated Business Planning

## Taking IBP to the Next Level of AI/ML

noodle.ai

FlowOps for Supply Chains

## Our IBP Accelerators

- FORECAST DE-BIASING
- PIPELINE PREDICTABILITY
- IBP DATA INGESTION
- INVENTORY MONITORING
- DYNAMIC COST DETERMINATION
- TOTAL MARGIN MANAGEMENT
- PROJECT BASED PLANNING
- SUPPLY OPTIMIZATION

# NVIDIA’s Supply Chain Challenges

# NVIDIA's Supply Chain Challenges

**Demand Volatility** for products and services

**Uncertain Supply** of critical materials

**Constrained Capacity** in manufacturing and logistics

**Demand-Supply** Matching

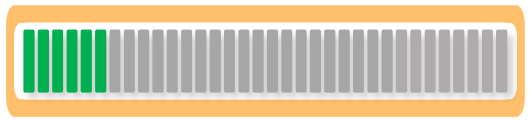
**Tariff and Regulations** changes

**Global Customer** product preferences and restrictions

# The Need for AI to Improve Forecasting & Planning Capabilities

# The need for AI

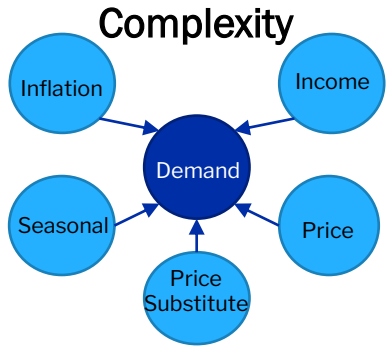
Remaining time for Analysis



## Traditional Forecasting

Due to restricted time:

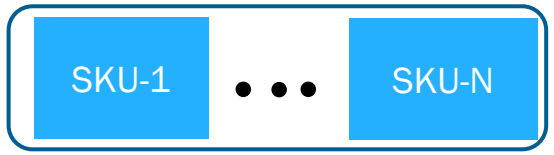
- Planning is done at an **aggregated** level
- Planning **complexity** is not handled sufficiently.



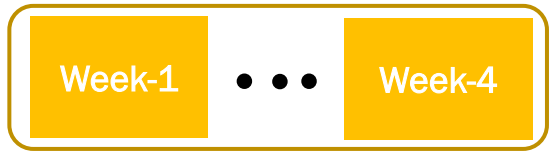

Planner

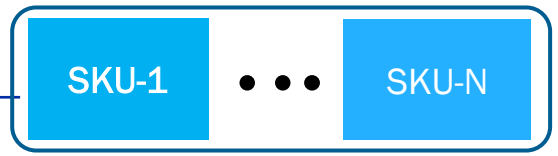
Level of Complexity Handled

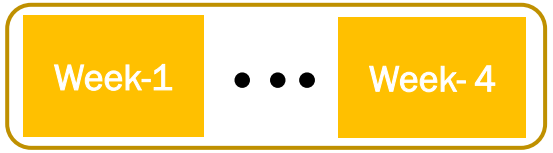
SKU Group



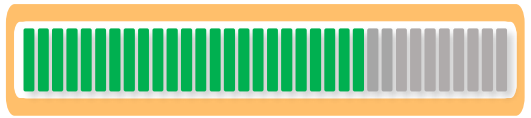

Monthly Aggregate



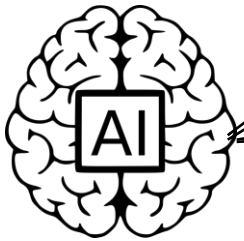



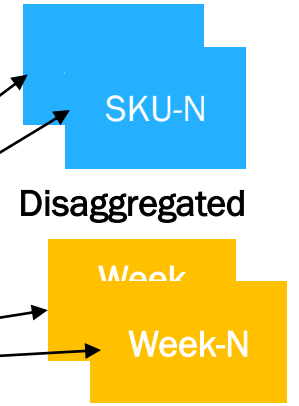

Remaining time for Analysis



## AI Forecasting

AI can process **large amount** of data using less time
This allows planning at a **disaggregated** level



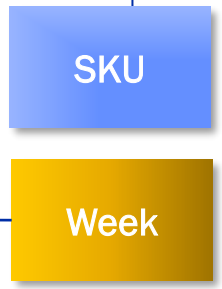




AI can filter unpredictable products for planner review

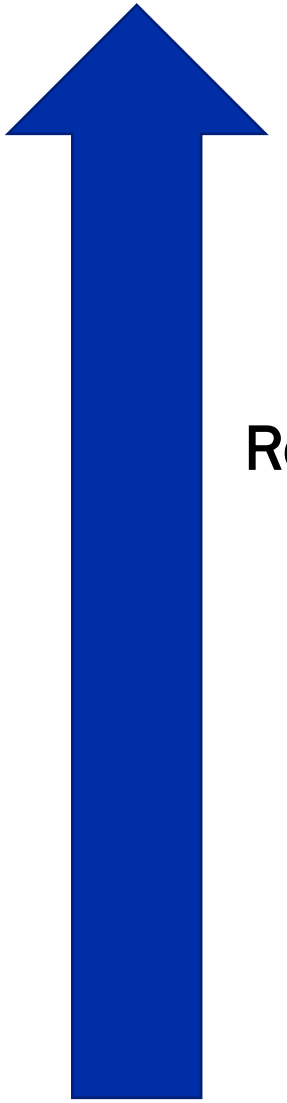
- AI relieves the planner from processing ALL the data
- Planner can focus their time on more difficult items
- Planner has greater bandwidth and flexibility to experiment with more complex scenarios

Level of Complexity Handled

Planner



# Pre-Requisites to Enabling AI



Pre-Requisite

Foundation

NVIDIA ***Kratos*** and ***cuOpt*** enables advance optimization and forecast due to their compute power

Systems of Intelligence

Moving to

Generative AI

NVIDIA **cuOpt**

NVIDIA **Kratos**

AI Planning

Consolidating Planning Systems

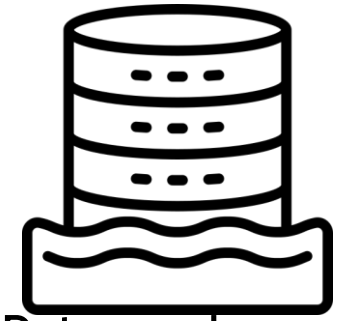
Systems of Planning

Moving to


Planning Framework

Systems of Records

Moving to



Data warehouse/ Datalake

# Incorporating AI into NVIDIA's Forecasting & Planning Processes

# Incorporating AI into NVIDIA's Forecasting & Planning Processes

AI: Predictive Analytics

Unconstrained JFF

Consensus Forecast (JFF) will generate an initial demand forecast

Constrained JFF

Final constrained JFF is generated after it ***optimizes for supply***

1

2

3

Demand

Supply

AI: Prescriptive Optimization

Gurobi Optimizer

NVIDIA

CUOPT

NVIDIA product lineup model will finetune further the original demand forecast according to the **supply**

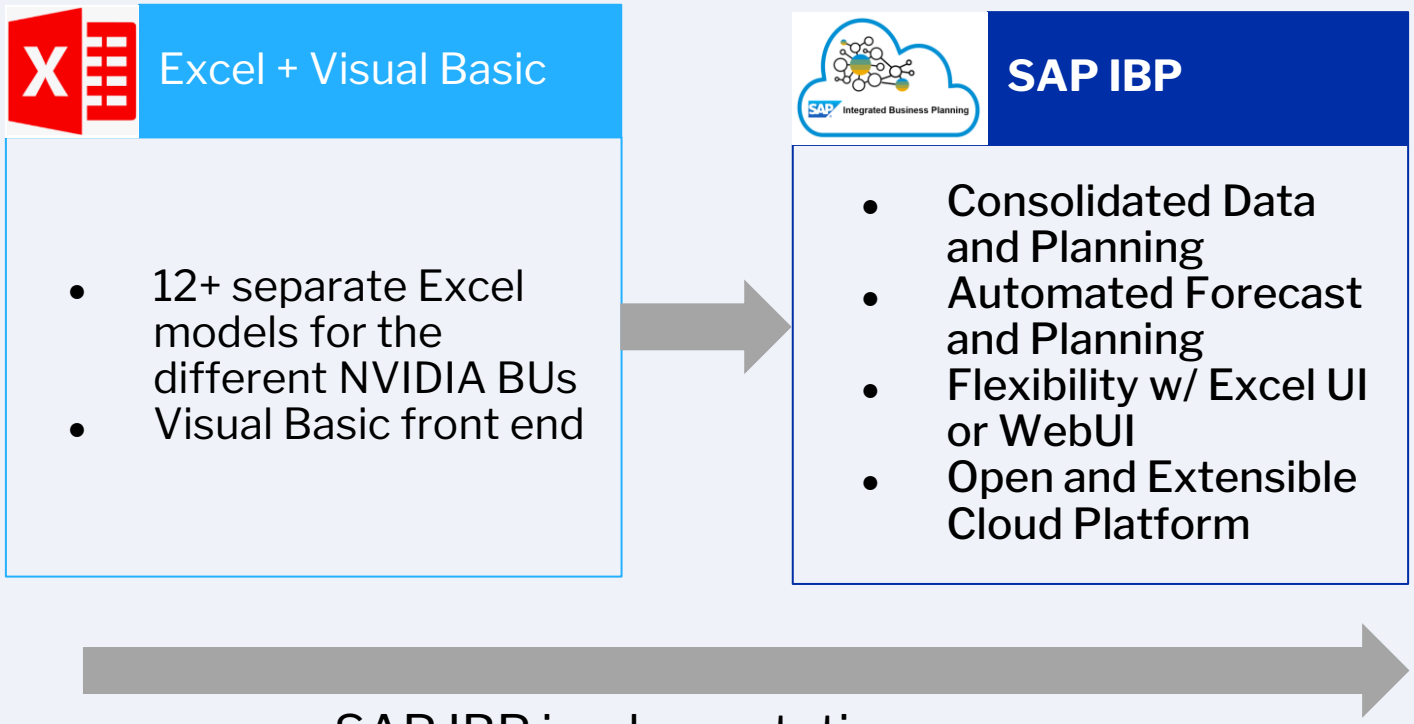
**Objective function**: Maximize (Revenue – Cost – Inventory Penalty + Others)
**Constraints:** demand over time, ASP, cost, SKU specs, wafer supply etc.

NVIDIA Kratos

*NVIDIA Kratos enables advance AI*

SAP IBP as System of Planning

# SAP IBP implemented as the System of Planning for End Customer Demand




SAP IBP implementation
Consumer BUs: 8-9 months
Enterprise BUs: 9-10 months

# of users: 300+ globally

## Key Business Benefits Realized

- **Cycle time for sell through forecast to revenue target setting reduced from 8 days to 4 days**
- **Estimated 10K+ hours productivity savings/year for Planners**
- **Consistent and improving forecast results**

# Predictive Analytics to Improve Forecast Accuracy with SAP IBP + NVIDIA Kratos

SAP IBP

Start Forecast Process → Prep Data and Pre-Processing → Send Notification to Kratos

Get Fcast from ODATA → Save Data → Post Processing → Forecast


NVIDIA Kratos Forecasting

Get Data via ODATA

Compute Forecast ( Python)

- Planner can employ automated forecast and planning in SAP IBP
- *Arimax, Arima, Gradient Boost, Croston, Exponential Smoothing*

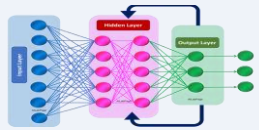
Planner can do manual "intuition" based forecasting

Planner

- SAP IBP provides extensibility to connect to an **external server**
- External server offers flexibility to use tools not available in SAP IBP
  - *LSTM, Transformer*
- Allows the freedom to perform more sophisticated scenario experiments

# Best Fit Forecast Across Integrated IBP and Kratos Models

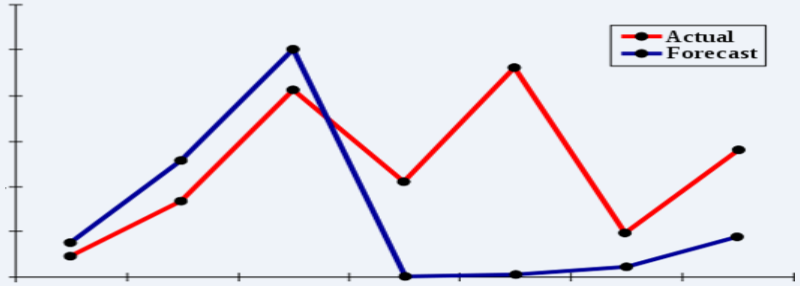
Define algorithm and independent variables



Recurrent Neural Network


Inflation Rate

Run forecasts and compute MAPE




Compare MAPEs across algorithms (IBP + Nvidia Kratos)

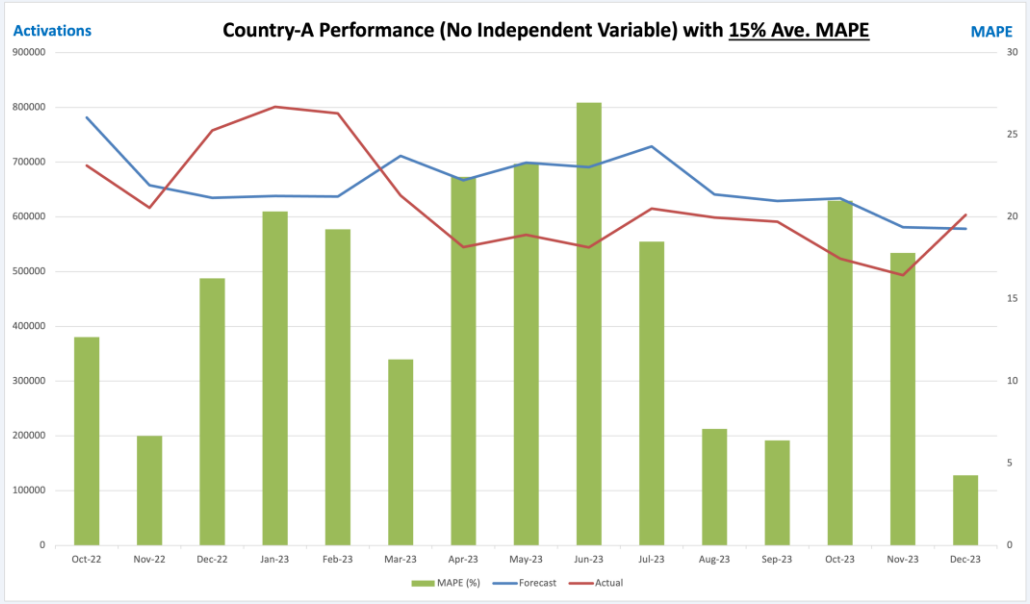
| Algorithm Name | Scenario | Aug-FY22 | Sep-FY22 | Oct-FY22 | Nov-FY22 | Dec-FY22 | Average |
|---|---|---|---|---|---|---|---|
| MAPE 3M | Calendar IV | 20% | 7% | 2% | 7% | 8% | 9% |
| DE MAPE 3M | Calendar IV | 2% | 2% | 7% | 0% | 3% | 3% |
| TE MAPE 3M | Calendar IV | 50% | 3% | 11% | 6% | 5% | 13% |
| AMX MAPE 3M | Calendar IV | 18% | 1% | 3% | 0% | 0% | 4% |
| GB MAPE 3M | Calendar IV | 47% | 0% | 4% | 0% | 1% | 9% |
| Neural Net - GRU 3M | Calendar IV | 4% | 5% | 3% | 10% | 3% | 5% |
| Neural Net - LSTM 3M | Calendar IV | 7% | 0% | 2% | 9% | 1% | 4% |
| Neural Net - RNN 3M | Calendar IV | 12% | 9% | 1% | 2% | 1% | 5% |

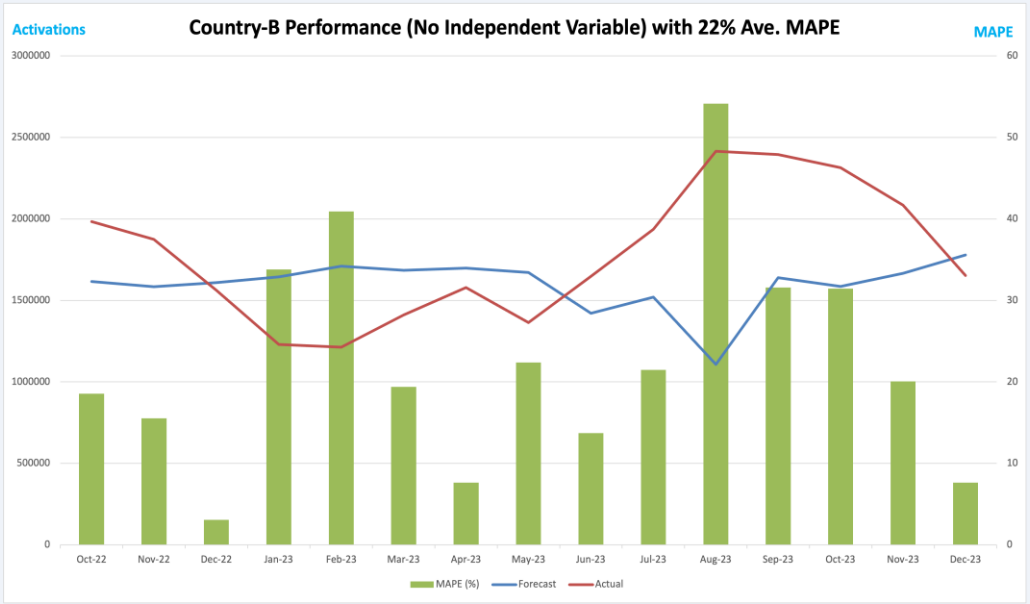
Select Best Model

| Algorithm Name | Scenario | Aug-FY22 | Sep-FY22 | Oct-FY22 | Nov-FY22 | Dec-FY22 | Total |
|---|---|---|---|---|---|---|---|
| MAPE 3M | Calendar IV | 5 | 5 | 5 | 10 | 10 | |
| DE MAPE 3M | Calendar IV | 0 | 0 | 0 | 0 | 0 | 0 |
| TE MAPE 3M | Calendar IV | 5 | 0 | 0 | 0 | 0 | 5 |
| AMX MAPE 3M | Calendar IV | 0 | 0 | 0 | 0 | 0 | 0 |
| GB MAPE 3M | Calendar IV | 0 | 0 | 0 | 0 | 0 | 0 |
| Neural Net - GRU 3M | Calendar IV | 0 | 0 | 5 | 0 | 0 | 5 |
| Neural Net - LSTM 3M | Calendar IV | 0 | 0 | 0 | 10 | 10 | 20 |
| Neural Net - RNN 3M | Calendar IV | 0 | 5 | 0 | 0 | 0 | 5 |

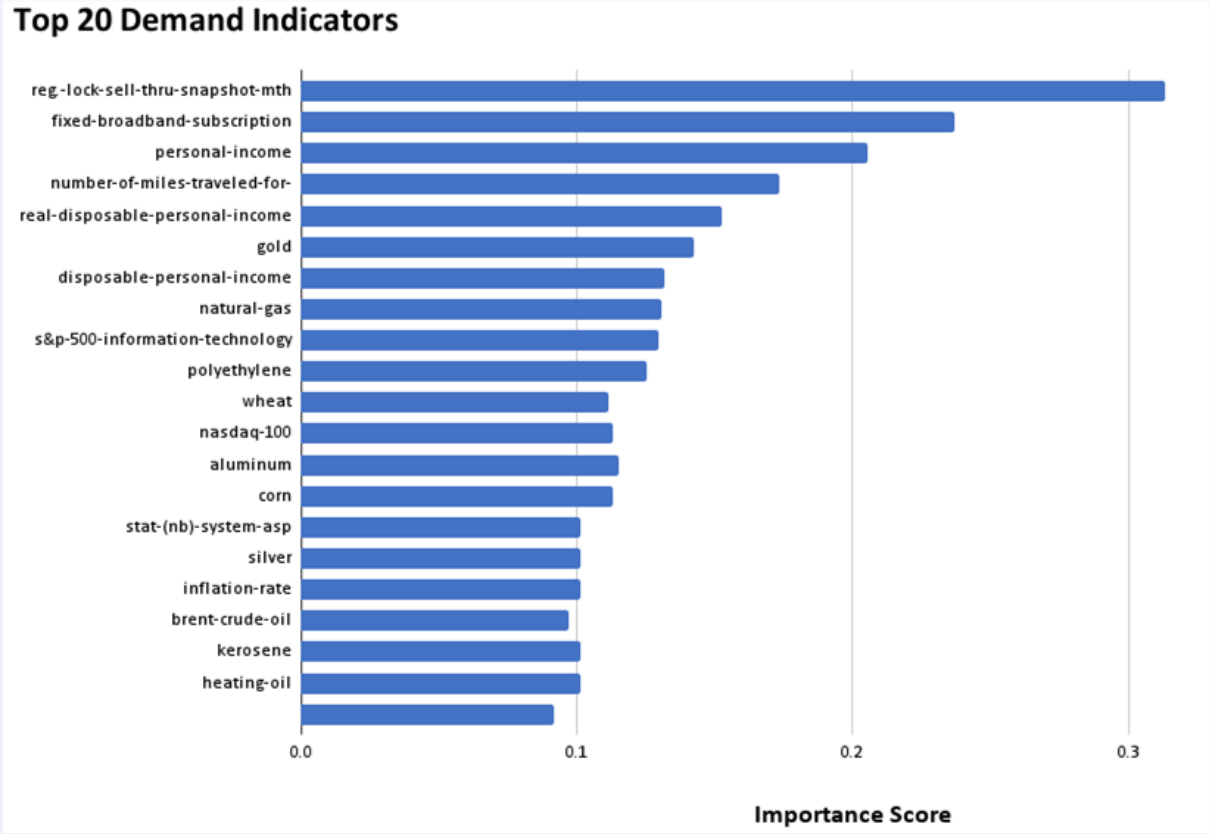
- Model predictions for each month are scored
- More recent months have higher score
- Highest scored model is selected

# Understanding the Top Factors Affecting Demand

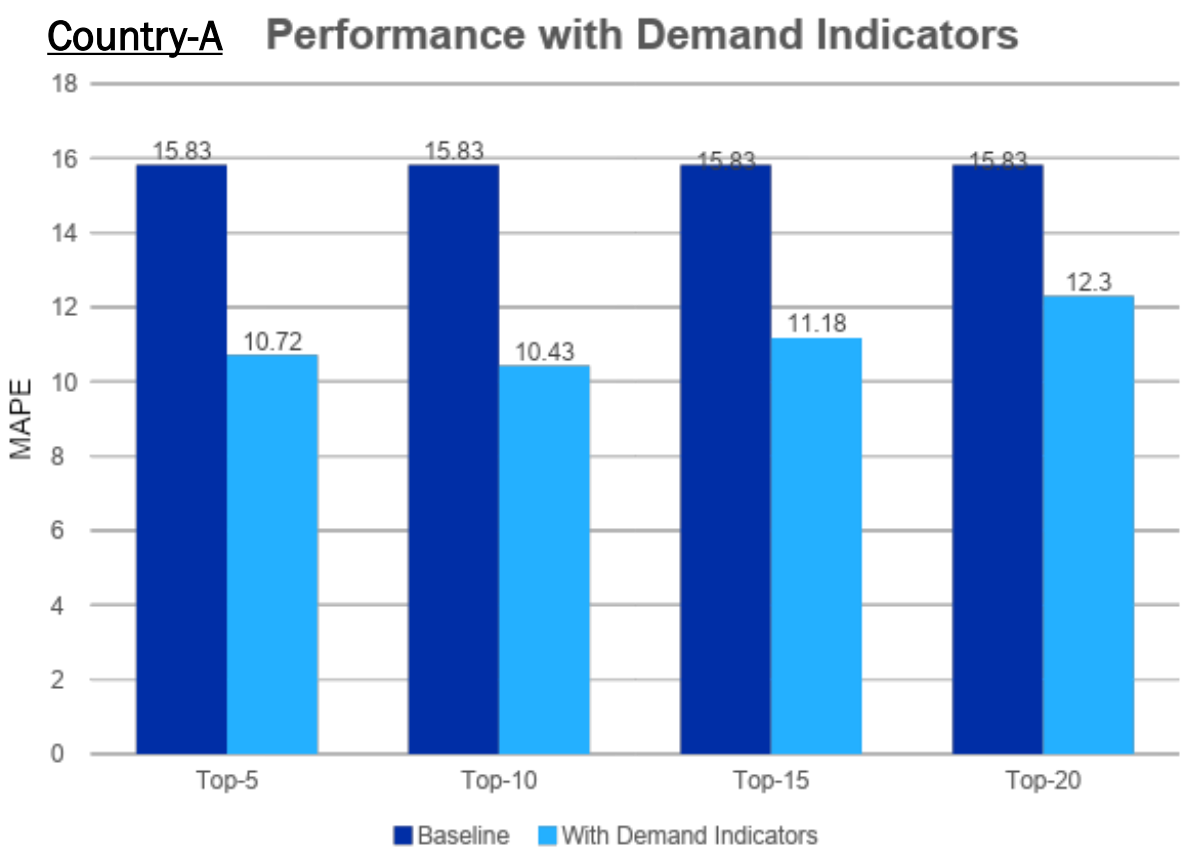


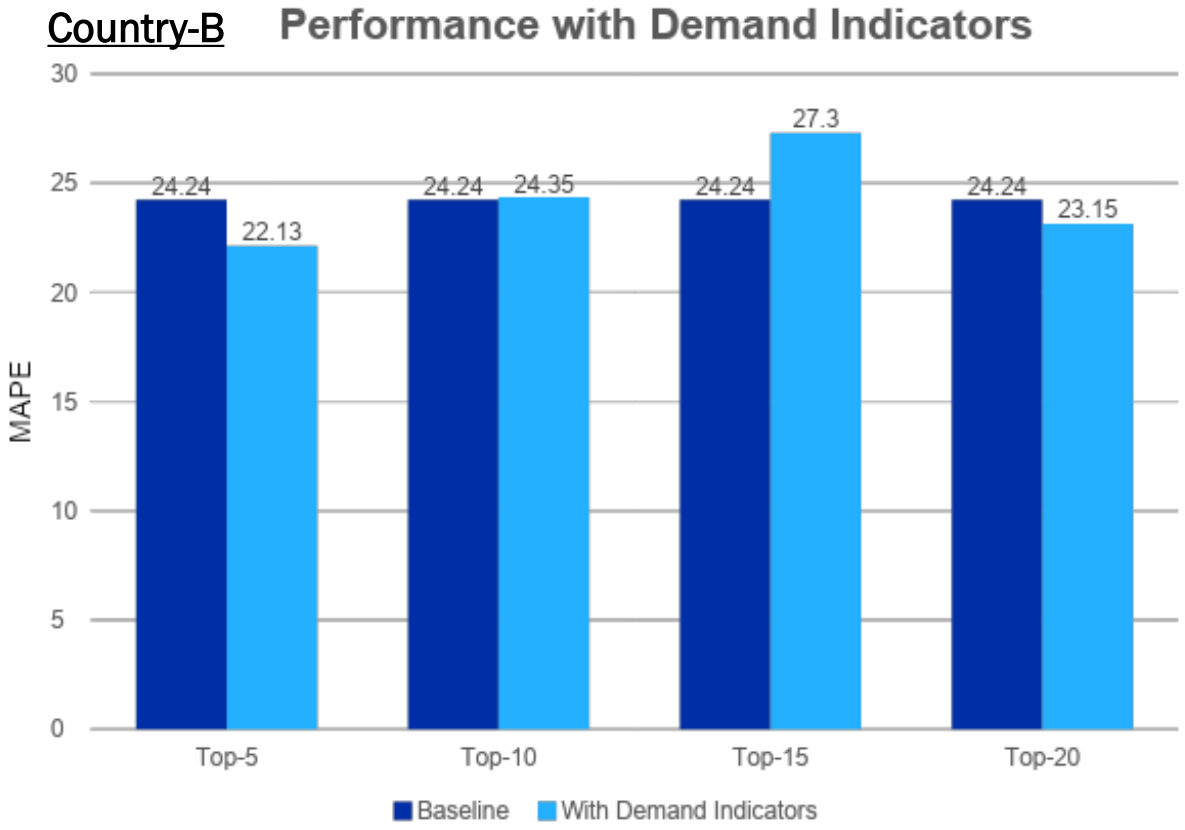




- **Baseline** performance remains weak
  - *MAPE: mean absolute percentage error*
- Incorporating demand indicators may capture complex relationships and thus can generate accurate forecast
- Focused on macroeconomic demand indicators
- Demand indicators are extracted and measured



# Top Demand Indicators Improve Forecast Accuracy



# Key Points to Take Home

1. Due to the interconnectedness of global trade coupled with the rise of e-commerce, a company's supply chain must adopt to the challenges of global disruptions (Covid, tariffs) and satisfying  increased demand with supply constraints. SAP IBP plus NVIDIA AI can meet the scale and complexity of these challenges.
2. Traditional forecast algorithms does not have the capacity and flexibility to consume large and diverse data to understand the complex relationships of different factors to generate a more accurate forecast.
3. A system of record and planning provides a foundation for organizing and managing data in a structured way that makes it easier to use the data to train intelligent systems and improve their accuracy and effectiveness
4. SAP IBP's native and open platform allows both the casual and heavy users the right interface, from easy-to-use excel components to SAP IBP's extensibility enabling performance boost with NVIDIA Kratos and NVIDIA CuOpt for more accurate forecasting and supply optimization, respectively.

# Thank You! Any Questions?

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