

TPM²⁴

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From Supply ***Chains*** to Demand ***Loops***: How the Fusion of AI & System Dynamics Will Revolutionize Global Trade

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Today's Agenda

- Introduction
- Artificial Intelligence, System Dynamics and the ties that bind: “Feedback Loops”
- Setting the stage for AI & Global trade: Examples of mainstream applications
- AI’s “Kitty Hawk Moment”
- Why AI for international business is so hard: Separating the hype from the hope
- AI and apps for global trade: Current examples
- AI and apps for global trade: What’s being worked on
- From supply chains to demand loops: The fusion of System Dynamics and AI
- The road ahead: Future apps for trade-based AI & System Dynamics

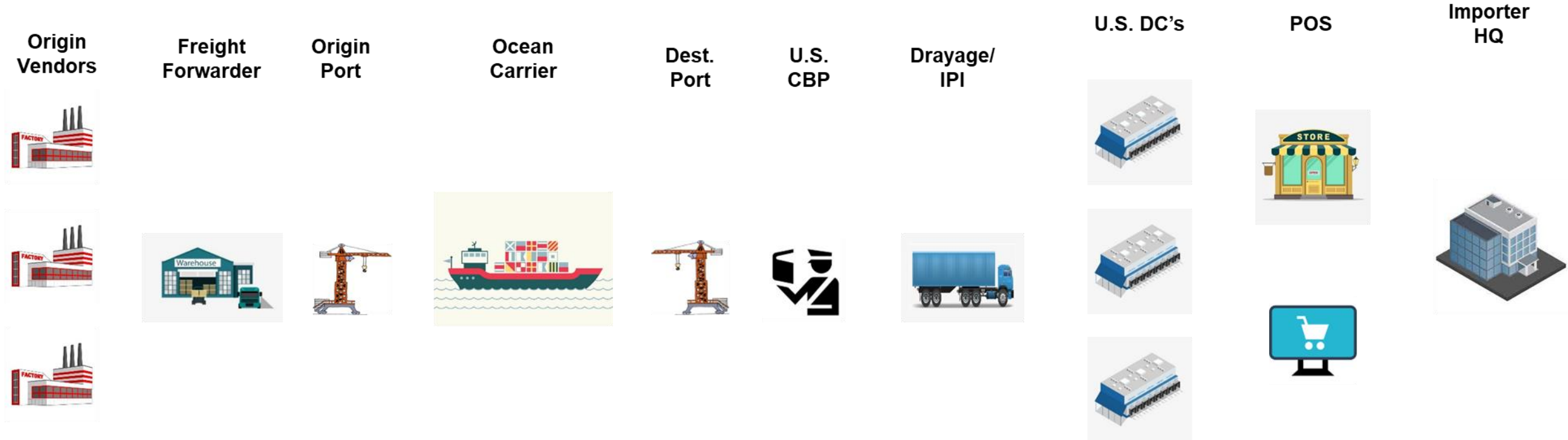


The Hypothesis of Today's Presentation

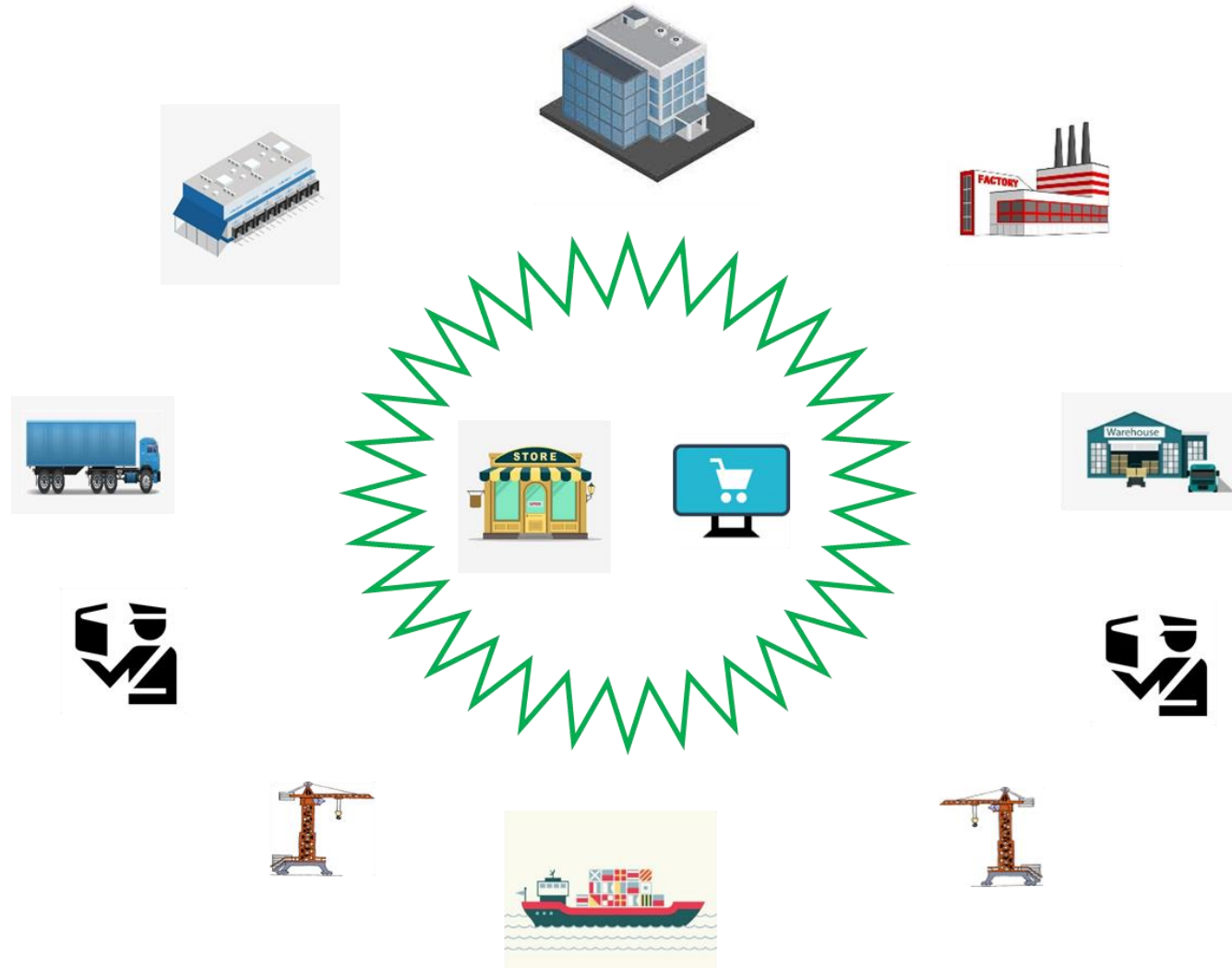
“...This presentation is founded on the belief that AI will be unable to create order-of-magnitude benefits until linear supply chain mindsets are abandoned for a circular, demand-based approach. Based on the tenets of “System Dynamics,” the presentation’s hypothesis is that AI will only reach its potential when people stop engaging in silo-based cause-and-effect decision making and begin to treat interactions between international business players as an array of interdependent and ever-expanding feedback loops”.

***The source of AI’s potential suboptimization:
When technologies change but people’s mind sets remain the same.***

What's Needed to Optimize AI for Global Trade: A Mental Shift From Linear, Cause & Effect Thinking...



...To a Circular, Demand-Based Approach Founded Upon System Dynamics & Fueled by AI



The Historical Challenge for Global Supply Chain Management

- The historical issue with supply chain management is that it's often treated as a linear sequence of siloed functions where decisions are made based on easily identifiable cause-and-effect relationships
- The reality is that a supply chain isn't a chain at all: It is a "system" that's made up of goal-oriented players whose decisions, activities, interactions and interdependencies not only create immediate outcomes, but that trigger behaviors in other areas of the supply chain based on those actions
- These constant, time-lagged and often unknown interactions are known as "feedback loops"



Two Examples of Linear, Cause & Effect Thinking With a Traditional Supply Chain Mentality


- *“By changing our sourcing activities from China to Mexico, we’ll eliminate the Section 301 tariffs and qualify for USMCA”*
- *“Due to the disruptions in the Red Sea and drought in Panama, if we change our import Incoterms Rules from CPT to EXW, we’ll take control of our inbound supply chain, improve transit times and reduce costs”*




*How Did I Know Feedback Loops Were the Common Ground
Between System Dynamics & Artificial Intelligence?*

Simple. I asked ChatGPT!!!!


If ChatGPT Says So, I Must Be Right!!!






You


How are "Systems Dynamics" and "Artificial Intelligence" Related?






ChatGPT

"Systems Dynamics" and "Artificial Intelligence" (AI) are related in their focus on understanding and modeling dynamic systems, although they approach the concept from different perspectives. Here's how they are connected:



1. Dynamic Modeling:


- **Systems Dynamics:** It is a methodology for understanding the behavior of complex systems over time. Systems dynamics models use mathematical equations to represent the interdependencies and feedback loops within a system.
- **Artificial Intelligence:** AI systems, especially those involved in machine learning, often deal with dynamic data and changing environments. Dynamic modeling is crucial in AI to capture patterns, trends, and adaptability over time.



2. Feedback Loops:

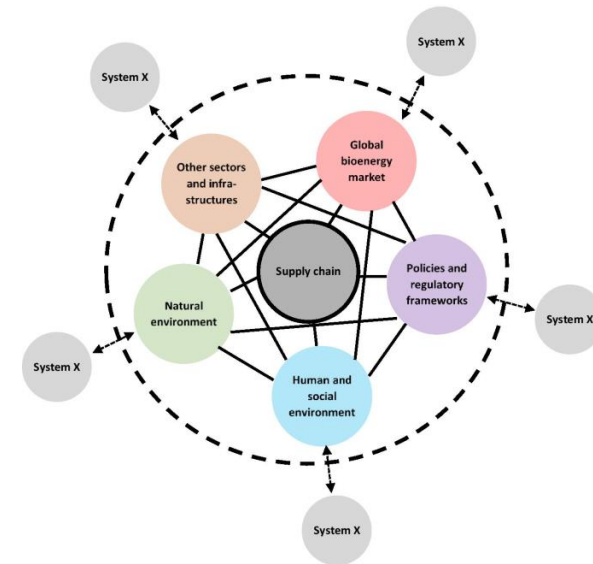
- **Systems Dynamics:** Emphasizes the role of feedback loops in systems, showing how changes in one part of the system can affect other parts and lead to dynamic behavior.
- **Artificial Intelligence:** Many AI algorithms, especially those in reinforcement learning, use feedback loops for learning and adaptation. Feedback mechanisms are essential for improving the performance of AI models over time.

Message ChatGPT...



For Once and For All: What the Heck is a Feedback Loop?

- Feedback loops form when the result of an action in one part of a system becomes input for other parts of the same system, that in turn generate their own output (and so things go from there...)
- The result of a single decision or action not only “feeds back” to the source of the original action, it impacts other parts of the system, which in turn influences actions taken by those elements
- Overall, this is known as an, “Information Feedback System”
- The key to today’s discussion is that feedback loops serve as the building blocks of both System Dynamics and Artificial Intelligence!!!



Setting The Stage for AI & Global Trade: Examples of Mainstream AI Applications

Setting the Stage for AI & Global Trade: Examples of Mainstream Applications

- In today's world, we're surrounded by examples of AI-based applications, tools & solutions
 - Chat dialogue recommendations
 - On-line applications for credit line increases
 - Autonomous vehicles
- AI-based solutions deploy a combination of tools that include algorithms, training data, machine learning, computer vision, sensors and/or neural networks
- For purposes of today's discussion, the common ground is that to be a truly AI-based application, it must make ***predictions***, offer ***recommendations*** and/or make ***decisions*** without human intervention



Chat Dialogue Recommendations: Large Language Models, Natural Language Processing & Machine Learning



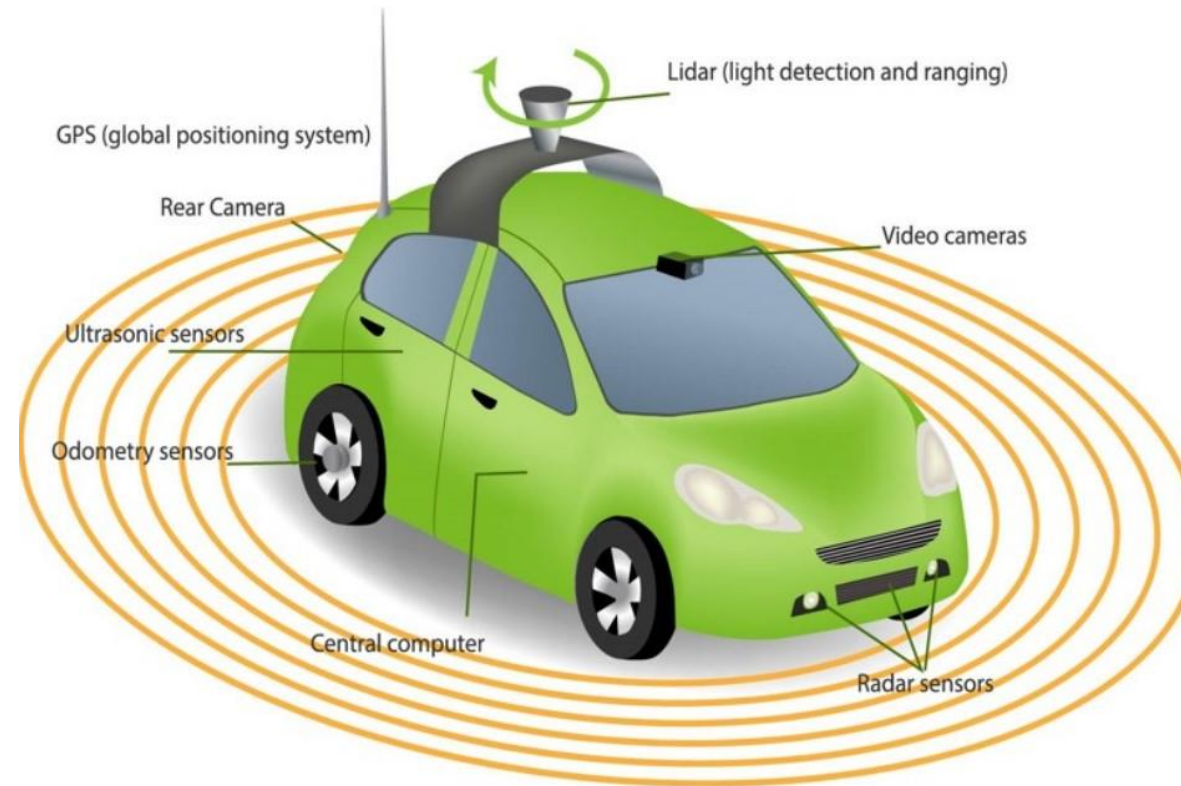
- 1) When you start typing, you create an output that becomes input for the Large Language Model, which then, as its own output response, suggests general use of sequential words
- 2) Over time, the model “learns” from your previous messages and writing style to offer **recommendations** for high probability sequential words
- 3) In the world of Machine Learning, systems are designed to improve over time based on experience

Application to Increase a Credit Limit: Predictions & Decisions Based on Decision Tree Algorithms



- 1) On-line applications for an increase in credit line are now done in seconds using “Decision Tree” algorithms and Predictive Analytics
- 2) Using a series of historical data (e.g., current salary, credit score, payment history) and “If/Then” sequences, the systems makes **predictions** on the probability of loan repayments and **decides** on yes/no/quantity increase accordingly, with no human intervention.

The Ultimate in AI Integration: Autonomous Vehicles



- 1) AV's use multiple AI technologies to enable a driver-free experience (Sensors, cameras, GPS, radar, LIDAR, etc.)
- 2) The most important of these is the "Central Computer" that makes driving **decisions** based on machine learning from past experiences, as well as real-time inputs from multiple sources.

AI's “Kitty Hawk Moment”

AI's "Kitty Hawk Moment"

- For thousands of years, man dreamed of being able to fly
 - The character "Icarus" from Greek mythology who was able to fly on wings made of wax
 - The drawings of flying machines from the works of Leonardo DaVinci in the late 15th century
- The first, "Kitty Hawk Moment" took place on December 17, 1903, when Orville & Wilbur Wright made a 12-second flight of 120 ft. at (you guessed it...) Kitty Hawk, North Carolina
- Within fifteen years, commercialized flying had taken off (thanks in part to WWI)



"I confess that in 1901, I said to my brother Orville that man would not fly for fifty years"

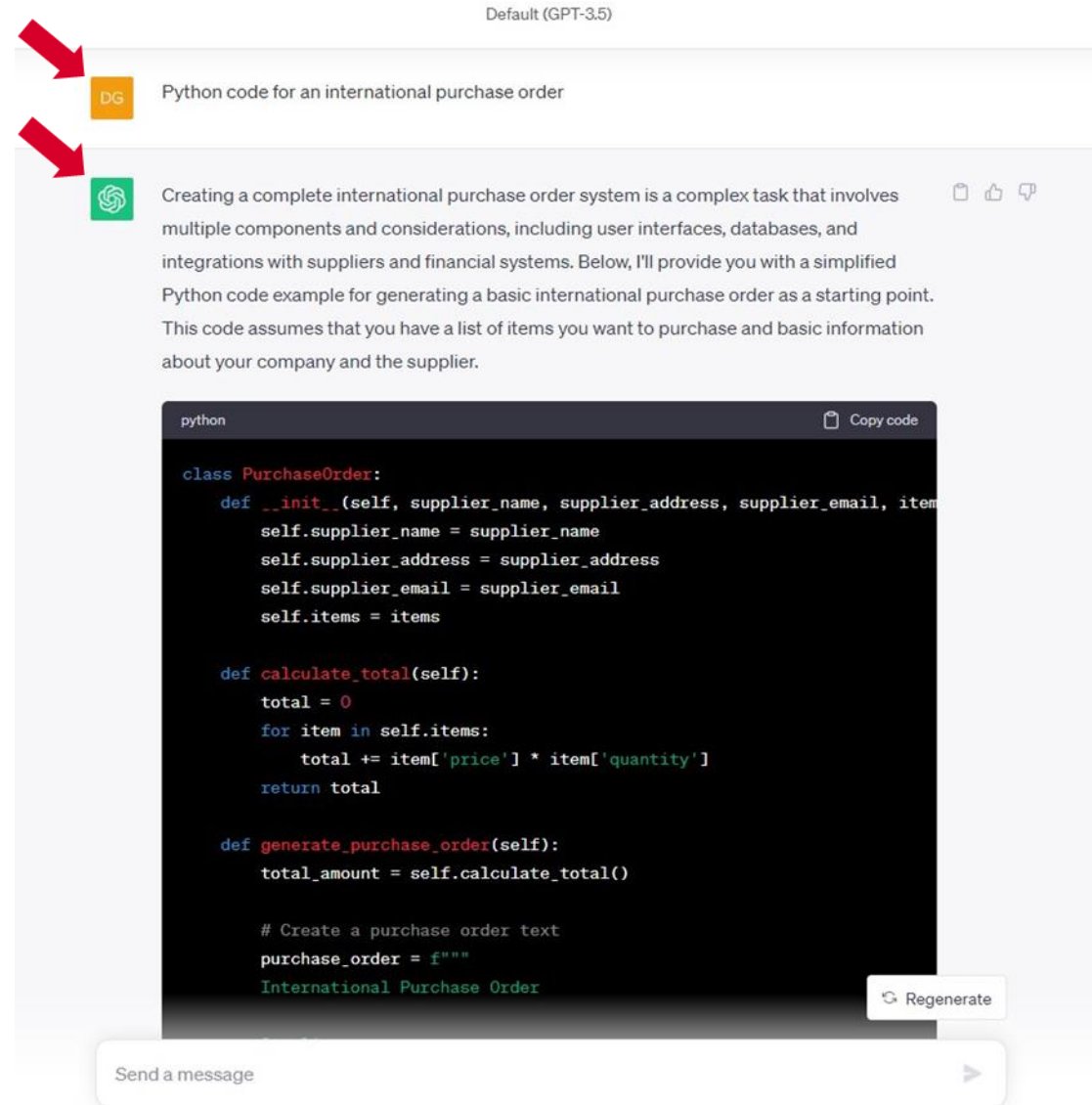
-Wilbur Wright

AI's "Kitty Hawk Moment"

- Apart from the existence of many mainstream applications, AI's Kitty Hawk Moment came on November 30, 2022 when OpenAI launched ChatGPT
- "GPT" stands for "Chat Generative Pre-Trained Transformer"
 - In English, that means that ChatGPT generates new outputs based on initial input to its Large Language Model
 - Supply chain example: ChatGPT writing Python code for executing an international purchase order
- In spite of these amazing advances, AI for supply chain has yet to have its Kitty Hawk Moment...



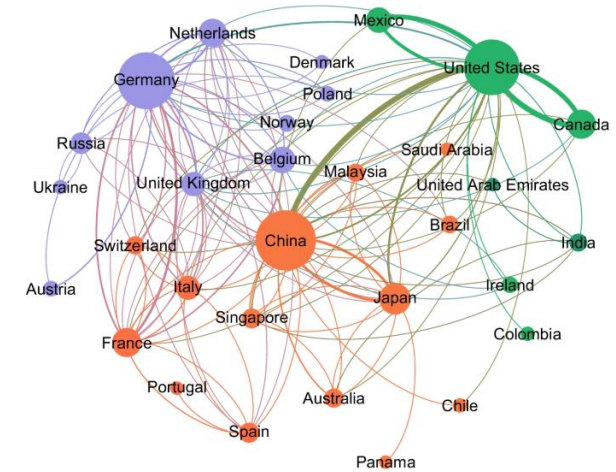
A Quick Look at ChatGPT and Supply Chain Apps: Writing Code in Python From a Text Request



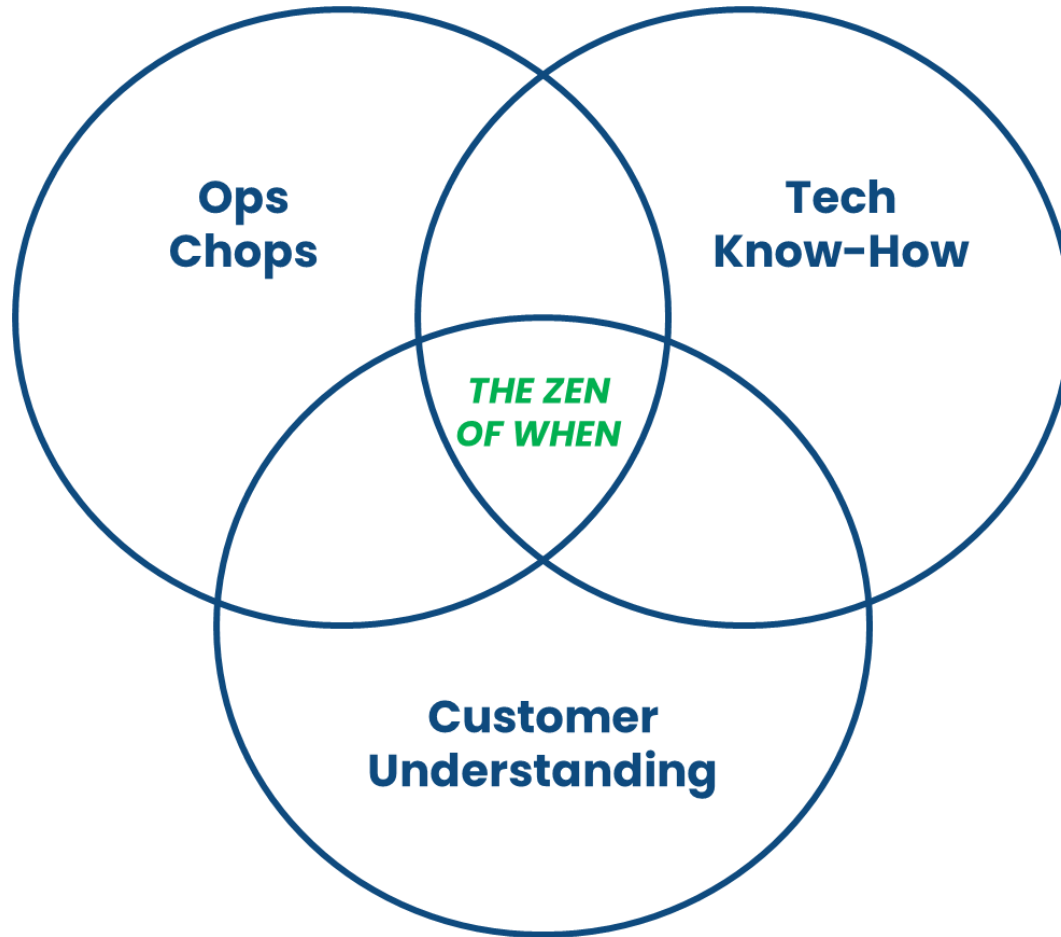
Why AI for International Business is so Hard: Separating the Hype from the Hope

Why AI for International Business is so Hard: Separating the Hype from the Hope

- AI for global business is so hard because international business is hard!!!
- At its core, product-based global trade come down to companies making predictions in the form of a sales forecast, placing bets by way of POs placed on suppliers and making adjustments when sales don't match the forecast
- Remember: The most basic import/export transaction is comprised of a dynamic system of at least a dozen goal-oriented actors whose strategies, policies, decisions and actions create a never-ending array of feedback loops
- BTW, it was hard to create tech solutions for global trade long before the advent of AI!!! Why, you might ask?...



Why AI for International Business is so Hard: The “Zen of When” Diagram



*“High impact Apps for supply chain, logistics & trade compliance can only be created ‘WHEN’ a balanced team exists that possesses equal measures of operational knowledge, technological know-how and a first-hand understanding of what really matters to customers. While very difficult to achieve, it’s at the intersection of these three variables that the **Zen of When** is found”*

–Dan Gardner, August 2023

Creating Real AI Solutions for Global Trade: Additional Knowledge & Required Skills...

Generative AI

Large Language
Models

Probability Theory

Algorithms

Machine Learning

Linear Regression

Decision Trees

Supervised vs
Unsupervised Learning

Labeled vs
Unlabeled Data

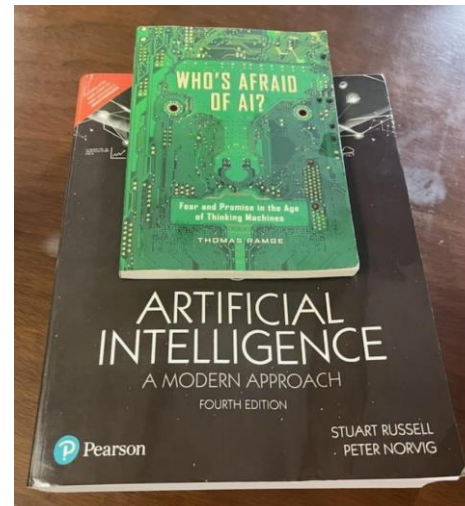
Training Data &
Test Data

Computer Vision

Neural Networks

Expert Systems

Inference Engines



AI & Applications for Global Trade: Current Applications (But First a Quick Primer...)

AI for Global Trade: Applicable Fields of Endeavor

- “Artificial Intelligence” (AI) is a field within Computer Science that creates systems capable of executing tasks and solving problems that require human intelligence, thinking & execution
- Three subsets AI with powerful apps for trade include:
 - **Robotics:** When combined with AI known as, “Autonomous Intelligence”, with a robot acting as an “Intelligent Agent”
 - **Computer Vision:** Teaches machines to perceive, interpret and act upon visual inputs
 - **Machine Learning:** Algorithms learn from large data sets (historical and new) to apply what’s learned to predict outcomes, offer recommendations and make decisions



The Big Hitter for Global Supply Chain Management: Machine Learning

- Machine (ML) Learning is a field within AI that “trains” computers to not only apply what it’s learned to specific scenarios, but to improve with experience
 - ML revolves around two components: Algorithms and Big Data (or better yet, “Your Data”)
 - An algorithm is a “precise and unambiguous sequence of instructions that can be followed to achieve a desired outcome” (Thanks again, ChatGPT...lol)
 - ML algorithms are trained by and learn from data sets known as “Training Data”
 - After learning from training data and being refined through “test data”, algorithms are exposed to new data, and based on what is “learned”, can draw conclusions, predict outcomes, offer recommendations and make decisions



Some Logos Promoting AI for Supply Chain, Logistics & Trade Compliance



Existing Use Case for Import Models: Classification, Valuation & Customs Entry

- As noted, there are firms in the market today offering AI-based solutions for the customs clearance process (C&V, entry prep & submission)
- This implies the ability to extract data from entry documents (C.I., P/L, B/L) and populate a 7501, as well as “make decisions” without human intervention
- NOTE: There’s a distinction to be made between simple OCR-based automation and tools like, “Intelligent OCR”
- What about the CBP standards for “Reasonable Care” & “Informed Compliance”?



Existing Use Case for Import Models: Container Appointment Making for Dray Providers

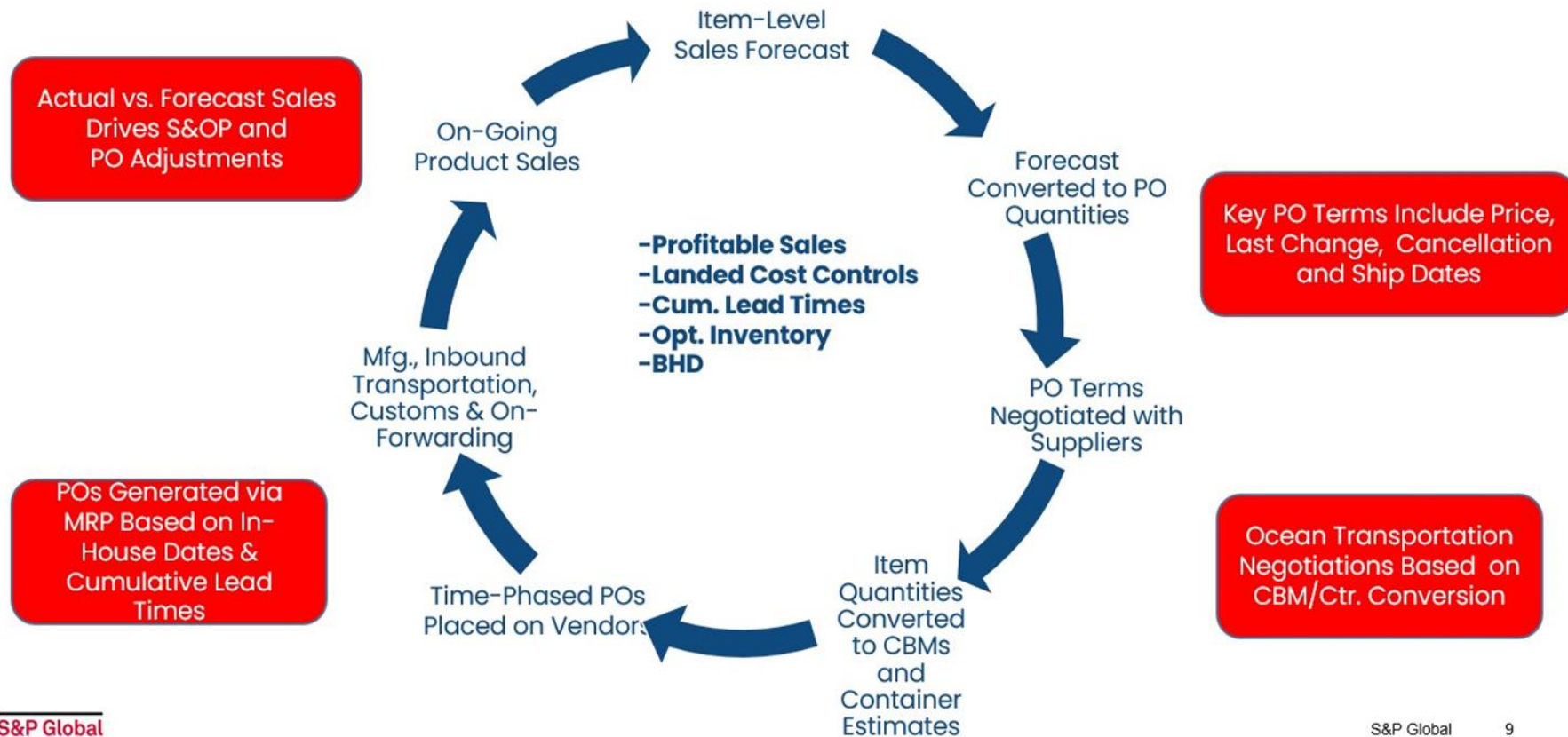
- Also noted, there are also companies in the market today that offer AI-enabled appointment making for container pick-up
 - Designed for drayage service providers
- This is a great example of a “Narrow AI” application (it does one thing)
- Essentially, the application makes decisions on booking container appointments based on open terminal appointments and the dray provider’s available assets (drivers & equipment)
- Connectivity between ocean terminal appointment system and dray provider’s TMS essential
- Decisions made by the system, no human intervention



Remember This Slide From Last Year? Forecasting, PO Management Inv. Allocation & S&OP

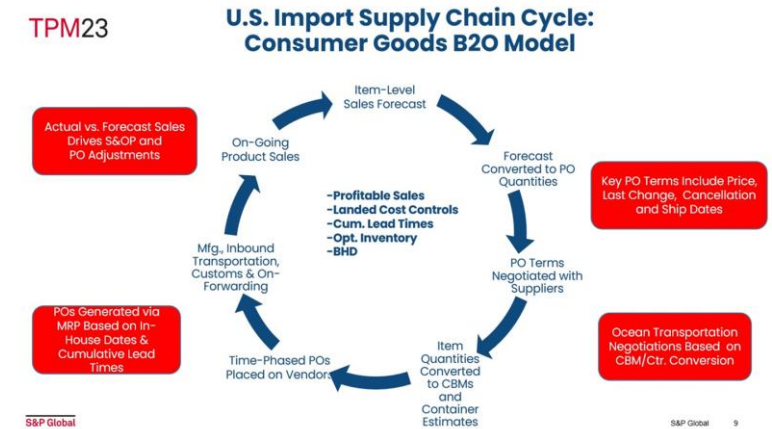
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U.S. Import Supply Chain Cycle: Consumer Goods B2O Model



Existing Use Case for Import Models: Forecasting, PO Management, Inv. Allocation & S&OP

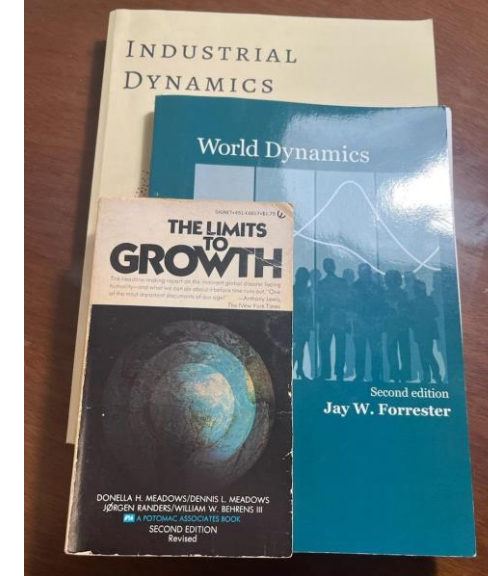
- Companies like “Logility” and “Syrup” offer multi-functional, AI-based solutions that link key elements of the import process (sales forecasts to actual sales, PO generation, inventory allocation, and Sales & Operations Planning)
- Internal/external connectivity between players is a must (ERP, historical sales data, POS data, visibility platform, 3PL ops & systems support)
- Decisions made by the system, no human intervention
- Represents a potential “Kitty Hawk Moment” for AI & global trade



From Supply *Chains* to Demand *Loops* The Fusion of System Dynamics & AI

Characteristics of any “System” ... Sound Familiar???

- Made up of goal-seeking, interacting and interdependent elements (supply chain players)
- Systems have physical and input/output-based limits
- Dynamic by nature (ever-changing)
- Driven by feedback loops
- Outputs are often non-linear (small actions trigger multi-faceted, far reaching and larger outcomes)
- Countervailing forces always push back
- Amplification is ever present (remember the “Bullwhip Effect” during COVID?)
- Time-lags exist between actions and results
- Unintended consequences abound



Changing the Paradigm: From Linear to System Thinking & The Role of Artificial Intelligence

“The human mind is excellent in its ability to observe the elementary forces and actions of which a system is composed. The human mind is effective in identifying the structure of a complex situation. But human experience trains the mind only poorly for estimating the dynamic consequences of how the parts of a system will interact with one another.”

-Jay Forrester, 1961
Industrial Dynamics



“This failure occurs in large part because we continue to examine single items in the problematique without understanding that the whole is more than the sum of the parts, that change in one element means change in the others.”

-Donella Meadows, 1972
The Limits to Growth

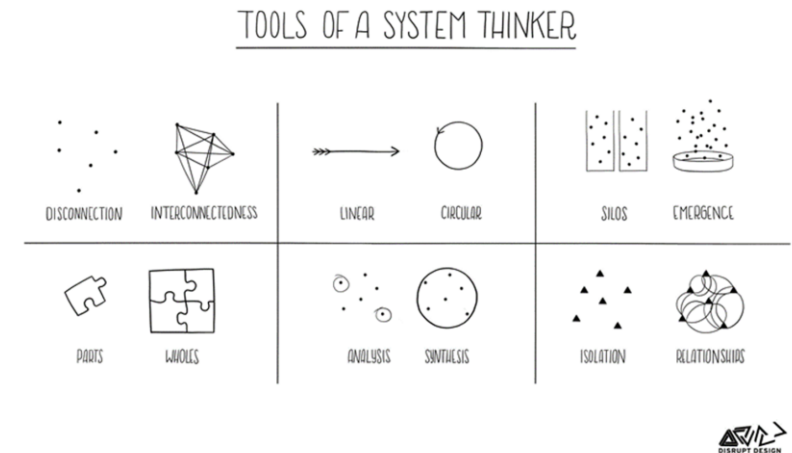
The Fusion of System Dynamics & Artificial Intelligence

- The human mind is sometimes limited in its capacity to see beyond immediate cause-and-effect relationships (especially “in the heat of the fight”)
 - Looking at the parts instead of the whole
- The data processing power of computers is infinitely greater than that of humans
- AI-based systems can now ingest, learn from and act upon massive amounts of data
- Algorithms can be designed to reveal far-reaching interdependencies, unseen patterns and unintended consequences ahead of time
- Different types of AI can be combined to create amazing solutions



Making the Most of Systems Thinking & AI

- Change your “Mental Model”
- Know your systems elements & focus on “Systems Engineering” (“formal awareness of the interactions between the parts of a system”)
- Seek out sub-systems and interdependencies amongst players
- Identify, draw up and simulate Feedback Loops
- Be on the look out for countervailing forces, amplification and unintended consequences
- Question all assumptions
- Beware the pernicious nature of time lags
- Build AI solutions that are based on System Dynamics, Feedback Loops & Systems Thinking!!!



The Road Ahead: Future Apps for Trade-Based AI & System Dynamics

Next-Level Tactical Applications for Import-Based AI: Executing Buyer's Consol & Transload Models



Buyer's Consolidation: Suppliers send goods to origin CFS, U.S. importer provides loading instructions and POL/POD info to 3PL. Importer commits inventory allocation at origin.

Transload: Vendors send FCL shipments to designated POD. Importer instructs 3PL how to distribute container contents from transload facility. Inventory allocations takes place just prior to arrival at 3PL transload facility

What's Coming: The process starts upstream with forecast data, demand management, vendor POs, actual sales, inventory management and S&OP, trickling down into operational execution, all without human intervention

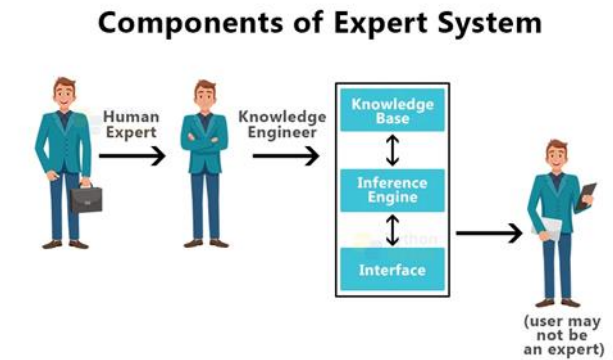
Not-So-Futuristic AI Apps for Global Trade: Expert Systems

- Most people agree that AI will fundamentally change the nature of work in global trade
- There are already solutions that threaten operational and managerial positions
- Opinion: Companies that combine AI with human expertise will be the most successful
 - There will be job loss in some areas and gains in others
- Virtual Assistants and in particular, “Intelligent Agents” will fundamentally change workplace relationships
 - Especially in the Age of Remote Work!!!



The Future of Work in Global Trade: The Deployment of Expert Systems

- **Expert Systems** – In its infancy in the field of AI, Expert Systems are meant to emulate the decision-making skills of humans
- ES simulate the judgement & behavior of an expert in a field (aka “Domain Expert”) to offer advice, recommend actions and make decisions
 - A “Knowledge Base” stores detailed information about the subject matter (often provided and input manually by humans)
 - Built upon the Knowledge Base, an “Inference Engine” uses tools like Decision Tree Algorithms, Business Rules and Machine Learning to infer new knowledge based on stored facts & rules, and new inputs
 - Expert Systems using hologram technology have a bright FUTURE in global trade



The Future of Remote Work in Global Trade: Hologram-Based Intelligent Agents

- Today, there are many examples of hologram technology used in supply chain...
 - Live people conducting meetings & demos
 - Product development pros reviewing samples with overseas vendors
- Imagine a scenario where a remote worker has access to an Intelligent Agent (real person or avatar) via hologram to guide him/her/them through their work
 - Ask questions, seek guidance, review work, query regulations
 - Intelligent Agent offers recommendations, predict outcomes and/or makes decisions
- Perhaps remote work won't be so remote anymore (but definitely more creepy)!!!



Some Closing Words on AI, System Dynamics & The Future of Trade

*“Understand the inner secrets
and return to original simplicity.”*

-The Bushido Shoshinsu

A Final Observation on Your Personal Journey in Global Trade

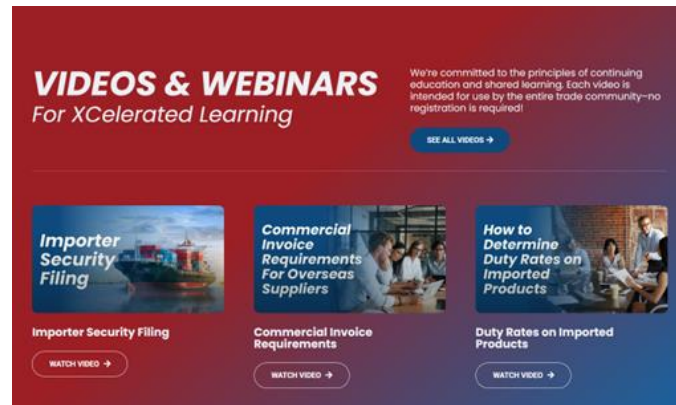
“The road is better than the inn.”

-Cervantes

Thank You and Enjoy TPM 2024!!!

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