ARTEFACT

FROM COST TO VALUE:

The Strategic Impact of AI in Supply Chain

THE ROLE OF ARTIFICIAL INTELLIGENCE IN COST REDUCTION AND SUPPLY CHAIN EVOLUTION

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The Authorship team is made up of multidisciplinary professionals with expertise in data, technology, business, and innovation. The entire Artefact team works collaboratively to deliver high-impact solutions, always aligned with our clients' needs.

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Artefact accelerates the adoption of data and Artificial Intelligence to positively impact people and organizations. We offer a wide range of services, from strategy to operations, implementing AI solutions across industries to help companies capture the competitive advantage of data and AI transformation.

Summary

Introduction

The New Reality: *Why Supply Chain Is the Pillar of Competitive Advantage*

Supply chain management is not just an operational function; it has become a fundamental strategic pillar for competitiveness and business success in the current market landscape. It acts as an essential hub for delivering customer value and optimizing resources throughout the organization.

> **A well-organized and efficient supply chain ensures timely deliveries, optimizes the use of resources, significantly reduces operational and storage costs, and increases customer satisfaction, thereby strengthening loyalty and retention.**

Additionally, it contributes to organizational resilience and improved cash flow. The supply chain management (SCM) process is comprehensive, encompassing everything from the acquisition of raw materials and manufacturing processes to inventory management, distribution logistics, and final delivery to the consumer, seeking to optimize performance at each of these stages.

Although the supply chain is often perceived as a critical cost center, its capacity to generate value is immense. Optimized management translates directly into a **competitive advantage and resilience, positioning the supply chain as a driver of strategic value.**

Artificial intelligence (AI), by optimizing these complex processes, elevates the role of the supply chain from an expense to a strategic investment that drives competitiveness and resilience.

The Current Scenario: AI Still Underutilized in the Sector

Despite the undeniable strategic relevance of the sector and the abundance of off-the-shelf solutions available in the market, the adoption of Artificial Intelligence in the supply chain is still in its early stages or is considered superficial by many companies. Recent research indicates that although generative AI promises significant advances in automation and efficiency, its implementation faces substantial obstacles, such as data quality, technological complexity, and, notably, organizational resistance.

There is a clear contradiction between the vast potential of AI and the slowness of its widespread adoption.

The global AI in logistics market has experienced **exponential growth**, with projections of **30% per year for the next five years**, and companies with higher investment in AI have reported **61% higher revenue growth**.

The global and Brazilian landscape of supply chain management and applied artificial intelligence is on an accelerated growth trajectory, driven by a profound digital transformation. Artificial Intelligence (AI) applied to the supply chain shows even more accelerated expansion: worldwide, estimates range from R$79 billion in 2025 to R$272 billion in 2031. In Brazil, the AI in supply chain market could reach R$8 billion by 2030.

This progress is explained by the concrete gains that AI brings in efficiency and cost reduction. Machine learning models and optimization algorithms enable:

- More accurate demand forecasts, reducing stockouts and excess inventory and recovering millions of reais in lost sales.
- Dynamic routing, which reduces logistics and fuel expenses by tens of millions of reais per year.
- Real-time visibility of the entire chain, allowing for proactive decisions and mitigation of operational risks.

With these benefits, AI transforms the supply chain from a cost center into a strategic value-generation engine, justifying the accelerated pace of global investment.

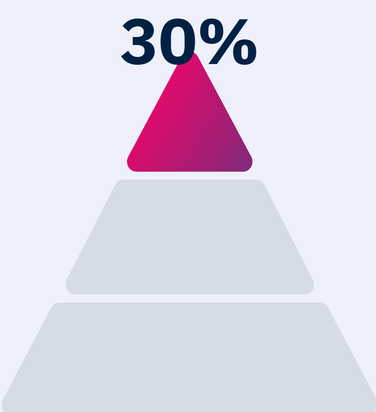
Annual growth of the global AI in logistics market	**+30% per year**	*Companies that invest the most in AI*	**+61% in revenue**
Global AI in supply chain market	**R$ 79 bi** *(2025)* **R$ 272 bi** *(2031)*	*Brazilian AI in supply chain market*	**R$ 8 bi**

> *We are in the midst of one of AI's biggest opportunities so far.*

Critical Cost Center

...of all the main cost drivers in organizations stem from operations such as manufacturing, distribution, and logistics.

Low AI Adoption Still



...of companies actually apply AI broadly into their Operations, impacting their potential to reduce costs significantly and maintain service levels.

Biggest ROI Opportunity

Operations offer the highest ROI for AI Implementation, with impact easily measured through cost savings, productivity, and predictability.

Sources: ¹ McKinsey Ops 4.0 ² Deloitte, State of AI ³ MIT Sloan, Winning With AI

The Transformative Opportunities of AI

Artificial Intelligence promises and delivers greater automation, efficiency, and personalization. Companies in various sectors are already exploring these innovations, using AI to automate critical processes such as demand forecasting, resource planning, and inventory management, as well as enhancing customer service with quick and personalized responses. The most frequently cited benefits include improved customer satisfaction, reduced operational costs, increased process efficiency, and greater automation. Looking to the future, AI promises to boost sustainability and promote even more significant advances in automation.

AI drives value across a wide range of areas in the supply chain:

From demand forecasting and production planning to risk management, supplier management, strategic sourcing, contract analysis, product design, predictive maintenance, and global trade optimization. AI allows companies to proactively adapt to an increasingly volatile market, which transforms challenges into strategic opportunities, enabling organizations not only to react to events but to anticipate them for their operations.

In this e-book, we will delve into how Artificial Intelligence is being explored in various areas of the supply chain, from strategic planning to logistical execution. We will cover real-world application cases, discuss robust methodologies for measuring the impact and return on investment (ROI) of AI, and explore the main market trends in the sector. Our goal is to provide a practical and strategic guide for leaders and executives seeking to transform their operational costs into tangible value and lasting competitive advantage through AI-driven innovation.

Chapter 1

Overview of Supply Chain and *Artificial Intelligence*

Current Challenges of the Sector: *A Critical and Vulnerable Cost Center*

> The supply chain is a critical cost center for companies, operating under constant pressure to optimize efficiency and margins. This area is susceptible to unpredictable external factors, which can range from strikes and extreme weather conditions to global pandemics, transportation accidents, and geopolitical instability.

Such disruptions can result in:

- Dignificant delays
- Production stoppages
- Substantial financial losses

Although the supply chain is the point where the company's value is effectively delivered to the market, ensuring product availability and customer satisfaction, the adoption of Artificial Intelligence solutions has not yet reached the robustness that its potential suggests. Persistent problems include the difficulty of integrating teams from different sectors and disparate systems, the continuous need for logistical improvement, and the challenge of effectively aligning with suppliers.

The volatility and unpredictability of the global environment, often described by the acronym **VUCA (Volatility, Uncertainty, Complexity, Ambiguity)**, exacerbate the traditional challenges of the supply chain, making reactive methods obsolete. AI emerges as the technology capable of processing the complexity and speed necessary for proactive and resilient management. By bringing uncertainties such as climate change, trade tensions, and energy crises, AI's ability to predict demand, identify hidden patterns, and anticipate problems is the key to competitiveness, and this transforms supply chain management into an intelligent and strategic orchestration.

What is the VUCA model?

Volatility

A key aspect of your work is subject to major, unpredictable peaks and troughs.

Uncertainty

The future is unknown, but external events are likely to be impactful.

Complexity

Many interconnected factors influence one another, in ways that are challenging to model confidently.

Ambiguity

Conflicting, noisy or insufficient data makes it difficult to assess what's really going on.

30%

of the average annual EBITDA is the cost of disruptions over a decade.
In supply chain, this occurs for 1 to 2 months every 3.7 years.

[1] Source: PWC | [2] Fonte: McKinsey (State of AI 2023, Future of Supply Chain & Tech and Regionalization Bolster Supply Chain)

Trends and Technologies in the Supply Chain Market

Growing Focus on S&OP (Sales & Operations Planning)

Sales and Operations Planning (S&OP) is a fundamental methodology that seeks to align the sales and operations areas to create an integrated plan, capable of meeting customer demands and ensuring operational efficiency. Artificial Intelligence enhances S&OP by enabling the assimilation and analysis of large volumes of data, resulting in more assertive decisions. This technology combines precision and explainability, offering detailed insights into how each variable impacts business performance.

With the use of AI, **S&OP begins to incorporate external data**, such as weather conditions and seasonal events, as well as **real-time information**, enabling significantly more accurate demand forecasts, inventory optimization, and better production scheduling. **AI-supported S&OP platforms also allow for "what-if" scenario simulations**, facilitating the assessment of impacts from supplier delays or unexpected changes in demand, as well as defining the best course of action.

This strategic application of AI in S&OP elevates the quality of the plan, increasing the accuracy of demand planning and intelligently optimizing resources. As a result, there is a direct impact on the sales volume achieved, on identifying the best opportunities, on increasing margins, and on reducing costs, always seeking the most effective combination of factors.

The Rise of Industry 4.0 in the Supply Chain

Industry 4.0, also known as the Fourth Industrial Revolution, focuses on process automation and the digitization of industrial information, combining the most advanced technologies to give businesses a competitive edge and reduce costs. Its fundamental pillars include the integration of digital technologies such as the Internet of Things (IoT), Big Data, cyber-physical systems (CPS), robotics, and cybersecurity. Within this context, Artificial Intelligence is a central application of Industry 4.0, enabling advanced robotics, automatic task scheduling, predictive maintenance, and the creation of "smart supply chains" that are capable of continuous learning and adaptation.

> **Industry 4.0 provides the data infrastructure that AI needs to operate at scale, transforming factories and warehouses into intelligent ecosystems. AI, in turn, extracts value from this massive data; without it, Industry 4.0 becomes just a voluminous data collection.**

The Normalization of ERPs, TMS, WMS, and Telemetry

Enterprise Resource Planning (ERP) systems, Transportation Management Systems (TMS), and Warehouse Management Systems (WMS) are widely adopted management tools that centralize business processes (ERP), plan and monitor logistics operations (TMS), and manage and optimize warehouses (WMS), respectively.

The integration between WMS and TMS is considered crucial for improving supply chain efficiency, offering a unified, real-time view of the operation. Telemetry, in turn, complements these systems by collecting real-time data from vehicles and equipment, providing crucial information for route optimization, predictive maintenance, and continuous fleet monitoring.

In this case, **Artificial Intelligence enables real-time data analysis**, identifies potential problems, and recommends solutions, such as demand forecasting and inventory optimization. AI transforms raw data into **actionable insights in real time**, allowing companies to extract maximum value from their existing IT infrastructure investments, rather than requiring a complete overhaul. It is important to note that **AI is complementary and does not replace these systems, but makes them smarter and more interoperable**, extracting value from data. Telemetry, by providing real-time data, feeds this AI layer, making decisions even more dynamic and responsive.

Emerging Challenges and the Transformative Role of AI

Integration of Systems, People, and Processes

One of the biggest challenges faced by companies is to effectively integrate systems, people, and processes to achieve superior results. The absence of integrated data between source systems creates a series of obstacles, such as difficulty in identifying common fields, the need for format standardization, and the development of source-to-destination mappings. Artificial Intelligence is already present in many of these systems, but challenges remain, as off-the-shelf solutions offer a low level of customization, often leading to the use of inadequate tools for specific problems.

To boost the results of all systems and tools (ERP, WMS, TMS, among others), it becomes necessary to develop a "tailor-made" Artificial Intelligence, capable of creating ideal solutions for the business context.

This approach allows for an exponential leveraging of the positive impacts of existing tools, reducing the need for extensive modifications and prolonging the useful life of the current infrastructure.

When dealing with people and processes, the need to develop proprietary Artificial Intelligence becomes even more relevant. There are particularities between plants and operations of the same company, and even greater ones between different organizations. Thus, creating internal solutions allows the company to better leverage its accumulated knowledge and experience.

The advancement of LLMs and Agents is transforming the market, making the construction of custom code increasingly accessible. With this, companies can develop their own solutions and integrate systems more efficiently, generating exponential results.

Different degrees of customization can be chosen each component

	Buy	Hybrid	Make
	Modular solutions that solve individual building blocks and are connected in a tailored way	Owning the infrastructure, interfaces, and using highly customized solutions	Solutions that aims to solve all needs at the same time, with little to no development effort
Pros	• Fast implementation • Low effort • Reliable and tested	• Balanced customization • Flexibility • Control over components	• Lower cost in the long run • Learning and ownership
Cons	• Complex to build • Sustainability Squad • Slower launch	• Vendor lock-in • High cost • Little to no customization	• Requires orchestration • Integration effort • Not always feasible

Tight Margins and the Quest for Efficiency

The growing complexity of global supply chains, combined with constant pressure to reduce costs and increase efficiency, has turned logistics management into a monumental challenge. Mobility costs, for example, can account for up to 30% of a product's final cost. Artificial Intelligence enhances efficiency and profit margins on several fronts: more accurate demand forecasting, which allows for ideal inventory and production adjustments; inventory management to avoid excesses that generate costs or shortages that result in lost sales; intelligent routing to reduce transportation costs and optimize delivery times; and predictive maintenance, which prevents unplanned downtime and increases the operational efficiency of equipment.

Lack of Visibility and Reactive Work

Disruptions, whether caused by natural, geopolitical, or operational factors, require rapid and adaptive responses. In this scenario, Artificial Intelligence integrates data from various sources, providing a holistic view of processes. Furthermore, AI can predict equipment failures through predictive maintenance and identify potential risks in the supply chain, allowing companies to act preventively. AI not only provides real-time visibility but also the ability to predict and mitigate risks, ensuring business continuity and minimizing the impact of external events.

The Segmented Value Chain: Planning, Warehousing, and Logistics & Distribution

To deeply understand the transformative impact of Artificial Intelligence (AI) on the supply chain, it is essential to analyze the value chain in three interconnected pillars, each with its own characteristics and opportunities.

Planning

The first pillar is Planning, which involves demand forecasting, production planning, supplier management, and risk mitigation. AI acts at this stage by increasing the accuracy of forecasts and predictive capacity, allowing companies to anticipate market fluctuations, adjust inventory levels, and define more efficient production plans.

Warehousing

Next, Warehousing focuses on optimizing the layout of distribution centers, automating internal processes, and managing inventory. With machine learning algorithms, AI enables more intelligent use of space, reduces waste, and improves inventory control, freeing up working capital and increasing operational productivity.

Logistics & Distribution

The third pillar, Logistics and Distribution, covers intelligent routing, predictive maintenance of fleets, and last-mile delivery efficiency. Here, AI generates significant gains by indicating more economical routes, reducing fuel consumption, predicting vehicle failures, and consequently, improving punctuality and customer experience.

By integrating Artificial Intelligence into these three pillars, the benefits manifest in several categories. Cost reduction is one of the most direct impacts, achieved through the optimization of inventory, transport routes, and predictive maintenance, which, combined with the automation of repetitive tasks, generate significant savings. Consequently, there is a notable increase in efficiency, as automated processes and faster, more accurate decisions optimize the use of resources and increase overall productivity.

> **AI also promotes a substantial improvement in decision-making. The ability to analyze large volumes of data in real time and simulate complex scenarios provides managers with actionable insights for more assertive strategic decisions.**

This strengthens the resilience and adaptability of the chain, allowing for the prediction of disruptions, mitigation of risks, and dynamic adjustment of operations in the face of external factors and market changes.

At the end of the chain, the result is a significant increase in customer satisfaction, who perceive value in faster and more accurate deliveries, greater product availability, and more transparent communication. In addition, route and inventory optimization directly contributes to sustainability, reducing fuel consumption, carbon emissions, and product waste, aligning operations with an environmentally responsible agenda.

> ***There are opportunities to start at every stage of the chain.***

Planning

AI enables a significant improvement in the accuracy of forecasting models, **reducing inefficiencies and waste throughout the chain.**

- S&OP and S&OE Optimization
- Scheduling Optimization

Warehousing

With AI, it's **possible to balance service level and cost**, optimizing inventory and reducing logistics waste.

- Inventory Policy
- Stockout Forecasting

Distribution

AI helps **address external variables and optimize routes and loads**, reducing one of the main cost drivers in the chain.

- Fuel Optimization
- Network Optimization

Levers

Planning	Warehousing	Distribution
Profitability	***Cost Reduction***	***Cost Reduction***
Efficiency	***Lost Sales***	***Service Level***

Chapter 2

How AI Impacts Planning

Intelligence from the First Step: *How AI Impacts Planning*

Planning is the foundation of any organization seeking to anticipate the future to meet its demands and manage its resources efficiently. More than a monthly agenda, it is a continuous cycle that seeks to prepare the organization for what is to come.

Imagine a simple yogurt on a supermarket shelf.

>>

For it to be available for purchase, a complex chain of decisions was made in advance:

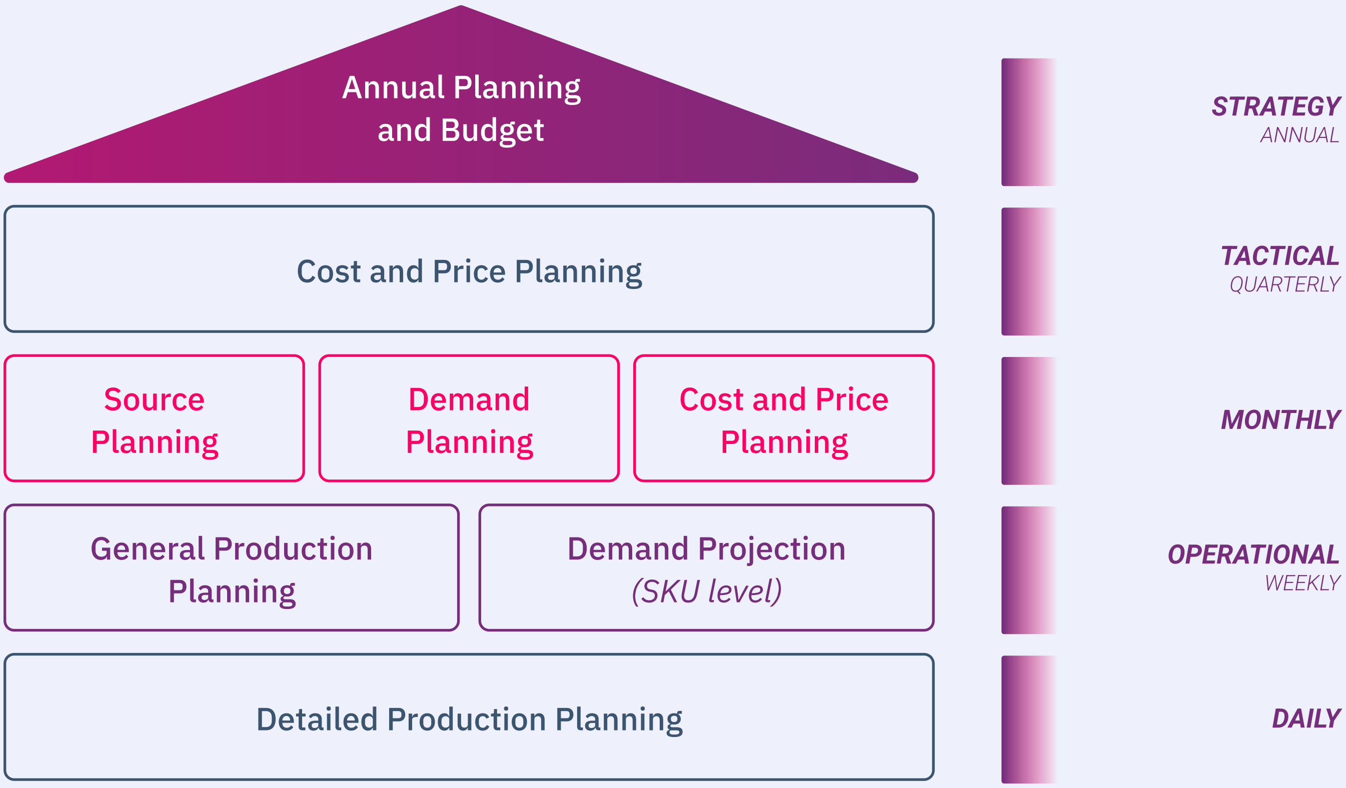
- >> The commercial team negotiated with the retailer
- >> Logistics planned the delivery
- >> The factory produced the item
- >> Supply area purchased the ingredients and packaging weeks before.

When we multiply this complexity by thousands of products, seasonalities, and sales channels, it becomes clear that success depends on precise orchestration.

This is where Sales & Operations Planning (S&OP) and Sales & Operations Execution (S&OE) come in, two complementary fronts that, when enhanced by Artificial Intelligence, transform the supply chain.

Planning is the foundation of any organization that aims to anticipate the future, meet its demands, and manage resources efficiently. More than just a monthly agenda, it is a continuous cycle designed to prepare the organization for what lies ahead.

Sales and Operations Plan & Execution



S&OP

Strategic and tactical process to balance demand and supply in the mid-to-long term (3–18 months), defining targets, capacity, and investments at an aggregate level.

Benefits of Cases:

Stronger alignment across sales, operations, and finance.

Cost reduction through better and earlier decisions.

S&OE

Tactical and operational process in the short term (0–12 weeks), focused on execution, daily/weekly adjustments, deviation correction, and real-time decisions to ensure adherence to S&OP.

Benefits of Cases:

Higher service level and operational resilience.

Cost reduction through rapid response to disruptions.

The Two Faces of Planning: S&OP and S&OE

Although they work together, S&OP and S&OE have distinct focuses and horizons. Understanding this difference is crucial for applying AI effectively.

Characteristic	S&OP (Sales & Operations Planning)	S&OE (Sales & Operations Execution)
Time Horizon	**Medium to Long Term:** Planning for 3 to 18 months (or even 2-3 years). Meetings are monthly and more aggregated.	**Short Term:** Execution from 0 to 12 weeks. Reviews are weekly or daily, focused on quick actions.
Focus and Objective	**Strategic and Tactical:** Focused on balancing demand and supply, working with forecasts, analysis, and goal setting.	**Tactical and Operational:** Oriented towards execution, monitoring the operation in real time to detect deviations and solve urgent problems, ensuring adherence to the S&OP plan.
Granularity	**Aggregated:** Deals with more general data and plans, by product family or region.	**Detailed:** Reviews data with greater granularity, which can reach the specific SKU level to ensure quick responses.
Main Function	Define the strategic game plan.	Ensure that the game plan is executed effectively on a day-to-day basis, acting as a "bridge" to the operation.

In summary, S&OP is about strategic planning, while S&OE is about tactical execution that ensures the strategy translates into effective action.

AI in S&OP: From Strategic Forecasting to Resource Optimization

In the S&OP cycle, Artificial Intelligence already delivers massive value, mainly in two areas:

1 *Predictive Models: The Foundation of Demand*

The starting point of S&OP is demand forecasting, and this is where AI has generated the greatest impacts. Instead of simple statistical methods, AI uses machine learning algorithms to identify patterns in large volumes of data and, crucially, to incorporate external explanatory variables that influence consumer behavior. A robust model considers:

- **Historical Data:** Sales base to capture trends and seasonality.
- **External Variables:** Promotional calendars, holidays, weather, economic indicators, competitor actions, and product cannibalization.

The objective is to estimate **unconstrained demand**—what the market would buy without inventory limitations. More than just a number, the models provide confidence intervals and explain which variables influence each result.

2 *Optimization Models: The Operational Response*

With the forecast in hand, AI helps to answer: "How can I meet this demand with my real constraints?". Optimization models seek the best decision, considering:

- **Objective Function:** Minimize costs, maximize demand fulfillment, or balance the load between factories.
- **Constraints:** Productive capacity, transportation cost, supplier lead time, service levels, and availability of inputs.

The great advantage is the ability to run scenario simulations ("what-if") in a structured way: What happens if a supplier is late? Is it worth paying for faster freight? This allows the subsequent financial review to be based on concrete data, quantifying the impact of each decision.

AI in S&OE: Agility and Precision in Day-to-Day Execution

If S&OP defines the plan, S&OE ensures it happens. This process acts as a bridge to daily execution, minimizing "fires" and adjusting resources to avoid stockouts or excess inventory. AI makes this process more agile and precise, with practical applications:

Real-Time Forecasting and Detection: Continuously processes data to detect deviations between the plan and what is actually happening, facilitating quick adjustments.

Inventory and Production Optimization: Based on dynamic short-term forecasts, AI helps to avoid shortages and excesses, adjusting volumes and schedules.

Agile Monitoring and Management: Integrates data from IoT sensors and monitoring systems to track and act quickly on operational bottlenecks.

Process Automation: Automates analysis, report generation, and alerts, freeing up professionals to focus on strategic decisions.

Simulation of Operational Scenarios: Predict the impacts of short-term decisions, such as a route change or a machine stop, reducing risks.

Exception Management: Proactively identifies problems like failures or delays and recommends quick actions to minimize their impacts.

Use Case

Case Study: Real Gains with AI in S&OE in the Home Appliance Sector

A home appliance company faced challenges in extracting and cross-referencing data on demand, inventory, and bottlenecks using manual spreadsheets. This caused work overload and a fragmented view of the operation, limiting analysis at the SKU level.

By implementing an analytical solution with AI, the company automated the consolidation of data from the entire S&OE cycle. The automation, combined with intelligent routines, allowed for the integrated and real-time cross-referencing of bottleneck, inventory, and demand data. The results were:

- **40% increase in operational efficiency.**
- **Improved granular analysis capability by SKU.**
- **Better communication and alignment between the Planning and Production areas.**
- **Significant reduction in inventory, thanks to improved analysis.**

This case demonstrates that the application of AI in S&OE not only frees up manual efforts but also improves the accuracy of decisions, generates economic gains, and creates a path for future strategic initiatives.

CHAPTER CONCLUSION

Uniting Strategy and Execution with Intelligence

Artificial Intelligence transforms planning from an isolated exercise into an integrated ecosystem. In **S&OP**, it brings robustness to strategic forecasting and optimizes the resource plan. In **S&OE**, it injects agility, precision, and rapid response capability into daily execution.

The true power, however, lies in the connection between the two. An S&OE process strengthened by AI generates high-quality data that feeds and enhances the next S&OP cycle, creating a virtuous circle of continuous improvement. Thus, AI ceases to be just a forecasting tool to become the engine that ensures that the defined strategy is executed with excellence on a day-to-day basis.

Chapter 3

Optimized Inventories

Optimized Inventories: *Optimal Service Level at a Reduced Cost*

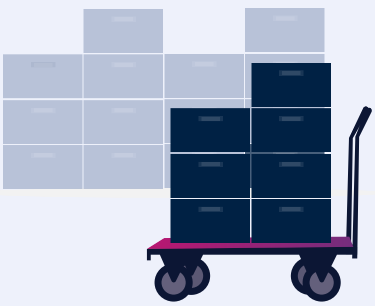
Inventory has always been one of the most sensitive pillars of the supply chain. It represents, at the same time, a buffer for uncertainty and a major cost center. Efficient inventory management directly impacts working capital, the service level provided to customers, and the profitability of the operation. In this sense, inventory optimization stands as one of the greatest opportunities to leverage value in the Supply Chain.

Inventory in the Context of the Supply Chain

Within the integrated flow of supplies, inventory connects demand planning, production, and distribution. Its function is to mitigate risks of variability and ensure market supply. However, holding excess inventory means tied-up capital and risk of losses; operating with insufficient inventory implies stockouts and loss of revenue.

Finding the balance between cost and service level is the real challenge. This challenge becomes more evident in industries with different production models.

In MTO (Make to Order), inventory levels can be lower, but the unpredictability of demand requires high flexibility in production capacity. In MTS (Make to Stock), the need to anticipate volumes and position products in the market increases complexity, making inventory planning critical to avoid both excess and stockouts.



Warehousing: The Eternal Trade-off

Warehousing is essentially a game of trade-offs: every decision involves balancing the cost of holding inventory (storage, insurance, working capital) against the risks of loss due to obsolescence and deterioration (write-off) and the need to ensure customer service levels.

> *This equation is even more complex because, often, the problem is not in the inventory itself. "Out of stock" situations can, in reality, be a consequence of demand forecasting failures, production capacity bottlenecks, or even deficiencies in the logistics network.*

Similarly, excess inventory may not be the result of a poor warehousing policy, but of inadequate portfolio segmentation, poorly managed life cycles, or a misaligned commercial strategy.

Therefore, correctly diagnosing whether inventory is indeed the problem is a fundamental part of the optimization process. Misidentifying the cause leads to ineffective replenishment policies and perpetuates the imbalance between costs and service level.

Planning as a Source of Value

Robust inventory planning generates direct gains in warehousing. Well-designed replenishment policies, appropriate portfolio classifications like ABC/XYZ analysis, and integration with demand forecasts allow for:

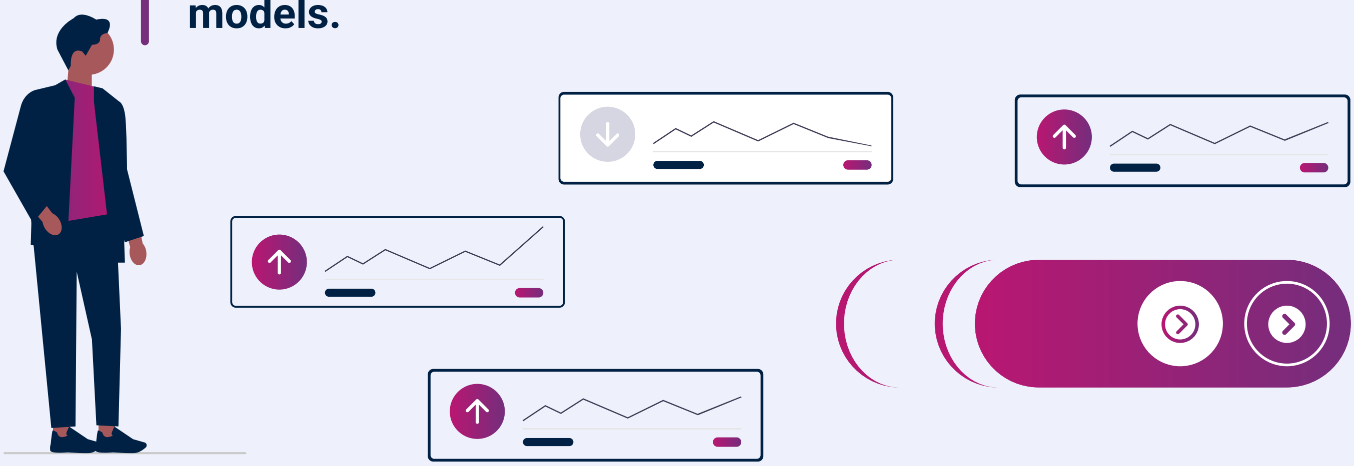
- Reduced warehouse costs: better space utilization and less need for additional capacity.
- Decreased idle inventory: frees up working capital and reduces the risk of obsolescence.
- Reduced write-offs: especially in industries with perishable or short-lifecycle goods.
- Decreased occurrence of stockouts: with greater prioritization of strategic products, whether by margin, volume, or customer relevance.

OPTIMIZATIONS BEYOND TRADITIONAL AI

Inventory Optimization

A common misconception in Supply Chain discussions is to assume that any advanced application of analysis or modeling is "Artificial Intelligence." This is not true. Optimization algorithms, such as Linear Programming, Mixed-Integer Programming, or allocation heuristics, are practices of Data Science. They are not AI, but they are fundamental for dealing with complex trade-offs and finding optimal balance points between cost and service level. Their outputs can even serve as inputs for AI models or intelligent agents, but they should not be confused with AI itself.

> **This distinction is essential: not every solution is AI, and understanding the problem correctly is more important than applying the "buzzword" of the moment. In many cases, the application of traditional optimization algorithms generates faster and more consistent gains than sophisticated machine learning models.**



Inventory Policy

Before discussing solutions based on algorithms or artificial intelligence, it is fundamental to understand that the starting point is always the inventory policy. A well-defined inventory policy should answer questions such as:

- Which products deserve greater inventory coverage, due to their margin or criticality for strategic customers?
- What is the acceptable minimum safety stock level for each item category?
- How do product life cycles impact replenishment (e.g., new launches vs. mature products)?
- What prioritization rules are applicable in situations of scarcity?

Classic tools, such as ABC/XYZ classification, safety stock levels, and parameterized replenishment rules, create the foundation. From there, more sophisticated solutions can be applied to refine and automate decisions. Without this foundation, the application of AI or optimization tends to generate only superficial adjustments.

To deal with this we need to work on 3 key indicators through an optimization model.

Security Stock

This is the lowest level of stock that a company can keep without running the risk of stockout, guaranteeing service levels until new supplies arrive.

To calculate this we use

- Consumption Rate
- Lead Time
- Demand Variation
- Lead Time Variation
- Desired Service Level

The application of AI calculation offers greater precision, adaptability and efficiency in the calculation to avoid stock-outs.

Target Stock

This is the level of stock that a company wants to keep to ensure that it can meet expected demand without excesses or shortages.

To calculate this we use

- Safety Stock
- Forecast Demand
- Lead Time

The application of AI calculation offers greater precision, adaptability and efficiency in the calculation to focus the team on the ideal stock level.

Maximum Stock

This is the maximum stock level that a company decides to keep in order to avoid excess products in the warehouse. In general, maximum stock is reached when a new shipment arrives and the stock before transportation is greater than or equal to the safety stock.

To calculate this we use

- Safety Stock
- Consumption Rate
- Lead Time
- Lot Size

The application of AI calculation offers greater precision, adaptability and efficiency in the calculation to avoid overstocking.

Use Case

Inventory Policy

The partnership between a large multinational CPG client and Artefact is an example of success in integrating data intelligence to define the Inventory Policy.

In collaboration with the logistics chain teams, specific solutions were developed for different types of inventory: raw materials, auxiliary materials, and finished products, both in factories and in distribution centers. Each context presented distinct particularities and challenges, requiring personalized approaches.

For finished products, advanced analyses and optimization algorithms were combined to define acceptable inventory ranges. The traditional formulations from the literature were enriched with automatically updated data sources, which enabled more frequent and accurate calculations compared to the previous process.

In addition, an optimization algorithm was implemented, designed to consider the most relevant factors for the business:

- **Prioritizing products with higher margins**
- **Adjusting to the relative service level of each customer**
- **Reducing storage costs.**

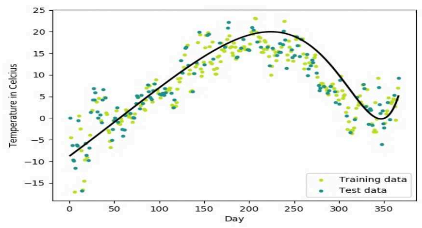
All recommendations are presented in a customized dashboard, which highlights risks of stockout or write-off and allows them to be addressed through adjustments in the production plan or transfers between warehouses.

The estimated results include a potential 2% increase in the current service level, a 4.8% reduction in inventory levels (with a direct impact on financial costs), and a 14% drop in write-offs, representing less product loss and disposal costs.

> ***The main model for an inventory policy project is the optimization of stocks, but demand and recommendation systems can be used to improve results***

Demand Forecasting

Model to forecast the demand of all products and estimate their stock levels

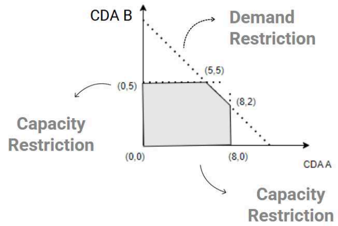


Data Inputs: Historical Sales, Promotional Calendar, Events, Historical Stock Levels...

- Demand Forecast

Optmization Model

Model to optimize the stock levels based on cost saving and service level

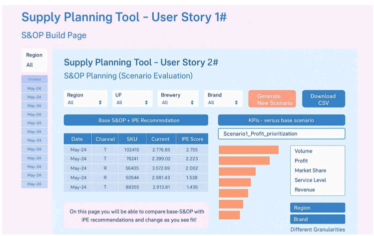


Data Inputs: Restrictions, Production Planning, S&OP Plan, Stock Capacity...

- Safety Stock
- Target Stock
- Maximum Stock

Simulation Model

Tool to allow the connection of all outputs and simulation of different scenarios

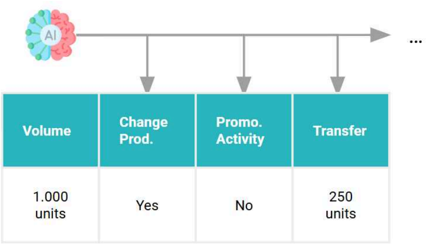


Data Inputs: Outputs and Inputs from the previous models

- Scenarios of change in Supply

Recommendation Model

Model to recommend what are the actions that can be taken to reduce stock levels



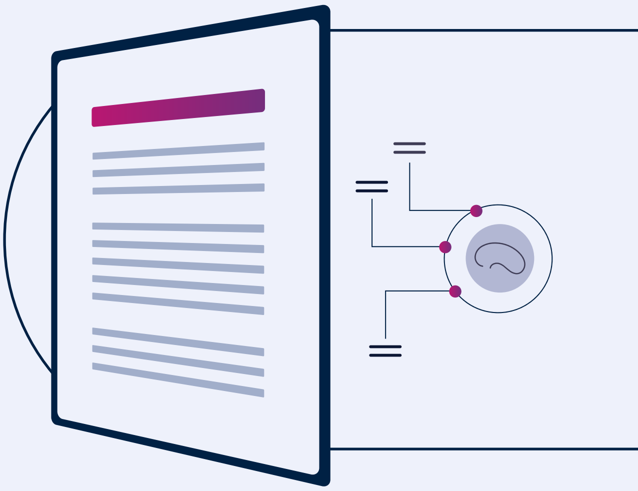
Data Inputs: Production Plan, Past Stock Influencing Actions, Transfers, Promotions...

- Recomm. Action
- Volume Allocation

Mandatory Model | *Optional Model*

Where Artificial Intelligence Comes In

The role of Artificial Intelligence in the context of inventory goes beyond simple forecasting. It is divided into three major levers:



Forecasting (demand prediction): statistical and machine learning models allow for identifying when inventory bottlenecks are, in fact, the limiting factor for sales. By calibrating expected demand with inventory policy, the organization can predict stockout situations before they occur.

Intelligent decision agents: once inventory policies are established (acceptable minimum and maximum ranges, safety parameters, lead times), this information can feed AI Agents. These agents continuously monitor risks and opportunities, suggesting concrete actions such as:

- Redistribution of products between warehouses
- Changes in the production plan
- Definition of promotional campaigns to accelerate the turnover of idle items

Dynamic Warehouse Layout Optimization (Slotting): AI algorithms can suggest the best position for items within the warehouse, taking into account turnover, seasonality, and rotation, reducing picking time and logistics costs.

Adaptability to the Realities of Each Industry

There is no universal inventory policy. Each industry has specific requirements that determine the best management strategy for each reality. The ROI of inventory projects varies according to the sector, the complexity of the portfolio, and the life cycle of the products. The application of optimization and artificial intelligence methodologies must take these particularities into account to generate financial returns.

Examples by industry

Perishable Consumer Goods

Context

Stricter inventory policies regarding expiration and rotation, use of forecasting to reduce seasonal stockouts.

Financial Return

Reduction of losses due to expiration and write-offs, in addition to increased revenue from decreased stockouts during peak periods.

Pharmaceutical Industry

Context

Integration of inventories with specific deadlines and demands of channels (hospital, retail, distributor). Necessary to consider higher safety stocks for critical products.

Financial Return

Balance between availability of essential medicines and release of working capital, previously tied up in excessive inventories.

Automotive and Auto Parts

Context

Differentiated policies for high and low turnover items. Decentralized inventories close to consumption points reduce unavailability costs.

Financial Return

Reduction of logistics costs and loyalty of B2B customers through greater reliability of parts availability.

Durable Goods Industry

Context

Longer planning horizon, greater dependence on safety stocks linked to extensive lead times and variability of raw materials.

Financial Return

Optimization of working capital and production stability with lower risk of stoppages due to lack of inputs.

Multichannel Retail (omnichannel)

Context

Unified and dynamic inventories to serve both e-commerce and physical stores. AI applied to slotting can reduce separation time and increase productivity.

Financial Return

Logistics productivity and increased revenue from reduced stockouts in digital and physical channels.

The value of inventory optimization varies for **each industry that captures ROI in different ways**. While some sectors focus on **operational efficiency** (reduction of storage costs, write-offs, transport), others work more with c**ommercial effectiveness** (avoiding stockouts, retaining strategic customers, capturing demand peaks). This adaptability is what makes intelligent inventory policies a competitive differentiator.

Chapter 4

Logistics & Distribution

Logistics & Distribution: *Boosting Inbound and Outbound*

Logistics is the main operation of the supply chain, and distribution is the final point of contact with the customer. AI is revolutionizing this stage, transforming it from a reactive cost center to a proactive and intelligent system. Logistics optimization with AI can be divided into two main fronts: inbound, focused on the entry of materials, and outbound, on the final delivery to the customer.

Inbound: Intelligent Management of Material Entry

Inbound logistics deals with the acquisition and receipt of raw materials and components, being a critical pillar for production efficiency. Traditionally, this area faces significant challenges that AI is capable of solving. **Some examples are:**

Relationship with Procurement and Suppliers

AI improves supplier management by analyzing not only performance history, but also product quality, delivery times, and total cost of ownership (TCO). Machine Learning algorithms can dynamically classify and segment suppliers, identifying the most reliable ones and those that represent potential risks. For example, AI can predict the probability of a supplier delivering an order late, based on historical data and external variables. This allows the procurement team to make proactive decisions, such as activating a secondary supplier or negotiating new contractual terms, even before the delay occurs. This predictive capability transforms the relationship with suppliers from transactional to strategic, allowing for more solid and resilient partnerships.

Lead Time Challenges

Lead time is a crucial factor that directly impacts inventory levels and production planning. Unexpected variations can cause bottlenecks, paralyzed production lines, or excess inventory, generating unnecessary costs. AI can analyze real-time transport data, traffic conditions, weather, and even geopolitical events or port strike reports to predict lead time with greater accuracy than traditional methods. The ability to predict delays based on real-time navigation data allows the company to dynamically adjust its production planning and inventory allocation, avoiding delays and bottlenecks on the assembly line and optimizing cash flow.

Detection of Supply Risks

In a volatile and interconnected world, proactive detection of supply risks is very important. AI can monitor and process information from diverse sources, such as global news, financial data of suppliers, sustainability reports, and real-time events, to identify potential risks. For example, an AI system can alert about political instability in a key region or about financial problems of an important supplier before they impact the supply chain. This enables companies to develop effective mitigation strategies, such as activating alternative suppliers or adjusting order volumes. This proactive approach to risk management is a fundamental pillar of chain resilience, going beyond simple reaction to unwanted events.

Outbound: *Optimizing Delivery and Customer Experience*

Outbound logistics is responsible for getting the final product to the customer quickly and economically. AI offers an arsenal of tools to improve each step of this process, from the moment the product leaves the distribution center to the customer's door. **Some examples are:**

Intelligent Routing

AI-optimized routing considers multiple real-time variables, such as traffic, weather conditions, delivery deadlines, vehicle restrictions (weight, height), delivery time windows, and fuel cost to create the most efficient and economical routes. This results in fuel savings, reduced labor costs, and decreased carbon emissions. AI can, for example, dynamically adjust routes during the journey to avoid an unexpected accident or traffic jam, or even recalculate the delivery sequence to optimize a vehicle's route.

Loading Optimization and 3D Modeling of Trucks

Optimizing truck loading is a complex challenge, especially with loads of different sizes and shapes. AI can use 3D modeling to simulate different load configurations, maximizing the use of available space and minimizing the number of trips required. This not only reduces freight costs but also contributes to sustainability by reducing the carbon footprint. An AI system can, for example, suggest the best way to stack irregular pallets or products of different categories to ensure load stability and safety, avoiding damage during transport.

Telemetry and Efficiency

Telemetry, when combined with AI, transforms vehicle data into actionable intelligence. AI can analyze driving data (acceleration, hard braking, dangerous curves), fuel consumption, downtime, and routes traveled to identify inefficiencies and suggest performance improvements for drivers, such as specific training or adjustments in driving habits. This not only increases efficiency but also improves safety, reduces vehicle wear, and enables predictive maintenance, avoiding unplanned stops.

Order Optimization

AI can intelligently group and sequence orders, consolidating deliveries for the same geographical area and ensuring that trucks are loaded in the correct order for efficient unloading. This speeds up the delivery process and improves the customer experience, especially in last-mile operations, where speed and precision are crucial. By predicting demand and optimizing orders, AI can reduce the number of partial deliveries and increase customer satisfaction.

OTIF and Cost Saving

AI directly impacts the main logistics KPIs. By optimizing routing, loading, and order sequencing, AI increases OTIF (On-Time, In-Full), ensuring that orders arrive on time and complete. Optimization on all these fronts, from the route to the loading, leads to a significant reduction in operational costs, making logistics a source of value and not just an expense.

Use Case

Transportation Planning

The strategic collaboration between one of the world's largest players in the CPG sector and Artefact demonstrates the power of data intelligence in transforming logistics operations and generating financial value.

Our client's logistics team faced a complex planning challenge. Although the monthly delivery volumes from factories to distribution centers were well-defined, execution was treated linearly. This approach ignored the weekly fluctuations in real demand, creating a critical problem: the concentration of deliveries in specific periods.

On some routes, for example, it was necessary to deliver 80% of the volume in the first week of the month, while others showed the opposite behavior. This lack of visibility into demand trends resulted in inefficiency and high costs.

The main consequences were:

- **Hiring of spot freights,** considerably more expensive, to cover unplanned demand peaks.
- **Movement of empty trucks between regions,** a purely reactive investment to support unexpected highs.

To solve this bottleneck, Artefact developed a customized planning solution. We created a statistical model to identify demand concentration trends for each of the more than 200 logistics routes.

The model began to issue predictive alerts, signaling the routes where planning was misaligned with actual future demand. To add an extra layer of precision and impact, the solution was designed to be updated daily, adjusting its own results based on deliveries already made. This allowed the model to become even more responsive, anticipating problems before they happened.

The implementation of the solution, made available to planning teams through an interactive dashboard, generated transformative and measurable results:

- **Cost Optimization:** Significant increase in the choice of freights with better cost-benefit, abandoning dependence on more expensive spot freights.
- **Waste Reduction:** Drastic drop in logistics investment with the elimination of unnecessary movements of empty trucks.
- **Increased Efficiency:** 12% gain in planning efficiency, which translated directly into a saving of millions of reais in logistics costs for the client.

This case reinforces how the application of data science not only optimizes processes but also becomes a **powerful lever of financial performance.**

Chapter 5

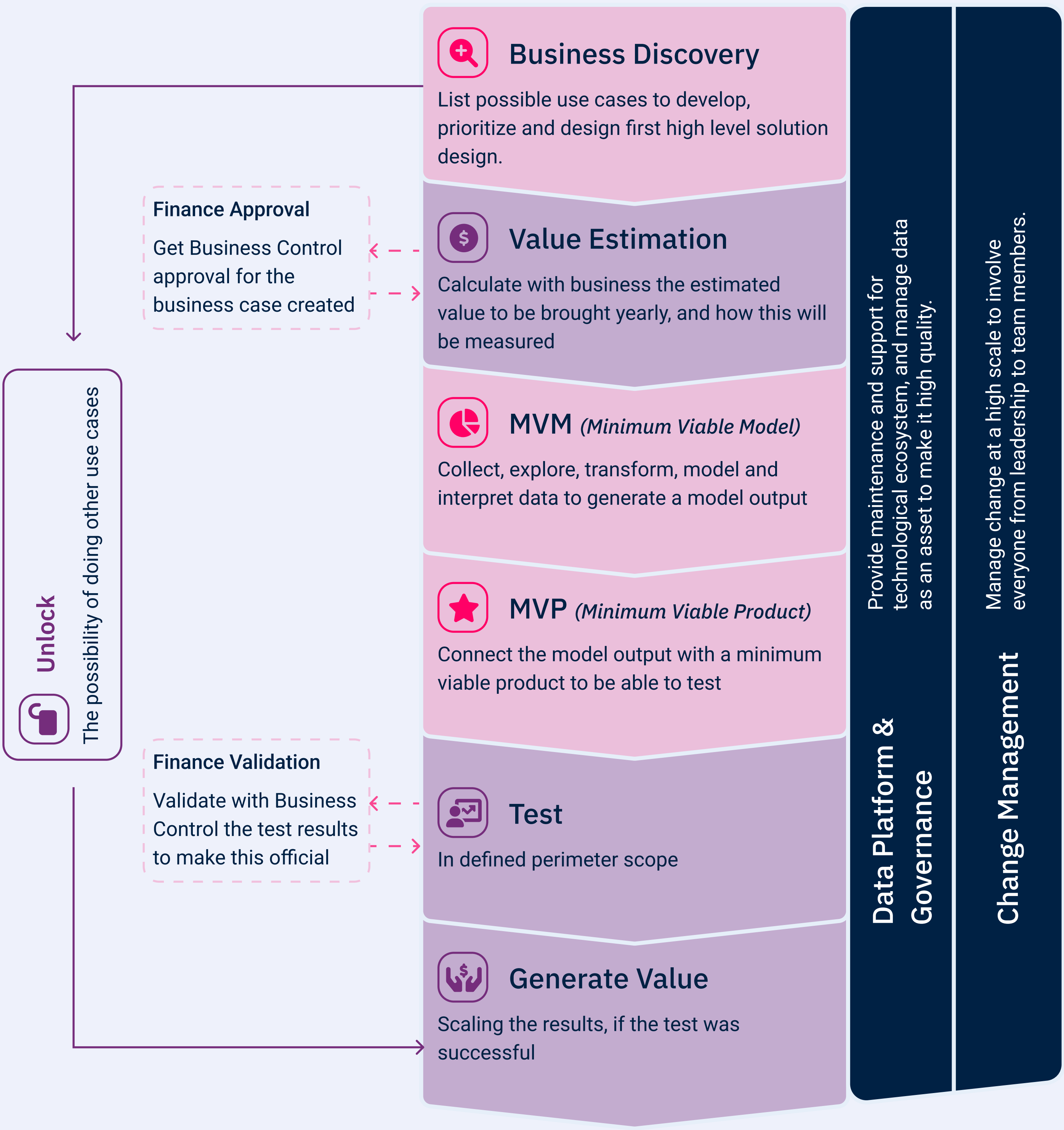
Measuring Impact

How to Measure Impact: *The Value Estimation Methodology*

The Value Estimation methodology is a structured approach to quantifying the financial and operational impact of an initiative before, during, and after its implementation. The goal is to move from a "technology cost" view to an "investment with return (ROI)" view. The process can be divided into 5 main steps:

Step	Description	Objective
1. Establish Baseline	Map the current process ("As Is") and measure its performance with existing KPIs.	Determine a starting point to be able to measure improvement.
2. Definition of Success KPIs	Identify the Key Performance Indicators (KPIs) that the AI solution will directly impact.	Focus measurement on the indicators that really matter to the business, such as efficiency, cost, and service level.
3. Estimation of Gains	Formulate hypotheses about the percentage of improvement that AI can bring to the defined KPIs.	Create a quantifiable goal. For example: "The use case will reduce the forecast error or cost by 15%".
4. Translation to Financial Value	Convert the improvement of KPIs into monetary value (R$).	Justify the investment by calculating the Return on Investment (ROI) and the impact on the company's P&L.
5. Post-Implementation Monitoring	Continuously track the KPIs after the solution is implemented to compare the actual result with the initial estimate.	Validate the value generated, correct course if necessary, and prove the project's success with the finance and controlling team.

While AI as Business Unit approach allows us to use the generated value to unlock new opportunities



Legenda:

Common steps for the Data Factory approach

Differential increments of the AI as Business Unit approach

Examples of value estimation in a use case

Let's detail how this methodology applies to the three major areas of the supply chain:

1 Planning (S&OP and Demand Forecasting)

- ***Establish Baseline***
  The current manual process has a forecast accuracy (MAPE) of 30%, causing lost sales and costs with excess inventory.
- ***Define Success KPIs***
  Forecast Accuracy (e.g., MAPE - Mean Absolute Percentage Error), Lost Sales due to Stockout (R$), Cost of Excess Inventory (R$).
- ***Estimate Gains***
  The hypothesis is that AI will improve forecast accuracy by 10%.
- ***Translate to Financial Value***
  A 10% reduction in forecast error can lead to a 5% decrease in lost sales and a 15% reduction in obsolete stock carrying costs, with an estimated saving of R$ 10 million/year.
- ***Monitor Post-Implementation***
  After launch, the KPIs are continuously monitored in agreement with the finance team to validate if the actual gain was achieved and to correct the course if necessary.

2 Warehousing and Inventory Management

- ***Establish Baseline***
  The current method generates an inventory turnover of 4x/year, keeps R$ 150 million in allocated capital, and has a service level of 90%.
- ***Define Success KPIs***
  Inventory Turnover (Number of times), Opportunity Cost of Inventory (R$), Service Level (Fill Rate) (%).

- ***Estimate Gains***

  The hypothesis is that AI can improve inventory turnover by 15% and increase the service level by 5 percentage points.

- ***Translate to Financial Value***

  The optimization should free up R$ 22 million of working capital that was tied up in inventory, in addition to avoiding losses due to lack of product.

- ***Monitor Post-Implementation***

  After implementation, turnover and service level will be continuously monitored to validate the capital release and ensure the sustainability of the gains.

3 Logistics and Distribution

- ***Establish Baseline***

  The routing process has an OTIF (on-time, in-full deliveries) of 80% and fleet utilization of 70%.

- ***Define Success KPIs***

  Transportation Cost per Unit/KM (R$), OTIF (On-Time, In-Full) (%), Fleet Utilization/Occupancy (%).

- ***Estimate Gains***

  The hypothesis is that AI will optimize routes, resulting in a 12% reduction in logistics costs with an increase in OTIF.

- ***Translate to Financial Value***

  The intelligent routing model can generate an annual saving of R$15 million in freight, in addition to improving customer satisfaction with more reliable deliveries.

- ***Monitor Post-Implementation***

  The KPIs of Transportation Cost/KM and OTIF will be continuously monitored to validate the actual gain and ensure better fleet utilization.

AI implementation presents a series of measurable levers.

Tangible and highly controlled processes, making it easier to measure results.

Process standardization is key in operations, ensuring scalability and exponential results.

As these are significant cost centers, even small percentage gains represent high value.

Technical accelerators from partners, often already available (e.g. Gurobi), act as project margin levers.

Examples of Results in 12 Months

- ***Planning:***
  Stockout Forecasting
  (R$ 12MM)
- ***Procurement:***
  Raw & Pack Inventory Policy
  (R$ 3MM)
- ***Warehousing:***
  Inventory Policy
  (R$ 5.7MM)
- ***Distribution:***
  Logistics Planning
  (R$ 48.4MM)

16x ROI

Considering few or even no assumptions for the validation of identified gains within 12 months after the implementation of the use cases.

[1]Average cost per use case: R$ 900k

Conclusion

Unlike other business units, operations are fundamentally oriented towards cost reduction through efficiency gains. In this context, the ability to track, structure, and, above all, quantify the financial impact of each project is not just a good practice, but a strategic imperative.

It is here that a paradox arises: although Artificial Intelligence represents one of the greatest optimization levers available, its adoption is still timid, with only 30% of operations claiming to use AI consistently in their daily activities. To break this barrier and scale the use of technology, organizations need a clear methodology to prove the value of their investments and connect the potential of AI to tangible results.

The methodology we present is designed precisely to build this bridge, but its success depends on answering two fundamental questions that should guide any data initiative in operations: Which business levers will my project really impact? And, crucially, how do I identify and measure this impact in the day-to-day operation?

Chapter 6

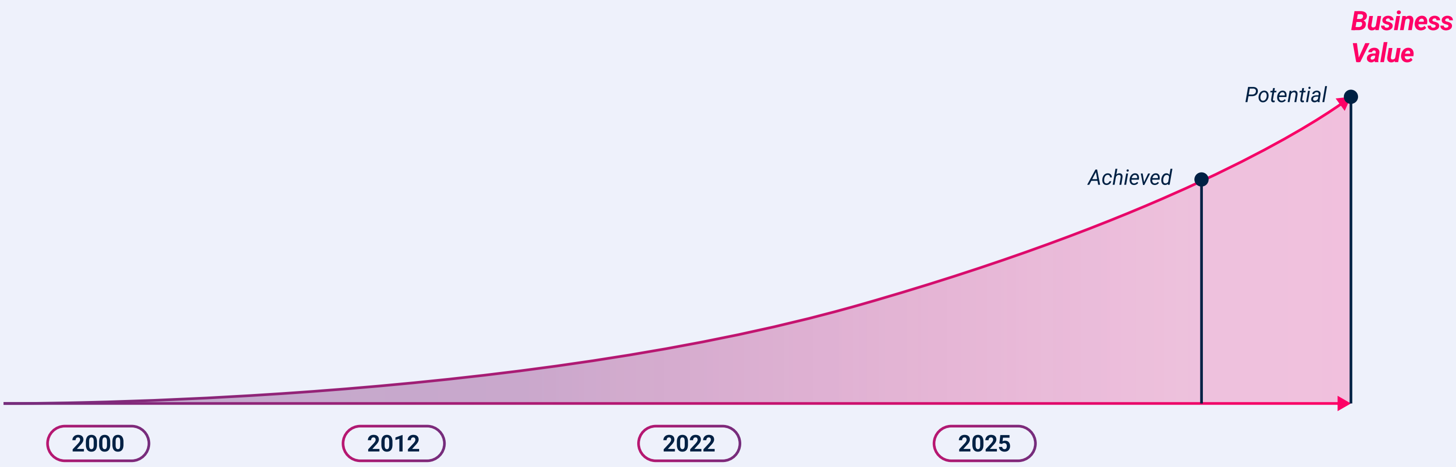
A New Trend: AI Agents

AI Agents: *The Next Frontier in Value Chain Autonomy*

The supply chain and manufacturing have historically been centers of cost and complexity, susceptible to fluctuations and external events. Although the sector has advanced in digitalization with the implementation of ERP, TMS, and WMS systems, the use of artificial intelligence (AI) has still been largely superficial, focusing mainly on analytical and predictive models.

> **The real qualitative leap for resilience and efficiency lies not just in predicting the future, but in enabling systems to act on these predictions. This is the essence of the next disruptive trend: the emergence of AI agents.**

From AI to Agent: The next lever of business value.



RPA
Supremacy

Traditional AI
Democratization

Generative AI
Diffusion

Agentic AI
Ascension

The Age of Autonomy: Redefining Intelligence in the Supply Chain

The evolution of AI in the supply chain can be understood in three distinct stages. Initially, AI was used mainly for predictive models, such as demand forecasting and inventory optimization. These tools, although valuable, act passively, providing insights for human decision-making. Generative AI, in turn, represented a new capability by allowing systems to understand unstructured data, such as supplier contracts and purchase records, and generate content in response to prompts. However, both predictive and generative AI, in their traditional forms, still depended on human intervention to convert the data and generated content into concrete actions.

AI agents represent the most advanced stage of this evolution, acting as a "watershed" that paves the way for an autonomous or semi-autonomous supply chain. Their main innovation lies in the ability to move from mere analysis to action.

This was made possible by advances in AI foundation models, which now possess reasoning, planning, and memory capabilities at previously unattainable levels. As a result, AI agents can not only process data but also make decisions, learn from experience, and adapt dynamically to achieve a predefined objective, with little or no human intervention. This transition transforms the supply chain from a back-office function into a strategic asset that can drive business agility and resilience.

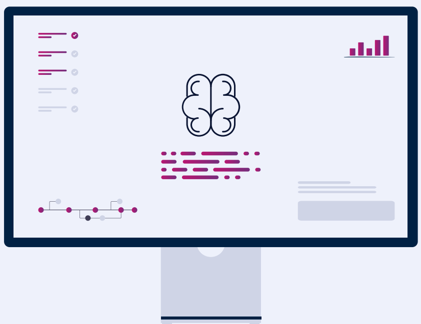
What are AI Agents?

For executive leadership, the distinction between an AI agent and existing automation technologies is fundamental to understanding its value. An AI agent is a software system that uses AI to perceive its environment, reason, plan, and execute tasks autonomously on behalf of a user or a business objective. The characteristics that differentiate it from a bot or assistant are its autonomy and complex reasoning ability. While a bot or an AI assistant responds to specific commands or questions within a limited context, **an AI agent can operate independently to achieve a larger goal.**

It can, on its own initiative, seek information from external sources, analyze data, make decisions, and execute actions proactively. For example, an assistant might recommend a route, but an AI agent can autonomously change the route of a fleet of trucks upon detecting a traffic jam in real time.

The ability of agents to interact with other agents to coordinate and execute complex workflows, a concept known as multi-agent collaboration, signals the emergence of a future where the orchestration of "fleets" of intelligent agents will become **a new strategic imperative for leadership.**

Emerging tools and protocols such as A2A (Agent2Agent) and MCP (Model Context Protocol) are being developed to enable this fluid communication between agents from different ecosystems and business systems, consolidating the infrastructure for large-scale adoption.



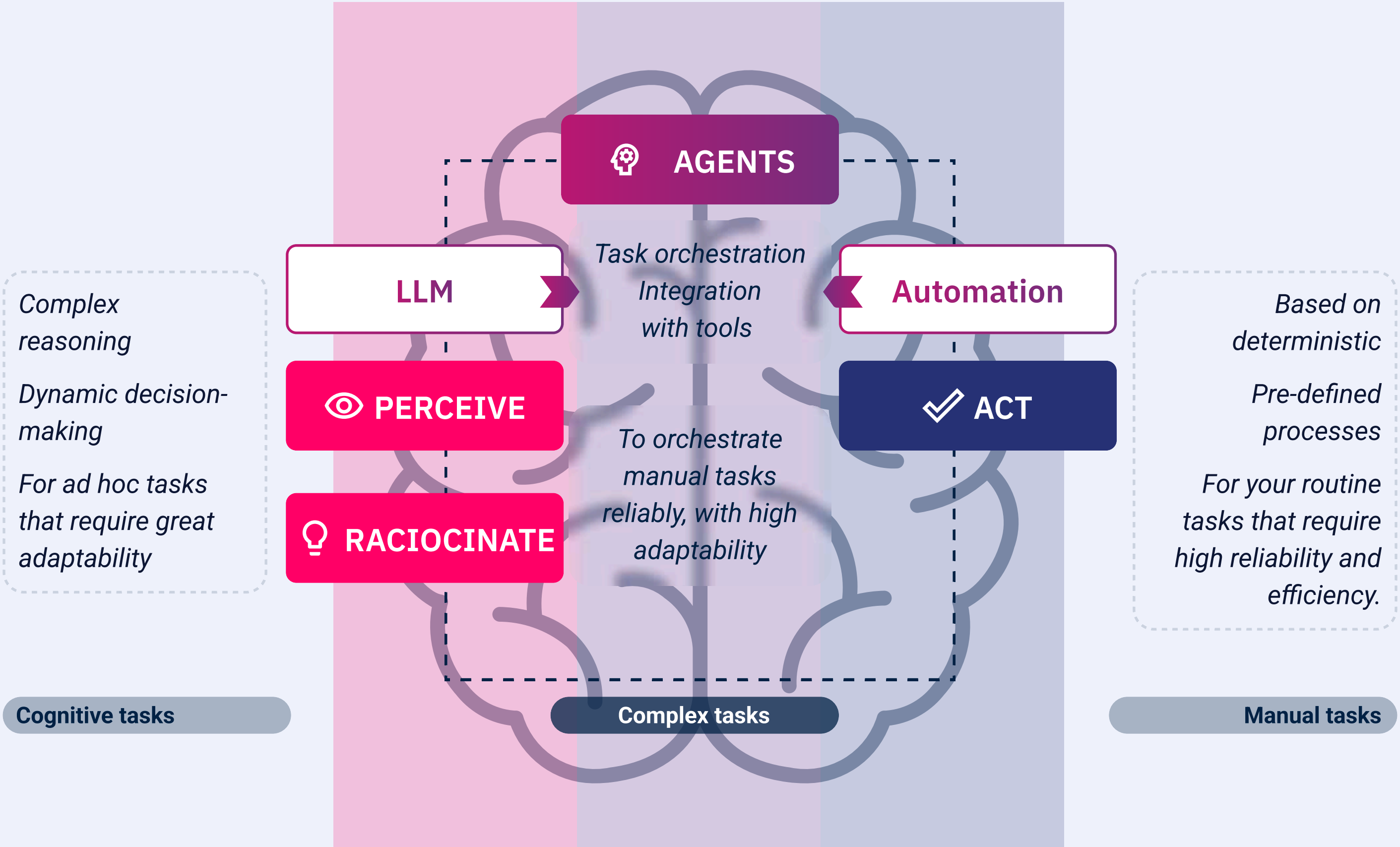
AI Agents vs. Traditional Automation

For many leaders, the concept of automation may be intrinsically linked to robotic process automation (RPA). Although RPA has generated significant value, it operates within fixed parameters and predefined workflows, following if-then logic. AI agents, on the other hand, represent a qualitative leap that dynamically reshapes the context and, in some cases, can even modify its own execution rules. The following table compares the fundamental characteristics to demonstrate the paradigm shift.

Characteristic	Traditional Automation (RPA)	AI Agents
Autonomy	**Low:** follows pre-defined flows.	**High:** operates and makes decisions independently to achieve goals.
Reasoning	If-then **logic and execution** of structured tasks.	**Logic, inference, and probabilistic models.** Considers multiple variables and ambiguities.
Learning	**Null:** does not learn from new data.	**Continuous:** adapts models and strategies over time to improve performance.
Proactivity	**Reactive:** only acts when triggered.	**Proactive:** can anticipate needs and initiate actions.
Scope	**Restricted** to repetitive and structured tasks.	**Manages complex workflows**, with multi-step tasks and unstructured data.
Strategic Value	**Operational efficiency**, reduction of manual errors.	Resilience, adaptability, predictive insights, and **competitive advantage.**

RPA focuses on doing tasks faster and with fewer errors. The AI agent, however, seeks a business outcome, operating more broadly to optimize complex workflows, such as demand forecasting, routing, and customer management. The strategic value is not just cost savings, but the ability to build a more transparent and resilient supply chain that can fluidly adapt to disruptions and context changes.

Agentic system work combine RPA & GEN AI technologies agents can perform autonomously a wide variety of tasks



The Opportunity of Agents in Planning and Production

The S&OP Negotiator Agent (S&OP Autonomous Negotiator)

The S&OP process is, in essence, a negotiation between departments with conflicting goals (Sales wanting to maximize fulfillment, and Operations seeking to optimize capacity). An Autonomous Negotiator Agent acts as an intelligent mediator, trained with data from historical negotiations, supplier behavior, and market prices. It can negotiate stock allocations and production schedules in real time to harmonize the goals of Sales and Operations. With this, leadership defines the strategic rules of the negotiation, while the agent executes the tactical micro-negotiations autonomously, making the S&OP cycle much more agile and consistent.

Agents in Warehouse and Quality Management

Quality Control Agent

Quality control is a meticulous activity, traditionally performed by human inspectors. A Quality Control Agent uses computer vision and machine learning to inspect products and detect defects during production or packaging phases. By automating this function, the agent reduces dependence on manual checks and ensures superior consistency. More importantly, it not only rejects items but frees up the human inspector to focus on higher-value tasks, such as root cause analysis of defects and proposing process improvements.

AI Agents and Operational Excellence

The Route Optimization Agent

Transport logistics is one of the most expensive links in the supply chain. A Route Optimization Agent operates on data from multiple sources, such as GPS, real-time traffic, and weather forecasts. Unlike traditional systems that rely on fixed plans, the agent can reason and dynamically adjust the route. If it detects a traffic jam, it can change a vehicle's route in real time to avoid delays, recalculate the arrival time, and notify the customer, ensuring greater efficiency and reducing fuel costs.

Agents for Safety and Workforce Optimization

Autonomous Shift-planner Agent

Shift planning is a complex task that balances operational demand with staff availability and skills. An Autonomous Shift-planner Agent can manage this task dynamically. It goes beyond a fixed schedule, adjusting staff allocation based on real-time variables, such as fluctuations in production demand, employee skills, and even workload history to avoid fatigue. This adaptability ensures a more efficient and flexible resource allocation, reducing labor costs and increasing team satisfaction.

Summary Table: AI Agents in Supply Chain and Manufacturing

Agent	Key Functionality	Business Benefit	Key Input Data
S&OP Autonomous Negotiator	Autonomously negotiates allocations and schedules between departments.	Acceleration of the S&OP cycle, greater consistency in decisions.	Sales targets, production capacity, inventory constraints.
Quality Control Agent	Uses computer vision to inspect products and detect defects.	Reduction of production errors, improved product quality.	Images and videos from production lines.
Route Optimization Agent	Adjusts transport routes in real time based on dynamic variables.	Reduction of fuel costs, faster deliveries.	GPS data, traffic, weather, road closures.
Autonomous Shift-planner Agent	Autonomous Shift-planner Agent.	Optimizes staff allocation based on demand and skills.	Increased efficiency, reduced costs, higher team satisfaction.

Agentic Room: The way to leverage exponential impact

Although the impact of AI agents in areas like Sales and Marketing is often direct and visible, in Operations, their true strength manifests in a different way: as an exponential value multiplier. Far from having a limited space, AI agents are the key to leveraging and scaling the impact of all existing data infrastructure.

The real magic happens when we apply agents to enhance the use of traditional AI models. Let's think of a stock rupture prediction model. By itself, its impact is clear but limited, as it depends on human intervention to assess each risk, redirect loads, or request production. The result is a ceiling on the efficiency that can be achieved.

> **This is where the AI agent elevates the game.** Firstly, it can intelligently prioritize the most critical risks raised by the model. Then, it proactively engages with the production, planning, logistics, and commercial teams to orchestrate a balanced solution. Taking the capacity to a new level, if we connect this same agent to a transport cost optimization model, it begins to identify not just a solution for the rupture, but the optimal solution that minimizes the financial impact.

There are numerous opportunities for Agentic impact across the entire value chain.

AGENTIC ROOMS

To generate exponential impact with Agents in Operations, implementing a single agent is not enough. True ROI emerges with the creation of an Agentic Room, that leverage other solutions, such as:

1. ***Traditional AI Models:*** AI Agents can enhance processes and decision-making efficiency, but advanced optimization and forecasting still rely on traditional AI.
2. ***System & Data Integration:*** The agents are trained with necessary data, but integration with key datasets and systems will allow them to take action directly.
3. ***Multiple Agents:*** The combination of multiple Agents enables simultaneous coverage of different processes and allows the factors within each to influence one another.

	Pain Points	Rooms		
PLANNING	Understanding of Actual x Planned and Drivers behind changes	*Sales & Operations*	Centralized Room to ensure maximum execution of sales plan.	**S&OP Optimizer** (traditional AI) **S&OE Agent:** Agente responsible for negotiating S&OE plan with all players.
SOURCING	Reacting quickly to issues and anticipating risk with suppliers	*Supplier Management*	Room focused on negotiating and managing suppliers.	**Risk Forecasting** (traditional AI) **Negotiator Agent:** Responsible for negotiating deadlines, adjustments and pricing with suppliers.
MANUFACTURING	Ensuring Quality and minimizing losses in the processes	*Operation Management*	Dedicated space to ensure both quality and efficiency.	**Quality Forecast** (traditional AI) **Quality Agent:** Agent responsible for analyzing Data and giving alerts for the drivers of quality risk.
WAREHOUSING	Inventory Management to ensure service level	*Warehouse Management*	Agents focused on ensuring service level at ideal costs.	**Inventory Policy** (traditional AI) **Inventory Insights:** Agent responsible for analysing capacity, current and future stock and alert issues.
DISTRIBUTION	Fleet Operation Management and Cost Reduction	*Fleet Management*	Centralized space to manage fleets and optimize processes.	**Cost Optimization Model** (traditional AI) **Route Agent:** Agent responsible for dynamically assign routes to fleet based on cost saving.

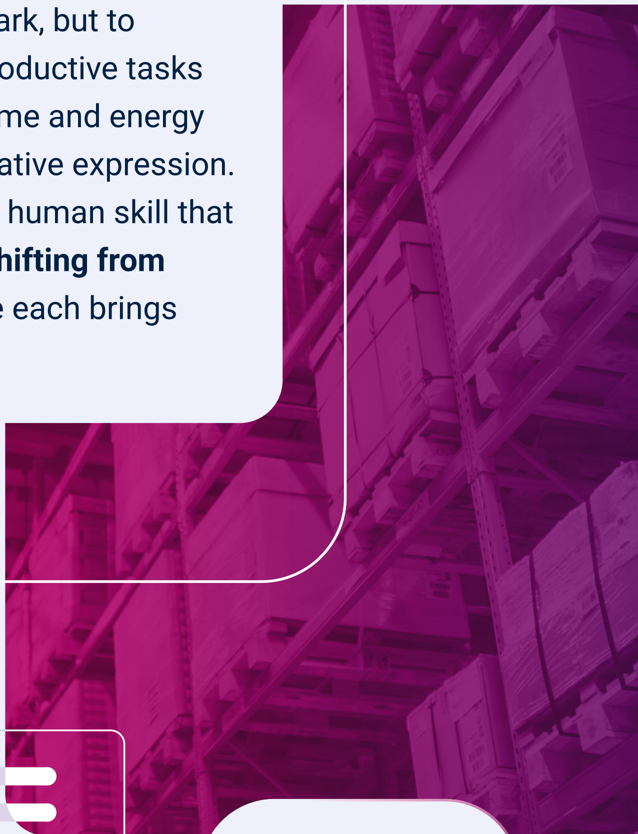
That is why AI agents shine in operations when they act as the core of an integrated ecosystem of models and automations. For their potential to be fully realized, the agent must be designed to assume a clear and specific function within the process, such as a Virtual Logistics Analyst or an Autonomous Production Planner. In this way, they transcend the function of a simple conversational chatbot to become autonomous tools that execute tasks and generate real business impact.

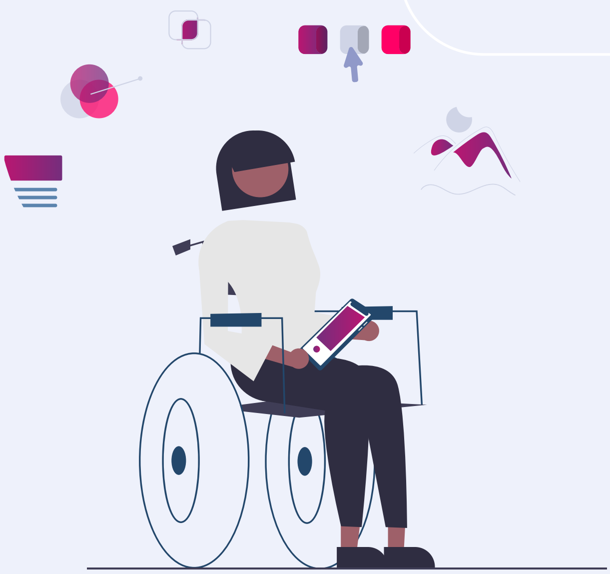
THE HUMAN LINK:

AI as a Partner in Creativity and Strategy

The Question of Creativity

The rise of AI in creation raises a central question: is technology a threat to human creativity? The evidence suggests the opposite. The true essence of human creativity goes beyond what can be replicated by algorithms, as it is rooted in feelings, passion, intuition, and cultural heritage. AI was not designed to replace this human spark, but to complement it, by removing repetitive, menial, and unproductive tasks from the workload of professionals. By freeing up the time and energy of experts, technology allows them to focus on true creative expression. Creativity is not a gift reserved for a few, but a universal human skill that can be amplified with the right tools. **The paradigm is shifting from "human in the loop" to a "human-AI partnership",** where each brings their unique strengths to the creative process.





Case Study

Robertet Group and the NaturIA Project

The Robertet Group, a world leader in fragrances, offers an example of how AI can boost the development and launch chain of new products.

In partnership with Artefact, the group developed the NaturIA project, **a tool based on generative AI aimed at accelerating perfume research.**

The platform consists of an **intelligent search engine and an inspiration panel**, capable of translating image briefings into conceptual descriptions that can be used to search for combinations in a database of over 65,000 formulas. The AI does not create the perfume, but facilitates the research process.

It suggests ingredient compounds, considering the perfumer's intentions, market trends, and Robertet's own sensory DNA.

With AI, Robertet can anticipate, already in the study phase, which combinations of raw materials are compatible with its global availability, which have the best production cost, and which meet the regulatory standards of each market. **The result is a significant reduction in time-to-market, allowing fragrances to reach shelves ahead of the traditional schedule.**

More than accelerating creation, the NaturIA project demonstrates that technology can help **ensure consistency between the product concept and its productive viability**. With this, it is possible to make the launch of new products a predictable, scalable, and data-driven process.

Chapter 7

Digital Twins

An Old Trend: *Digital Twins*

The concept of a Digital Twin dates back to NASA during the space race in the 1960s, although the term was only coined in 2002 by Michael Grieves. Essentially, a **Digital Twin is a digital mirror of a real process, machine, or operation, whose objective is to improve simulation and analysis, showing how the mirrored system would react in different scenarios.** Initially used to study the behavior of rockets, today they are widely applied to improve operational performance, becoming a central concept of Industry 4.0 and, perhaps, a pillar of the future Industry 5.0.

The goal is to use real-time data from assets to create a digital version that can simulate conditions, predict reactions, and use AI to enhance results. In practice, it allows operations to run a parallel mirror of themselves, continuously learning while testing new possibilities.

Digital Twins, Simulations, and AI: Clarifying the Differences

Digital Twins are often confused with simulations or isolated use cases of AI, but the three concepts, although interconnected, are distinct:

Simulations:

A simulation is a static photograph of how a scenario might behave. It operates with "yesterday's data" and does not adapt to real-time data.

Artificial Intelligence:

AI use cases can react dynamically to real scenarios, but they usually have a limited scope, dealing with specific processes without broad integration with the system.

Digital Twins:

The Digital Twin brings these elements together. It uses historical data, integrates AI for prediction and optimization, and leverages real-time data from complex systems. The most important point is that it creates a two-way interaction: the Digital Twin not only analyzes data but also provides direct feedback to operations, allowing for real-time adjustments.

For example, in the manufacturing of glass bottles, cooling is a critical step. A Digital Twin can determine the optimal cooling pace at each moment, balancing quality and resource use. If the quality of the raw material changes and affects the process, the Digital Twin adapts, communicates new instructions to the operation, and maintains efficiency, eliminating isolated adjustments.

What are Digital Twins?

Balanced between Actual & Planned

A Ascensão do Digital Twin

1960s
NASA

Original Concept Designed by NASA to support the Space Race and the moon landing in the 1960s.

2000s
in Business

The term "Digital Twin" is coined by Dr. Michael Grieves and enters the radar of the industry as a concept outside rocket science.

Industry
4.0

With advancements in technology and the growing accessibility of cloud computing and sensors, Digital Twins have become increasingly common in complex operations.

AI &
Agents

The rise of AI and Agentic AI is exponentially expanding the capabilities of Digital Twins and amplifying their impact on business operations.

Types of Digital Twin

Digital Twins can be classified into different levels of complexity and scope, according to the required granularity and integration:

1 Asset Twins

These are digital twins that represent a single asset or specific process, such as a sheet metal cutting machine. They allow for monitoring performance and anticipating failures of individual equipment.

> **Main challenge:** the sustainability of an Asset Twin depends heavily on the availability and quality of sensor data from the monitored asset.

2 System Twins

Focused on a broader control variable, such as energy consumption in a plant. They connect various assets to represent and optimize the behavior of a system or an operational dimension.

> **Main challenge:** the integration between IT (information) and OT (operation) systems is fundamental to ensure that the twin is actionable at scale.

3 Process Twins

These are the most complex digital twins, representing the integrated view of multiple twins along the chain. They allow for simulating and optimizing complete processes, such as production sequencing.

> **Main challenge:** the development of Process Twins requires a deep understanding of the business and its interdependencies so that simulations reflect reality and support high-impact decisions.

Where are Digital Twins Being Used?

Digital Twins can be applied throughout the value chain:

- **Planning:** Improving S&OP and S&OE processes by combining real-time data with prediction and optimization models. If demand falls, the Digital Twin can adjust the S&OP and production planning.
- **Supplies:** Evaluating the impact of raw material characteristics. For example, it can detect if soybeans with high moisture are reducing efficiency and adjust the process.
- **Manufacturing:** Traditional application, where digital replicas of plants allow for monitoring, adjustments, and predictive modeling. Sensors can predict the color of beer, optimizing the use of malt.
- **Warehousing:** Using WMS data to optimize inventory levels and create a "control tower" to monitor activities like picking and packing, identifying failures.
- **Logistics:** Exploring telemetry and GPS data for 3D optimization of truck loading, route planning, and combination of vehicles, drivers, and orders.

Benefits and Challenges in Implementation

Digital Twins offer measurable improvements, such as performance optimization, failure prevention through predictive maintenance, and better data-based decision-making. By integrating monitoring, prediction, and optimization, they provide a holistic view that increases efficiency and reduces costs.

However, implementation presents challenges, especially from the perspective of Operational Technology (OT):

IT-OT Integration: The bidirectional data flow requires a robust infrastructure and interoperability between systems of different ages.

High-Granularity Instrumentation: Collecting high-resolution data (e.g., micro-vibrations) increases accuracy but also investment and maintenance costs.

Data Quality and Reliability: Harsh industrial environments can compromise data integrity, requiring constant calibration and redundancy.

Integration with Legacy Systems: Plants with old PLCs, SCADAs, or DCSs may require retrofitting, middleware, or converters, increasing complexity.

Use Case:

Machine Calibration through AI

In many industries, such as manufacturing and processing, self-generation of energy through gas turbines is an operational necessity. However, the efficiency of these turbines is highly sensitive to environmental variations, such as temperature and humidity, as well as changes in fuel properties.

Traditionally, the fine-tuning of this equipment is a manual process, performed by specialists at seasonal intervals. This method, besides being time-consuming, is ineffective, as the ideal tuning is lost as soon as the environmental conditions change. The result is fuel consumption above what is necessary, an increase in pollutant emissions (such as nitrogen oxides and carbon monoxide), and high operational costs, directly impacting the sustainability and profitability of the operation.

To face this challenge, a major machine developer decided to use AI and create a Digital Twin of the gas turbine. It works as follows:

- **Creation of the Digital Twin:** A virtual model of the turbine is built using Machine Learning (ML) algorithms, which learns and understands all the operational nuances of the physical equipment.
- **Continuous Monitoring:** The software monitors in real time the environmental conditions, gas properties, and turbine performance.

- **Autonomous Optimization:** Every two seconds, the AI analyzes the data and calculates the optimal adjustments for fuel combustion and flame temperature. These optimizations are automatically sent to the turbine's control systems.

This approach transforms a manual and reactive process into an autonomous and predictive operation, ensuring that the turbine always operates at its "optimal point" of efficiency.

The implementation of this Digital Twin technology with AI generates tangible and high-impact results for the industry:

Metric	Result Achieved
CO Emissions Reduction	Decrease of up to 14%
NOx Emissions Reduction	Decrease between 10% and 14%
Fuel and CO_2 Reduction	Savings between 0.5% and 1%

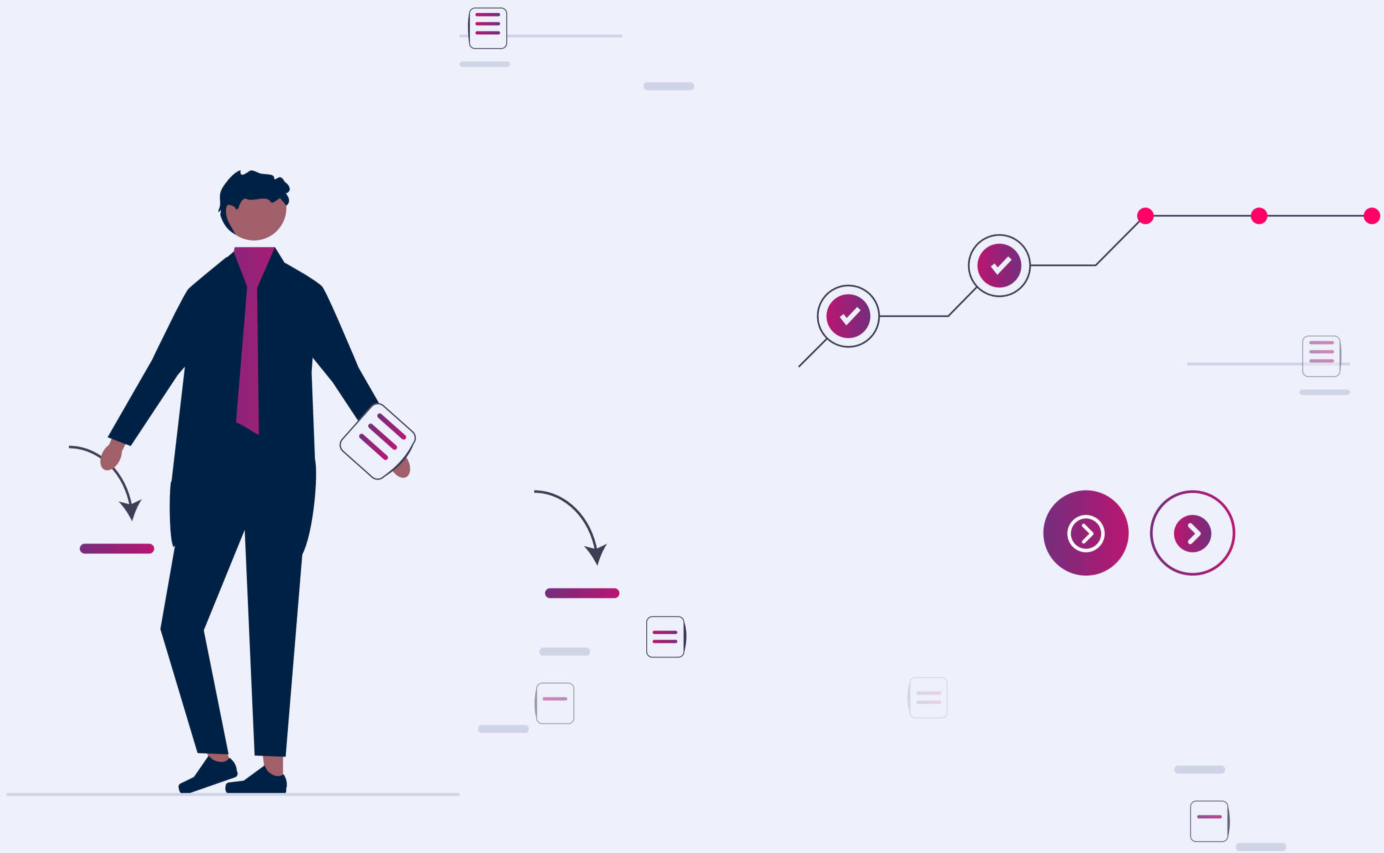
In addition to sustainability gains, the solution allows industrial plants in regions with strong environmental regulation to extend their production windows. The automation of the adjustment process also frees up the team of specialists to focus on higher value-added tasks, optimizing the use of human resources.

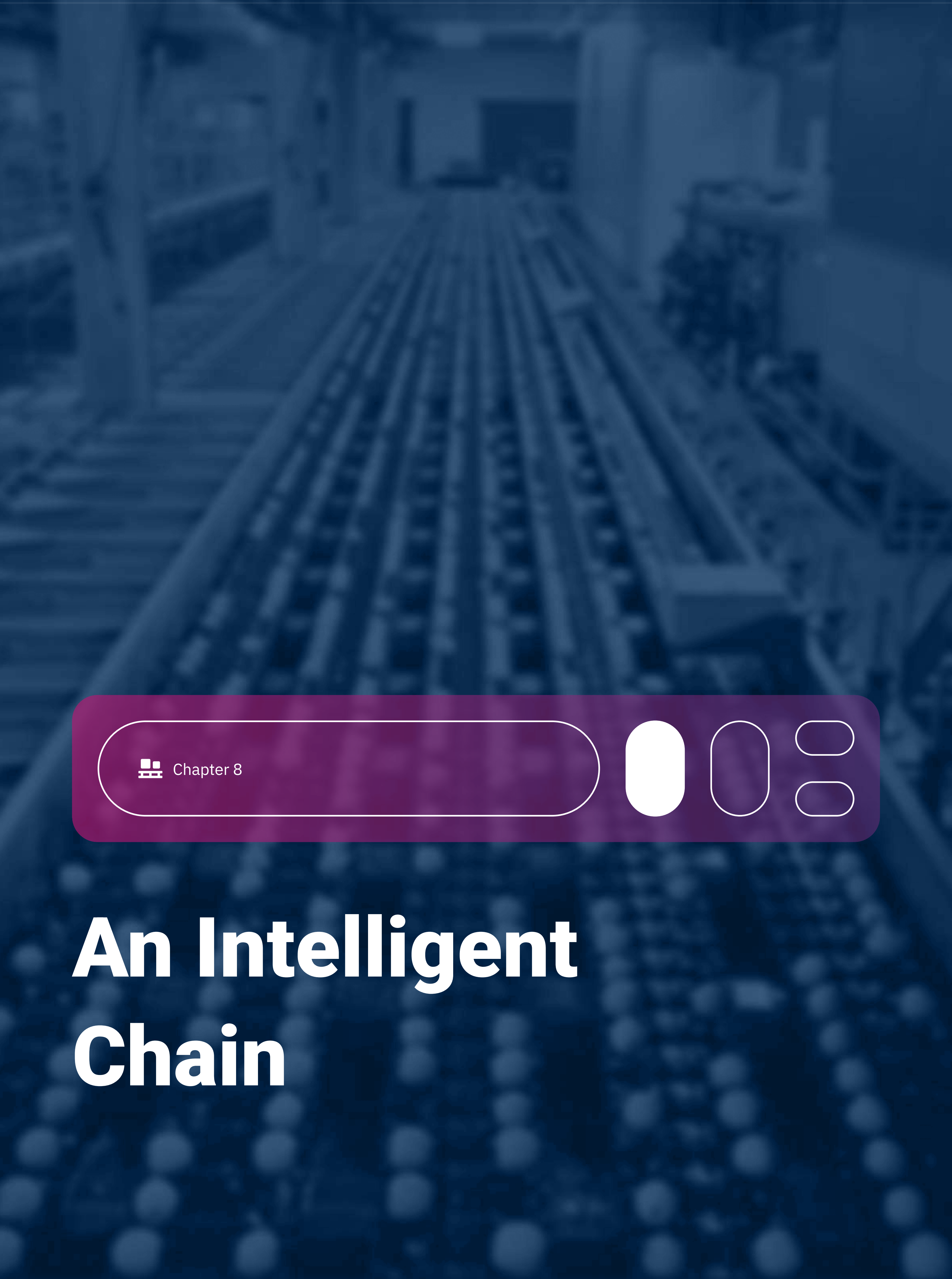
This use case demonstrates how the combination of Digital Twins and Artificial Intelligence can go beyond monitoring, creating autonomous systems that actively optimize industrial processes, generating financial and environmental value for the supply chain and manufacturing.

Fonte: CONTROL.COM. GE Digital Introduces a Digital Twin Solution to Autonomously Tune Gas Turbines. Disponível em: https://control.com/news/ge-digital-introduces-a-digital-twin-solution-to-autonomously-tune-gas-turbines/. Acesso em: 23 out. 2025.

Chapter Conclusion:
A Bridge to the Future

Advances in AI and the reduction in sensor costs make the implementation of Digital Twins more accessible than ever. Still, the mindset around the topic remains excessively linked to manufacturing, where OT investment and the IT-OT balance are more complex. The real opportunity lies in seeing Digital Twins as a bridge to Industry 4.0 and even 5.0. It is not necessary to transform the entire operation at once. Adoption opens the way for companies to evolve from a reactive model to a proactive optimization model. The results are clear: greater efficiency, more precise decisions, and, above all, cost reduction, the main objective of operations.





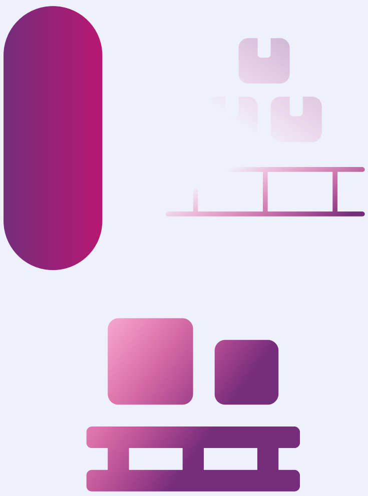
Chapter 8

An Intelligent Chain

Point of View of an Intelligent Chain

> **Imagining a supply chain completely optimized by AI is to envision a fluid, proactive, and autonomous operation, where decision-making is based on real-time data, and not on reactions to past events.**

This vision moves drastically away from traditional models, which depend on spreadsheets and manual processes, to become a digital and intelligent ecosystem. This transformation begins with a solid foundation. The basis of an intelligent supply chain is the end-to-end integration of data. This means unifying information from ERP, WMS, TMS systems, IoT sensors, vehicle telemetry, and even external data such as weather forecasts and market trends. This unified and accessible data layer is what feeds the AI engine, allowing for total and real-time visibility of the entire operation.



With the foundation established, AI begins to optimize each stage of the Processes. Planning, for example, ceases to be a monthly task to become a continuous and predictive process. AI adjusts demand forecasts in real time, optimizes inventory levels and replenishment policy, and suggests dynamic production plans. In warehousing, AI orchestrates robots for picking and packing, optimizes product allocation in the warehouse space, and predicts equipment maintenance. In logistics, routing becomes autonomous, adapting to traffic incidents and weather conditions in real time to ensure OTIF (On-Time, In-Full).

The optimization of these processes is directly reflected in improved KPIs (Key Performance Indicators). The accuracy of demand forecasting increases, transportation costs decrease, delivery speed accelerates, and customer satisfaction reaches new heights.

The work ceases to be reactive and becomes proactive, with the team focused on continuous improvement and strategic decisions.

This change in focus requires the evolution of Teams/People. AI does not replace the team, but empowers it. Professionals who previously spent time on manual and repetitive tasks, such as data entry and report generation, now use AI's intelligence to make faster and more strategic decisions. New roles, such as data scientists and AI analysts, become crucial to the operation. The company culture moves towards data-driven decision-making, with AI acting as an intelligent assistant.

The next level of evolution for this intelligent chain is the rise of AI Agents. Unlike an AI model that only generates insights, an agent is an autonomous system capable of making decisions and executing tasks independently.

An agent can, for example, analyze the need for stock replenishment, check the availability of a supplier, create the purchase order, and even schedule transportation, all without human intervention. These agents operate 24/7 and can manage multiple tasks simultaneously, freeing up the team to focus on more complex issues.

Reaching this point requires a well-planned adoption roadmap. The journey is not a simple system migration but a cultural and technological transformation.

A possible path for implementing this intelligent chain includes:

- **Digital Maturity Assessment:** Understand where the company is today in terms of data, systems, and processes.
- **Focused Pilot Projects:** Start with a pilot project in a high-impact area, such as routing optimization or demand forecasting, to prove the value and build internal confidence.
- **Expansion and Integration:** After the success of the pilot, expand the solution to other areas of the chain, integrating systems and processes.
- **Gradual Automation:** As confidence in AI grows, begin to automate decision-making in lower-risk tasks, allowing agents to take on a larger role.
- **Autonomous Chain:** Reach the point of an intelligent supply chain, where AI orchestrates much of the operations autonomously, with human intervention focused on supervision and continuous improvement.

AI-driven operations evolve hand in hand with business value.

The roadmap of AI in Operations is not linear; each phase, from planning to distribution, follows its own pace.

Level 1
Automation

Standard Reports & Analytics

Challenge: Countless Manual Reports and Ad Hoc Analyses.

Level 2
Data Centralization

Automated Dashboards & Alerts Systems

Challenge: An overwhelming volume of reports and analytical data to consume.

Level 3
AI First Steps

Forecasting & Optimization Models

Challenge: Multiple disconnected models with varying degrees of overlap.

Level 4
Intelligence Centers

Simulators and Recommendation Systems

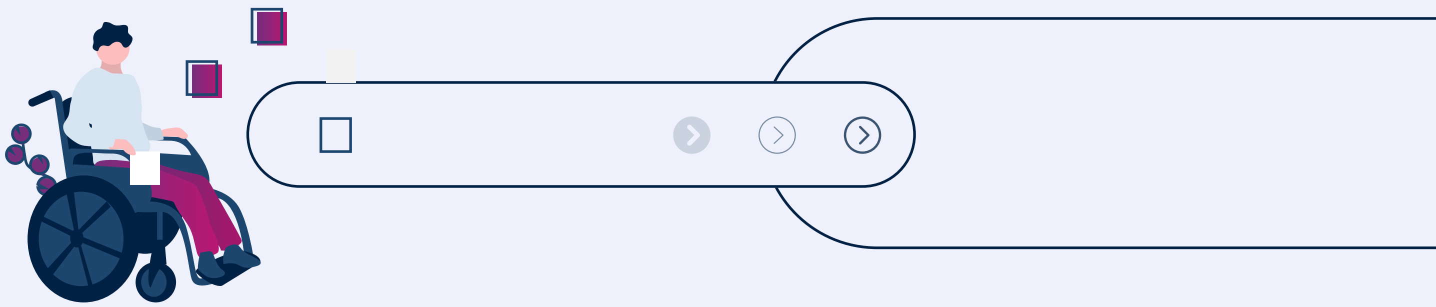
Challenge: Integrating model outputs into operations through IT-OT convergence at scale.

Level 5
Smart Operations

Digital Twins & AI Agents integrated into the operation

Challenge: Upskilling teams to effectively leverage and operate all systems and models.

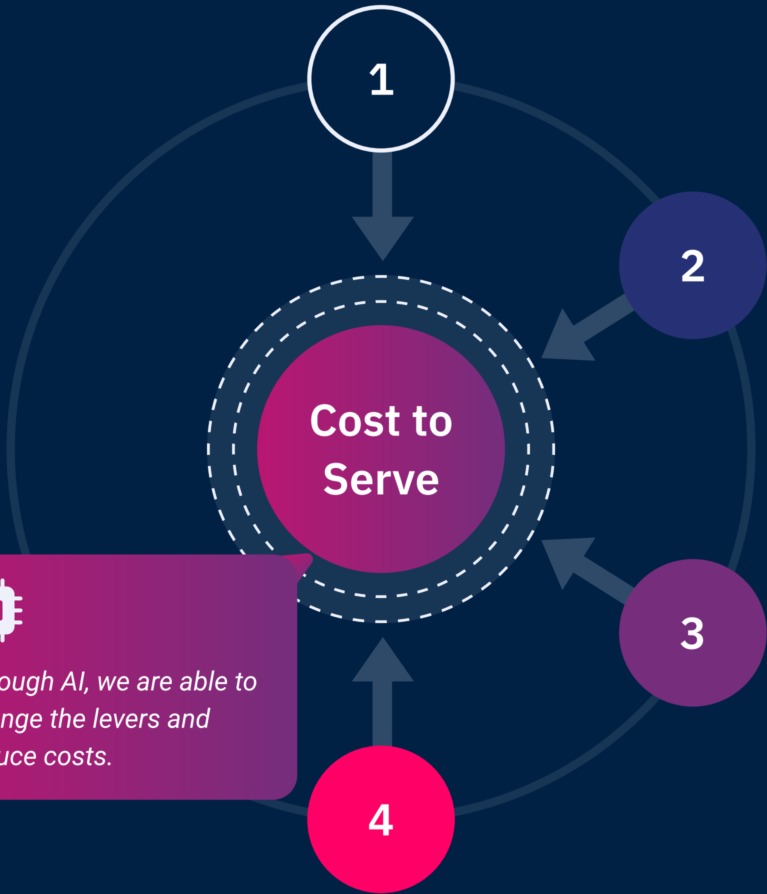
Instead of an abrupt change, adoption should be a gradual and well-planned process. Below, we present a detailed step-by-step guide to this evolution.



Despite the high cost of operations, divided across the different stages of the value chain, Artificial Intelligence transforms this scenario by unlocking exponential gains in efficiency, scale, and impact.

Diagnosis

The first step is to build the foundation on which all intelligence will be developed. Without quality data, any AI initiative is doomed to fail.



AI

Through AI, we are able to change the levers and reduce costs.

Optimization

With the foundation validated, the focus shifts to optimizing the core processes of the chain, expanding the use of AI to generate scale gains.

Enablement

Technology alone does not create value; it's the people who use it that make the difference. This step is crucial to ensure adoption and sustainability of the transformation.

Autonomy

This is the most advanced phase of the journey, where the supply chain begins to operate autonomously — with AI not only suggesting, but also executing actions.

Step 1 Diagnosis and Foundation

The first step is to build the foundation on which all intelligence will be developed. Without quality data, any AI initiative is doomed to fail.

Digital Maturity Assessment:
Conduct a complete diagnosis to understand the current scenario ("As Is"). Map all existing systems (ERP, WMS, TMS), the quality and availability of data, manual processes, and the level of digital skills of the teams.

Definition of Data Architecture:
Develop a plan to unify information. The goal is to create a single source of truth, integrating data from sensors (IoT), telemetry, internal systems, and external sources (weather, market trends).

Focused Proof of Concept (PoC):
Start with a high-impact, low-risk pilot project to validate the technology and prove the value (ROI). Good options include optimizing a specific route or forecasting demand for a single product line. Success here creates the necessary momentum for expansion.

Step 2 Process Optimization and Scale Gains

With the foundation validated, the focus shifts to optimizing the core processes of the chain, expanding the use of AI to generate scale gains.

Expansion to Adjacent Processes:

Use the lessons from the pilot to implement AI in other areas. If you started with demand forecasting, move on to inventory optimization; if the focus was on routing, expand to yard management and predictive fleet maintenance.

Automation of Repetitive Tasks:

Start automating manual tasks that consume team time, such as extracting and compiling reports, data entry, and basic KPI monitoring. This frees up professionals for higher value-added activities.

AI as a "Co-pilot":

In this phase, AI acts as an intelligent assistant. It generates insights, recommends actions, and simulates scenarios, but the final decision is still human. The goal is to increase the analytical capacity of the team and accelerate decision-making.

Step 3 *Training and Cultural Transformation (People)*

Technology alone does not generate value; it is the people who use it that make the difference. This step is crucial to ensure the adoption and sustainability of the transformation.

Training and Qualification:
Train the teams to work with the new tools. Professionals in planning, logistics, and warehousing need to understand how to interpret AI outputs to make more strategic decisions.

Development of New Competencies:
Invest in the formation of new roles, such as data analysts and scientists focused on Supply Chain, who will be responsible for refining the models and extracting ever-deeper insights.

Fostering a Data-Driven Culture:
Promote a culture where decisions are based on data and evidence, not just intuition. Celebrate the successes of AI projects and demonstrate the positive impact on the company's results.

Step 5 Towards Autonomy with AI Agents

This is the most advanced phase of the journey, where the supply chain begins to operate autonomously, with AI not only suggesting but also executing actions.

Implementation of Autonomous Agents:
Introduce AI agents to automate end-to-end decision processes in lower-risk tasks. For example, an agent can be programmed to analyze stock levels, generate a purchase order, send it to a pre-approved supplier, and schedule collection, all without human intervention.

Intelligent Orchestration:
Agents begin to interact with each other, orchestrating complex workflows. A demand agent can communicate a forecast change to a production agent, who, in turn, adjusts the planning and notifies the purchasing agent of the need for more raw materials.

Supervision and Continuous Improvement:
The role of the human team evolves to that of supervisor and strategist. Professionals monitor the performance of the agents, adjust the parameters of the algorithms, and focus on resolving exceptions and continuously improving the autonomous ecosystem.

By following this roadmap, a company can transform its supply chain in a structured way, mitigating risks and ensuring that every investment in technology translates into real and measurable value for the business.

Chapter 9

Artefact as a Partner

Why Artefact is the *ideal partner in this transformation*

The transformation of a traditional supply chain into an intelligent ecosystem is a complex challenge that requires a partner with proven experience in data, AI, and business consulting. Artefact positions itself as the ideal partner for this journey for several reasons.

Expertise in Data and AI

Artefact has a team of data scientists, Machine Learning engineers, and AI specialists. With the ability to analyze large volumes of data and identify complex patterns, Artefact not only implements AI but also builds the necessary data foundation for artificial intelligence to work. The company specializes in building predictive and prescriptive solutions, capable of predicting future scenarios and recommending concrete actions.

Strategic and Business Vision

Artefact's approach goes beyond the technical. The company understands that AI in the supply chain is not just about technology, but about business transformation. Artefact's consulting focuses on how AI can generate measurable financial value, reducing the "cost to serve" and increasing profitability. They work in partnership with clients to identify the most critical pain points and develop an AI roadmap that aligns with business objectives.

Adaptable and Scalable Solutions

Artefact understands that every company is unique. Instead of ready-made solutions, the company offers a personalized approach that adapts to the specific needs of each client. Whether it's a small or medium-sized company looking for a SaaS solution or a large corporation with complex systems, Artefact builds solutions that are adaptable and scalable, ensuring that AI grows with the business.

Success Cases and Strategic Partnerships

Artefact's experience is reflected in its global success cases and strategic partnerships. The company has a track record of success in implementing AI solutions in companies from different sectors, which demonstrates the ability to deliver tangible results. By choosing Artefact, companies not only acquire cutting-edge technology but also a strategic partner who understands the challenges of the supply chain and is committed to turning cost into value.

Our proven impact

Over years of partnership in driving business through data and AI solutions and strategies, we've made a significant impact — consistently adding value to the methodologies and growth initiatives of our clients and partners.

35%

Increased Operational Efficiency

Implementation of customized AI solutions to optimize internal processes at a major consumer goods company, resulting in a faster and more efficient operation.

20%

Reduction in operational costs through the application of advanced automation technologies

40%

Improved demand forecasting accuracy using AI-based predictive analytics

What our clients say about us!

Our projects have already delivered significant gains to our clients. Here are a few testimonials from those who've seen the results up close.

Demand and Supply Forecasting

With Artefact's forecasting solution, we increased accuracy and reduced the time required by internal teams. In just three months, we achieved significant financial gains.

Stockout Forecasting

With Artefact's stockout forecasting, we mitigated risks, increased efficiency, and safeguarded revenue across the entire supply chain — all in just five days.

Some of our clients

Some of our clients: We work with some of the most recognized brands in the sector. We partner with over 1,000 clients worldwide, including more than 300 major international brands.

ARTEFACT
AI IS ABOUT PEOPLE

WE OFFER **END-TO-END** DATA & AI SERVICES

Strategy & Transformation

- Data & AI Strategy
- Data Maturity Assessment
- Hackathons
- GenAI Academy
- Data & AI organization
- Corporate Training
- Data & AI Days
- Artefact AI Summits

AI Acceleration

- AI & Gen AI Factory
- Data & AI for Operations
- AI for Customer Care
- Data & AI for Private Equity

Data Foundations & BI

- Data Governance & Management
- Data – New BI – Self Business Intelligence
- Data for Sustainability

IT & Data Plataforms

- Data-Centric IT
- Cloud Services
- Tech-Agnostic Solutions
- Smarter Decision-Making
- Optimized IT Operations

Marketing Data & Digital

- Consumer Data Environment
- Measurements (MROI) & Insights
- Data-driven Sales
- Data Valorization & Category Management
- Marketing Analytics
- GMP Certified Reseller

Expertise by Industry:

FMCG | RETAIL & E-COMMERCE | LUXURY & COSMETICS | HEALTHCARE | BANKING & INSURANCE | TELECOMMUNICATIONS | SPORTS & ENTERTAINMENT | TRAVEL & TOURISM | PUBLIC SECTOR & GOVERNMENT | REAL ESTATE | MANUFACTURING & UTILITIES

Links & *References*

[1] **Book| Publication**

CHRISTOPHER, Martin. Logistics and Supply Chain Management. 5. ed. Harlow: Pearson, 2016.

[2] **Business Article**

SLIMSTOCK. O que é o sucesso da supply chain e como alcançá-lo? Slimstock Blog, 2024.

[3] **Book| Publication**

IVANOV, Dmitry; DOLGUI, Alexandre. A digital supply chain twin for managing the disruption risks and resilience in the era of Industry 4.0. Production Planning & Control, v. 32, n. 9, p. 775–788, 2021.

[4] **Book| Publication**

MENTZER, John T. Fundamentals of Supply Chain Management: Twelve Drivers of Competitive Advantage. Thousand Oaks: SAGE, 2004.

[5] **Business Article**

REMIRA. S&OP and IBP in comparison: what are the differences and similarities? Remira, 2023.

[6] **Business Article**

DATUP. S&OP vs S&OE: diferenças e como usá-las. Datup.ai, 2023.

[7] **Report**

EY. How supply chains benefit from using generative AI. EY Insights, 2024.

[8] **Report**

4INTELLIGENCE.AI. MACHADO, A. L. D. Planejamento e S&OP: o impacto do uso da Inteligência Artificial nas indústrias. 4Intelligence, 2023.

[9] **Book| Publication**

SLIMSTOCK. Software de Execução de Vendas e Operações (S&OE). Slimstock, 2023.

[10] **Book| Publication**

SIMCHI-LEVI, David; KAMINSKY, Philip; SIMCHI-LEVI, Edith. Designing and Managing the Supply Chain. 4. ed. New York: McGraw-Hill, 2023.

[11] **Technical-Institutional Source**

GOOGLE CLOUD. O que são agentes de IA? Definição, exemplos e tipos. Disponível em: https://cloud.google.com/discover/what-are-ai-agents?hl=pt-BR. Acesso em: 1 set. 2025.

[12] **Technical-Institutional Source**

AWS. The rise of autonomous agents: What enterprise leaders need to know about the next wave of AI. AWS Insights. Disponível em: https://aws.amazon.com/blogs/aws-insights/the-rise-of-autonomous-agents-what-enterprise-leaders-need-to-know-about-the-next-wave-of-ai/. Acesso em: 1 set. 2025.

[13] **Technical-Institutional Source**

YOUTUBE. Revolutionizing Supply Chains with AI The Future is Now. Disponível em: https://www.youtube.com/watch?v=U-6CXTeoYx4. Acesso em: 1 set. 2025.

[14] **Technical-Institutional Source**

CLOUDFLARE. O que é um agente de IA? | IA agêntica. Disponível em: https://www.cloudflare.com/pt-br/learning/ai/what-is-agentic-ai/. Acesso em: 1 set. 2025.

[15] **Technical-Institutional Source**

CNN BRASIL. O que são agentes de IA, que inauguram nova fase da inteligência artificial. Disponível em: https://www.cnnbrasil.com.br/tecnologia/o-que-sao-agentes-de-ia-que-inauguram-nova-fase-da-inteligencia-artificial/. Acesso em: 1 set. 2025.

[16] **Technical-Institutional Source**

GOOGLE CLOUD. Vertex AI Agent Builder. Disponível em: https://cloud.google.com/products/agent-builder. Acesso em: 1 set. 2025.

[17] **Technical-Institutional Source**

AWS. AI Agents - Amazon Bedrock. Disponível em: https://aws.amazon.com/bedrock/agents/. Acesso em: 1 set. 2025.

[18] **Technical-Institutional Source**

GOOGLE CLOUD. Anomaly detection overview | BigQuery. Disponível em: https://cloud.google.com/bigquery/docs/anomaly-detection-overview. Acesso em: 1 set. 2025.

[19] **Technical-Institutional Source**

CNN BRASIL. Criatividade não pode ser trocada por IA, diz líder de assistente virtual. Disponível em: https://www.cnnbrasil.com.br/noticias/criatividade-nao-pode-ser-trocada-por-ia-diz-lider-de-assistente-virtual/. Acesso em: 1 set. 2025.

[20] **Technical-Institutional Source**

ARTEFACT. Solução ROBERTET NaturIA: Quando artificial intelligence se torna... Disponível em: https://www.artefact.com/br/cases/naturia-when-artificial-intelligence-becomes-the-partner-of-robertets-creators/. Acesso em: 1 set. 2025.

[21] **Technical-Institutional Source**

PWC BRASIL. Desafios da implementação da inteligência artificial na... Disponível em: https://www.pwc.com.br/pt/publicacoes/setores-atividade/assets/produ%C3%A7%C3%A3o-industrial/2024/folder_ia-em-supply-chain.pdf. Acesso em: 1 set. 2025.

[22] **Report**

INSPER. Roadmap para a adoção de inteligência artificial nas organizações. Disponível em: https://www.insper.edu.br/pt/conteudos/gestao-e-negocios/roadmap-para-a-adocao-de-inteligencia-artificial-nas-organizacoes. Acesso em: 1 set. 2025.

[23] **Scientific Article**

SIMCHI-LEVI, David; MELLOU, K.; et al. Large Language Models for Supply Chain Decisions. arXiv preprint, 2025.

[24] **Business Article**

ORACLE BRASIL. O que é planejamento de vendas e operações (S&OP)? Oracle Brasil.

[25] **Business Article**

PLANNERA. S&OP vs S&OE: quais são as diferenças entre os dois? Plannera, 2023.

[26] **Business Article**

DSC. Como a IA pode auxiliar no planejamento de S&OP? DSC Blog.

[27] **Book| Publication**

STRATEGYCHAIN. O que é S&OP e Integrated Business Planning? StrategyChain.

[28] **Business Article**

IMAM. S&OP – IBP – S&OE – Planejamento Tático Colaborativo. IMAM Blog.

[29] **Business Article**

INTITO. Key differences between S&OP and IBP. Intito.

[30] **Business Article**

CICLOACADEMY. S&OP/IBP e S&OE/ITP: por que empresas falham na execução. Ciclo Academy.

[31] **Business Article**

DOCUSIGN. S&OP (Sales and Operations Planning): o que é e benefícios. DocuSign.

[32] **Book| Publication**

CHOPRA, Sunil; MEINDL, Peter. Supply Chain Management: Strategy, Planning, and Operation. 7. ed. Harlow: Pearson, 2019.

[33] **Book| Publication**

SILVER, Edward A.; PYKE, David F.; PETERSON, Rein. Inventory Management and Production Planning and Scheduling. 3. ed. Hoboken: John Wiley & Sons, 1998.

[34] **Book| Publication**

BALLOU, Ronald H. Business Logistics/Supply Chain Management. 5. ed. Upper Saddle River: Pearson Prentice Hall, 2003.

[35] **Report**

MCKINSEY & COMPANY. The future of supply chain: AI-driven optimization and digital twins. New York, 2022.

Glossary

AI (Artificial Intelligence)

A field of computer science dedicated to the development of systems that can perform tasks that would normally require human intelligence, such as learning, reasoning, and problem-solving.

API (Application Programming Interface)

A set of definitions and protocols that allows different software to communicate and exchange data.

APS (Advanced Planning and Scheduling)

An advanced production planning and scheduling system used to optimize capacity, deadlines, and costs in the supply chain.

Big Data

Datasets so large and complex that traditional data processing methods are inadequate to analyze and manage them.

Bullwhip Effect

A phenomenon in the supply chain where small variations in end-consumer demand result in progressively larger demand fluctuations as one moves up the chain (retailer, wholesaler, manufacturer, supplier).

CPS (Cyber-Physical Systems)y

Systems that integrate computation and communication with physical processes, where software and hardware are deeply intertwined.

Cybersecurity

The practice of protecting systems, networks, and programs from digital attacks.

Digital Twins

Virtual replicas of physical objects, processes, or systems that are updated in real-time with sensor data, allowing for simulations and predictive analysis.

Edge AI

Processing of AI data on devices or servers close to the data source (at the "edge" of the network), instead of in a centralized data center.

ERP (Enterprise Resource Planning)

A management system that centralizes and integrates business processes, such as finance, human resources, production, and sales.

Explanatory Variables

External or complementary variables—such as weather, promotions, holidays, and economic indicators—used to enrich predictive demand models.

Forecast (Demand Forecasting)

The process of estimating future demand based on historical data, statistics, and AI models.

Generative AI

A subfield of AI capable of generating new content (text, images, audio, video) based on training data.

Industry 4.0 (Fourth Industrial Revolution)

A concept that encompasses the automation and digitalization of manufacturing and the supply chain, using technologies like IoT, AI, Big Data, and robotics.

IoT (Internet of Things)

A network of physical objects embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet.

KPI (Key Performance Indicator)

A quantifiable metric used to evaluate the success of an organization, project, or activity in relation to its objectives.

Last-Mile Delivery

The final step of the delivery process, from the distribution center to the end customer, usually the most expensive and complex.

LLM (Large Language Models)

Large-scale language models trained on large volumes of textual data, capable of understanding, generating, and explaining decisions in natural language.

Machine Learning (ML)

A subset of AI that allows systems to learn from data, identify patterns, and make decisions with minimal human intervention.

MAPE (Mean Absolute Percentage Error)

A metric used to evaluate the accuracy of forecasts, representing the average percentage error between predicted and actual values.

Middleware

Software that acts as a bridge between different applications, operating systems, and databases, allowing them to communicate and exchange data.

MTO (Make to Order)

A strategy that manufactures products only after receiving a specific customer order, focusing on customization and flexibility, but with longer delivery times.

MTS (Make to Stock)

A production strategy where products are manufactured and stocked based on demand forecasts, aiming to have ample stock available for quick order fulfillment.

NLP (Natural Language Processing)

A branch of AI that enables computers to understand, interpret, and generate human language.

OTIF (On-Time, In-Full)

A performance indicator (KPI) in supply chain management that measures the percentage of orders delivered within the agreed-upon timeframe (On-Time) and in the exact quantity and with the expected quality (In-Full), evaluating logistical efficiency and customer satisfaction.

PLC (Programmable Logic Controller)

An industrial electronic device that executes programs to control and monitor machines and manufacturing processes.

Robotic Process Automation (RPA)

Technology that allows configuring software or a "robot" to emulate and integrate the actions of human interaction in digital systems to execute a business process.

ROI (Return on Investment)

A financial metric that evaluates the efficiency of an investment by comparing the gain obtained with the cost of the investment.

S&OE (Sales & Operations Execution)

A short-term operational process, focused on execution and dynamic adjustment of plans in the face of unforeseen events, usually in horizons of days to weeks.

S&OP (Sales & Operations Planning)

An integrated planning process that aligns the sales, marketing, production, and finance areas to create a unified business plan.

Slotting

The process of optimizing the placement of products within a warehouse to maximize storage and picking efficiency.

Supply Chain

The network of all people, organizations, resources, activities, and technologies involved in the creation and sale of a product, from the delivery of raw materials from the supplier to the end customer.

Telemetry

Technology that allows the measurement and transmission of data from remote points to receiving equipment for monitoring and analysis.

TMS (Transportation Management System)

A transportation management system, responsible for planning, executing, and monitoring logistics transport operations.

VUCA (Volatility, Uncertainty, Complexity, Ambiguity)

An acronym that describes or reflects the volatility, uncertainty, complexity, and ambiguity of general conditions and situations.

Warehouse 4.0 (Smart Warehousing)

A warehouse that uses Industry 4.0 technologies, such as IoT, AI, and robotics, to optimize operations, increase efficiency, and automation.

WMS (Warehouse Management System)

A warehouse management system, software focused on managing and optimizing the processes and operations of warehouses.

Write-off

A financial loss related to unused or expired inventory, accounted for as a loss.