

TRIPLE A.I. SUPPLY CHAINS

by Fabrice Thomas and Hervé Legenvre



Hau L. Lee, a Stanford professor described high performing supply chains back in 2004 as Agile, Adaptative and Aligned. Agile refers to the ability of supply chains to face daily uncertainties and variations, adaptability refers to the ability to adjust to more significant changes over time; and aligned refers to the quality of the relationships with partners along the chain that contribute to delivering sustainable performance. While the triple A framework is as relevant as ever for supply chain leaders, in this article we put forward the concept of Triple A.I. supply chains

as Agile, Adaptative and Aligned needs to be complemented by Informed, Interconnected and Intelligent supply chains. In a nutshell, this means that information gathered along and beyond the supply chain are combined into short, mid, and long-term insights and scenarios that facilitate human decisions (see figure 1).

Decision-making within the supply chain needs to address different time horizons. First, within a short-term time lens, a supply chain needs to be agile and informed, allowing all teams to orchestrate the supply chain in real time. Acting as an effective control tower impacts

on quality, cost and delivery performance while ensuring a positive P&L impact. Second, within a mid-term time lens, a supply chain needs to be aligned and interconnected allowing all teams to strengthen supplier and customer relationships and to optimise end-to-end flows. In terms of performance this contributes to achieving customer centricity and delivering on the corporate strategy goals. Finally, taking a long-term time lens, supply chains need to be adaptable and intelligent. They mobilise a broad ecosystem of partners that can collectively address any challenge or seize any opportunities based on facts. Being future-ready creates strategic resilience and generates inclusive performance well beyond operational and financial results. This contributes to delivering on the broader goals that matter to all external stakeholders, such as social and environmental impacts.

We start by describing what Informed, Interconnected and Intelligent supply chains are. Then, we will look at four key stages of implementation for triple A.I supply chains.

The last stage describes how Chief Supply Chain Officers can assemble all the pieces of this strategic jigsaw puzzle together.

INFORMED SUPPLY CHAINS

Supply chain teams face complex and dynamic environments that require aggregating reliable information. Some of them are internal sources of information accessible in existing systems, others are external sources of information such as alerts on weather issues, strikes or geopolitical issues. To support decision-making, multiple sources of information are combined. Providing access to all existing information available creates transparency but it can result in information overload and paralysis.

Therefore, to perform effectively, operational activity information needs real-time updates and a powerful visualisation. Multiple information sources need to be combined to reveal

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Figure 1: Triple AI Supply Chain



what is at stake and how this stake can be addressed. Then, operational teams need to easily look at one event from a different perspective and to drill down through different layers of information. If a component is blocked within a harbour, this means accessing information about alternative transportation routes from the supplier location; or visualising the level of inventory for this component in different locations; or accessing information about alternative suppliers of this component.

INTERCONNECTED SUPPLY CHAINS

Supply chains consist of a myriad of assets through which goods, information and money circulate. Gaining real-time visibility on a supply chain can quickly escalate in virtualising a complex network of physical activities. Anyone trying to consider its scope three carbon emissions knows how difficult it is to build such a picture even over a few of steps within a supply chain. While we can start connecting information across a certain scope, over time this can be expanded to broaden the visibility and strengthen the ability to anticipate and accelerate when needed.

The internet of things enables interconnections. Indeed, as data are increasingly produced by objects and can be visualised on many devices, the tracking and monitoring of many activities is facilitated.

How does this work in practice?

It is 6.00 am in a San Francisco warehouse

“The warehouse manager is looking at a large screen in a Star Trek-like control room. A few touches and the couple of cases that require attention are scrutinised. Decisions are made rapidly with the right data. Interconnecting systems has allowed to bring together customer requirements, real-time location of goods, storage conditions and arrival movements from sales teams and warehouses. Recently, key suppliers have started to share real-time data as well. Contingency planning is in good hands now.”

While we all dream of having such a control room, it is a challenge to bring everything together. In some areas, information might abound while other areas are still dark spots. While IoT allows to access more data, some information-processing activities are still poorly digitalised. Customs-related information is still in most circumstances produced and shared by humans.

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This expansion is also facing obstacles because of interoperability problems. Today we still lack data-processing standards for some basic information such as process-to-pay including invoices. Most managers know how challenging it is to interconnect internal and external sources

of data. Such interconnection challenges grow as we expand visibility from deep-tier suppliers to clients, as we consider multiple linkages such as transport, customs, regulatory bodies and as we look at different dimensions such as money, real-time localisation, traceability, certificates, carbon impacts and other.

Also building the right digital infrastructure is essential. Companies cannot implement an ERP, a couple of complements and claim victory. They must move forward and think carefully about their digital infrastructure. We should stop patching legacy systems and we need to move towards the cloud. Supply chain executives must think as architects who envision the future use case they need to implement.

While there are challenges to be addressed, accessing information from a myriad of assets, and combining them intelligently from real-time thinking to strategy war rooms can be a source of competitive advantage.



INTELLIGENT SUPPLY CHAIN

Moving towards intelligent supply chains requires considering each piece of information as a gem. Some gems are shiny but of little value. Many humans share a passion for the weather forecast but rarely consider it in their actions... other pieces of data are uncut diamonds which need to be sharpened and assembled with many other gems to shade light on important issues. Finally, some information can be useless for some time... till it become critical. For instance, many of us have reinvented ourselves as junior epidemiologists during the COVID period.

So while it is challenging, helping information shine and assembling the right sources of information together helps to take human bias out of decision-making processes. It can help optimise the rational side of supply chains. It can help supply chain teams focus on strategic decisions without losing time on reporting and report interpretation. It can transform fire-fighting into anticipation and facilitate real-time acceleration of decisions.

Intelligent information management for supply chain provides a real-time view and a



In 2016, Flex, the manufacturing solution provider unveiled Flex Pulse. This is the company supply chain analytics solution. It supported \$26 billion in revenue, 1.2 million active parts, 20,000 suppliers, 1,000+ customers with their distinct supply chains and 120 manufacturing sites.

Today, Flex Pulse is a cloud based visibility platform dedicated to coordinating supply chain across sourcing, transportation, manufacturing, and inventory. Flex has now 9 centres across the globe that orchestrate Flex supply chain on a real time basis thanks to Pulse.

unified view of how our extended supply chain behaves today, tomorrow and under any severe condition we might consider. Intelligent supply chain is not solely about leveraging artificial-intelligence technologies. Often, visualisation that reveals what matters, can already be powerful. Pareto diagrams have already offered powerful visualisations of inventory levels, statistical process controls reveal potential quality risks; value stream mapping - a lean visualisation tool - reveals waste across a few sites and can help a team think differently about the future. Now, artificial intelligence also helps. It can provide insights and foresight on the evolution of demands, on delivery performance, on prices and costs. But the most powerful visualisation should also be complemented by the flexibility to look at an event from different angles.

Now that we have described what Informed, Interconnected and Intelligent supply chains are; we can consider how Triple A.I. supply chains can be implemented in four steps.



1

STAGE 1 - Designing a client-centric and sustainable supply chain

Supply chains need to be client-centric, and they need to be properly designed before being powered with information, interconnection, and intelligence. Client-centric supply chains are designed to respond to the complete client expectations. First, this means that client expectations in terms of delivery, accuracy, volumes, order confirmation and transparency are integrated in the design of the supply chain. Second, supply chain design needs to consider complementary products or services of value to the clients. These complements include premium delivery, synchronization of delivery with installation and training activities, as well as ease-of-access to consumables, maintenance, updates, upgrades, and end-of-life services. Well-handled these complementary services and products are a source of client satisfaction and revenue. If they are ignored, even a well-functioning supply chain can generate client dissatisfaction. The covid period has revealed that major gaps exist between the simplicity expected by clients and the reality.

Designing a client-centric supply chain requires moving away from optimising technical connections across operational silos. Supply chains need to be segmented so they can bring together multiple product flows that share common customer value, product attributes, manufacturing and supply capabilities, and performance considerations. The chains of relationships from suppliers to clients need to be considered so alignment, adaptability and agility can be achieved, and distinctive value can be offered to clients.

We have already distinguished strategic planning from operational decisions. Designing supply chain aims at creating distinctive, long-term performance. It comprises some of the most strategic decisions Executives in modern corporations need to take. While being strategic these decisions need to keep some options open at planning and operational level so adaptability and agility can be achieved. Too many

constraints make a supply chain crack when unexpected events challenge it.

This can require reintegrating activities to regain control of data so new integrated data-led services can be delivered to clients. This can also be achieved through the further outsourcing of activities to high-performing suppliers. This can entail establishing a global hub or localising some activities. Blindly following trends is not always the best recipe for success. Supply chains need to be designed to respond to client expectations and to handle diverse constraints. Supply chains should also answer to social and environmental considerations as they are both imperative and scrutinised by many external stakeholders. While many good practices exist, none of them is universal only the thorough comparisons of alternative options can help find the best solution and its limits of application.

Supply chains need to be segmented so they can bring together multiple product flows that share common customer value, product attributes, manufacturing and supply capabilities, and performance considerations.

While customer-centric supply chains focus on the horizontal flow of goods, money and information, some vertical perspective needs to be integrated within their design. These vertical perspectives include empowering finance with visibility on revenue and costs so they can manage financial analysts' expectations. According to research, supply disruption can impact a firm valuation for over a year. Another vertical perspective includes providing the right information to sales so they can inform and support clients effectively. Finally, it also consists in providing added value for tax or legal departments.

Supply chain should be designed to deliver customer centricity, profitability, growth and sustainability. We have a wealth of good practices that can be used to optimise the flow



of goods, data, and money. But the thorough comparisons of alternative options can identify what is the best option.

How does this work in practice?

Somewhere in Europe

“In 2020, one medical company had started to rethink its logistic strategy. The 2020 lockdown had led the team to experiment with a couple of new transportation tactics. The data collected was highlighting the benefits of substituting some air transportation with ocean and train transportation. The figures were encouraging. Over 1300 tons of CO2 could be eliminated while the complete logistic cost base could be reduced even if some inventory levels would go up in a few locations. The team was enjoying the outcomes of a project rapidly executed. Having access to right information along a full supply chain creates power, consensus and speed.”

2

STAGE 2 - Getting the right data and the right system

Large corporations who operated supply chains for many years are sitting on a large amount of data. Data might be a gold mine if these datasets have been structured and regularly updated. However, without sound data-management practices, companies end up relying on

erroneous, missing or obsolete data and individuals lose trust in data. Today, the focus on digital transformation is forcing most companies across all industries to rethink how they collect, structure, store, aggregate, update and complement their data. But such efforts need to be future proof and allow any future business option to scale.

From a financial standpoint, data-management initiatives are hard to justify. Return on investment, based on operational improvements, is difficult to assess and tends to take a year or two. Therefore, it is necessary to associate these initiatives to new perspectives that outline the complete business potential. Considering new perspectives helps envision and establish the right data foundation that can help scale any future strategic option. This calls for ambition, leadership, and strategic thinking. Building the foundation of a valuable digital transformation requires taking into consideration customers, competition, innovation, and value creation opportunities, not just existing data quality and operational efficiency.

Focusing on the Volume, Veracity and Velocity of existing data can fuel technical excellence. Well-structured and reliable bills of materials, with consistent information on demand, lead

times, inventory levels and logistic routes, is a good foundation for operational success.

In terms of Velocity, as competition occurs between supply chains; real-time access to information brings competitive advantages. Veracity is also key. Getting closer to raw data sources brings benefits; it shunts multiple interpretation lenses. Velocity and Veracity combined allow to make the best choices out of the best data in real-time.

But the future value data can deliver and the required Variety in terms of data needed to achieve customer centricity should be considered. This starts with a thorough understanding of the end-to-end client experience and most specifically of the concerns, worries or problems they face. From this, future data requirement can be envisioned. For instance, a hospital that orders large equipment should be able to anticipate any issue in the last 100 meters of the logistic chain. And the supplier of equipment needs to consider how it can provide either the right data or the right service to process the client data so issues within these last 100 meters can be avoided.

While it will never be possible to get everything right first time in terms of data, some goals need to be set. For operational decisions, data need to enable an accurate and rapid reaction. At planning

level teams should have an improved capability to perform reliable comparisons of scenario through a good understanding of the total costs of each scenario. And strategic decisions can become more fact-based and allow better supplier selection. Many companies still poorly integrate the cost of non-quality or the cost of late delivery in their supplier selection process for instance.

Then comes the choice of the system that powers the data and empowers the people to deliver customer value. Here, ambition needs to drive decisions, not the immediate ease of implementation. Cloudification and robust implementation of IoT solutions can offer major steps forward while patching and bridging of legacy systems cannot be a viable long-term option. Like a supply chain, the technical infrastructure needs to be aligned with the business ambition, adaptable to future business options and agile enough to respond to day-to-day demands.

Future performance also requires improvements at institutional levels. Digitalisation of customs' activities is a necessity for leading economies. New standards and modern infrastructures need to be established. The EU project, Alice (Alliance for Logistics Innovation Through Collaboration in Europe), brings for instance a complete ecosystem that aims at a 10 – 30% increase of efficiency in the EU logistics sector





resulting in € 100 – 300 billion cost relief. This will require an open global logistics system based on interconnections and intelligence.

STAGE 3 - From supply chain analytics to digital twins

Supply chain analytics aims at bringing and combining all relevant information in one place in real time, while digital twins aim at performing dependable simulations using real-time data to anticipate supply chain dynamics.

The long-term goal associated with the use of analytics and digital twins is to have machines which take ownership of simple decisions while humans focus on key priorities and options at hand. A container powered by a smart contract could, within a set budget, decide what routes it can take over time to achieve an optimal cost vs speed performance. A warehouse operator will have at his/her fingertip a clear and ordered overview of what needs to be done. Priorities should be clear and informed by reliable information. A supply chain planner would know the ten most critical products he/she should work on and have a few costed options for each of them. Finally, a buyer would have all the information needed to effectively manage the alignment with key suppliers and prepare in time for future supplier-selection activities.

But the reality is less glamorous. We all need to start with the basics first.

Moving towards supply chain analytics starts with assembling a set of measures to ensure “on-time delivery” with a good accuracy. Over



Supply chain analytics also provides the opportunity to understand weak signals. By combining different sources of data, you might realise that suppliers who are changing items' delivery date more often than usual, are likely to deliver late a few weeks after.

time more options can be added, further accuracy can be achieved, and a broader scope can be considered. This can sound quite basic, but this is a necessary level of maturity. In terms of functionalities, a first step with supply chain analytics is to receive warnings and priorities, a second step is to gain access to scenarios for each priority. Going further, supply chain analytics also provides the opportunity to understand weak signals. By combining different sources of data, you might realise that suppliers who are changing

items' delivery date more often than usual, are likely to deliver late a few weeks after. This provides good signals that help anticipate future issues and manage relationships effectively with suppliers.

Also supply chain analytics needs to deal with challenges in terms of data visualisation. Complex maps and graphs might be accurate but poorly actionable. The challenge is always to be able to move from the full picture to the right details easily. For this, the user interface is key, yet challenging to get right. Some of the existing market solutions are very poor in this matter. And the user interface should be easy to share within a small team as more than one expertise can be required to interpret what happens and agree on what should be done.

Digital twins were first used in manufacturing environments back in the 90s. With the advent of the internet of things, the ability to sense and track objects has allowed to economically capture more data in real time. This enables the creating of digital twins for supply chains and for products throughout their full lifecycle. Using real-time data, simulations are available

and allow us to take informed decisions on what is likely to happen.

In a nutshell Digital Twins help replace hope and fear with more certainty and confidence in decisions taken. For instance, you can visualise the complete supply chain and can spot a supply item on its way to a sub-contractor. This supply item is located on a boat, you can access all relevant cost and quality information on the item, as well as the current capacity and performance of the sub-contractor who will soon integrate the item into a larger system. As you are informed that this item is on a critical path, you are provided options. To ensure that all clients will be served on time, one option offered to you is to assemble the system in one of your sites, another option suggests an alternative logistic route that can be used to accelerate the delivery. The digital twins can provide scenarios: if a supply is late, it can tell you what the options are and what the existing backups are.

With the right supply chain analytics and digital twin capabilities, the dream is to unify the performance calculation in a real time. In this ideal world, impacts on the Quality-Cost-Delivery triangle are understood, measured, and simulated instantly as needed. This changes the jobs of planners and buyers. Planners become supply chain leaders. they set the goals and the boundary conditions in line with customer demand. Buyers become supply chain designers who provide options in terms of capabilities, price, and contract to planners so they can put the flow in motion.



Looking at the long-term horizon, the supply chain has a strategic decision-maker capability and will be future-ready. It anticipates challenges and opportunities. This contributes to making the supply chain adaptable and intelligent.

To achieve the ultimate goals of supply chain analytics and digital twins, the road remains long. It will require new ways to sharing , using standard formats across complete supply chains. We are still far from this in many sectors.

STAGE 4 - The CSCO new Operating Model

Establishing a triple AI supply chain requires the Chief Supply Chain Officer implement a new operating model. The role of the Chief Supply Chain Officer is not to be an expert on each function, but to assemble all the pieces together over time. This operating model is best explained by distinguishing what needs to be done along different time horizons.

Looking at a short-term horizon the supply chain has a control-tower capability. It aims at orchestrating the supply chains and reacting to changes

using real-time information. This contributes to making the supply chain informed and agile. This delivers on quality, cost and delivery performance while ensuring positive P&L impact.

Looking at the mid-term horizon, the supply chain has an end-to-end flow manager capability. Teams can assess

and implement new supply chain scenarios based on complete cost / benefit projections. This strengthens supplier and customer relationships. It contributes to making the supply chain aligned and interconnected. In terms of performance, this contributes to achieving customer centricity and delivering on the corporate strategy goals.

Looking at the long-term horizon, the supply chain has a strategic decision-maker capability and will be future-ready. It anticipates challenges and opportunities. This contributes to making the supply chain adaptable and intelligent. It creates value well beyond operational and financial results. This contributes to delivering on the broader goals that matter to all external stakeholders including social and environmental impacts.

The following table can be used to assess progress, to build and mobilise the right team in order to implement a Triple A.I supply chain.

Time Horizon	Short-term, operational	Mid-term, planning	Long-term, strategic
Collective capability	Control tower	End-to-end flow manager	Future-ready decision maker
Objective	Orchestrating the supply chain and reacting to changes using real time data	Achieving customer centricity & delivering the corporate goals	Anticipating challenges and opportunities to achieve strategic resilience and delivering inclusive performance
Tripe A.I. focus	Agile and informed	Aligned and interconnected	Adaptable and intelligent
Signs of success	Are we excelling at: <ul style="list-style-type: none"> • Coordinating day-to-day activities • Keeping the supply chain transparent and under control • Achieving the best Performances trade offs • Minimising disruptions and risks 	Are we excelling at: <ul style="list-style-type: none"> • Planning future flows • Improving performance of existing flows • Securing compliance and delivering value to finance, legal and tax teams • Contributing to the R&D and industrial roadmap • Enhancing supply chain expertise 	Are we excelling at: <ul style="list-style-type: none"> • Ecosystem engagement - influencing • Strategic intelligence (geopolitical – economic - market-technology-tax-regulation) • Social and environmental impact elimination • Strategy development and execution • People management
Domains of expertise and performance	<ul style="list-style-type: none"> • Delivery to final customer • Logistics • Transportation • Warehouse management • Order management • Customs and tax • Source-to-pay 	<ul style="list-style-type: none"> • Supply chain architecture • Supply chain integration • Supply chain synchronisation • Planning • Strategic sourcing • Supplier relationships • Customer relationships • Adaptation to regulation • Project management • Quality management • Inventory strategy • Operational excellence 	<ul style="list-style-type: none"> • Optimising the product-flow architecture • New supply chain incubation • Delivering sustainability • Technology-enabling • Integrated cost management
Roles impacted by Triple AI	<ul style="list-style-type: none"> • Supply Chain Management agents and managers • Traffic, Freight & Transport Coordinators • Procurement, Production, logistics agents and managers 	<ul style="list-style-type: none"> • Market and technology intelligence analysts • Business Process analysts • Operations Research analysts • Data analysts • Manufacturing, industrial & quality engineers and managers • Distribution, materials and warehouse Managers • Strategic sourcing managers • Project planners 	<ul style="list-style-type: none"> • Customer performance analysts • Complete cost analysts • Lifecycle impact analysts • Distribution and flow analysts • Procurement and vendor relation directors • Logistics directors • Strategic planning directors • IS, Finance and HR supply chain managers
Using analytics and digital twins for	<ul style="list-style-type: none"> • Real-time data access • Information visualisation • Alerts and reactions • Data democratisation • People empowerment 	<ul style="list-style-type: none"> • Accessing expectations, constraints, and performance across the full flow • Visualising and assessing impact of alternative flows • Easing the planification and the securitisation of the supply chain 	<ul style="list-style-type: none"> • Assessing the full impact on company financial performance and valuation • Operating strategy war rooms augmenting strategic decision-making capabilities • Building long-term models and scenarios

CONCLUSION: LEADERSHIP AND VISION

We start this conclusion with a thought experiment.

This is 2024 – Singapore – the Supply Chain HQ of a manufacturing company. The bi-yearly strategic scenario building meeting has started.

“The CSCO has invited some team members, some stakeholders and some external partners and experts to a strategic-building event. The aim is to explore how the supply chain could survive a major event.

A professor describes how a conflict between the two countries could evolve and lead different countries to take sides. The head of the local harbour infrastructure describes how this could impact its operation and other major harbours

in the regions. The supply chain team pulls out of the data what suppliers and routes are likely to be disrupted... This would lead to an impossible-to-manage situation.

It was decided that the team needed to build a scenario where the company would be able to swiftly operate in two separate parts of the world. Scenarios with solutions, models and data should be ready for the next meeting planned in a week.

This experiment illustrates how triple A.I. supply chains will have the ability to anticipate and handle major shifts related to geopolitics, climatic and environmental risks, pandemics, economic changes such as taxes and trade tariffs. This positions Supply Chains as a guardian of the company performance, as a source of customer satisfaction, as a vector of growth, and as a major driver of financial performance.

Triple A.I. supply chains are Agile & Informed; Aligned & Interconnected, Adaptive & Intelligent. Within triple A.I. supply chains, information gathered along and beyond the supply chain are combined along a triple time horizon. Short, mid and long-term insights and scenarios facilitate human decisions.

Within triple A.I. supply chains, information gathered along and beyond the supply chain are combined along a triple time horizon.

Triple A.I. supply chains are more than a combination of outstanding technologies and operational processes; they deliver outstanding performance as a CSCO shares a daring vision and facilitates leadership within the team, among stakeholders and external partners. Triple A.I. supply chains create trust for clients, suppliers, finance teams and other stakeholders. This is all about motivating individuals, being attractive to clients and suppliers, and delivering a daring brand promise to clients. As we conclude this article,

we hope to pursue the discussion in the future. Many questions come to mind: How can the CSCO deliver real digital transformations focused on clients and value created? How can we ensure the best management of supply chains against different time horizons? How can we build supply chains that foster trust, innovation, environmental performance, and customer centricity at the same time? How do we create systems that simplify user experience without sacrificing on the richness of options? And how can we bring everyone forward in our teams and perform a smooth implementation of the changes? **EBR**

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