

Supply chain visibility and Control Tower



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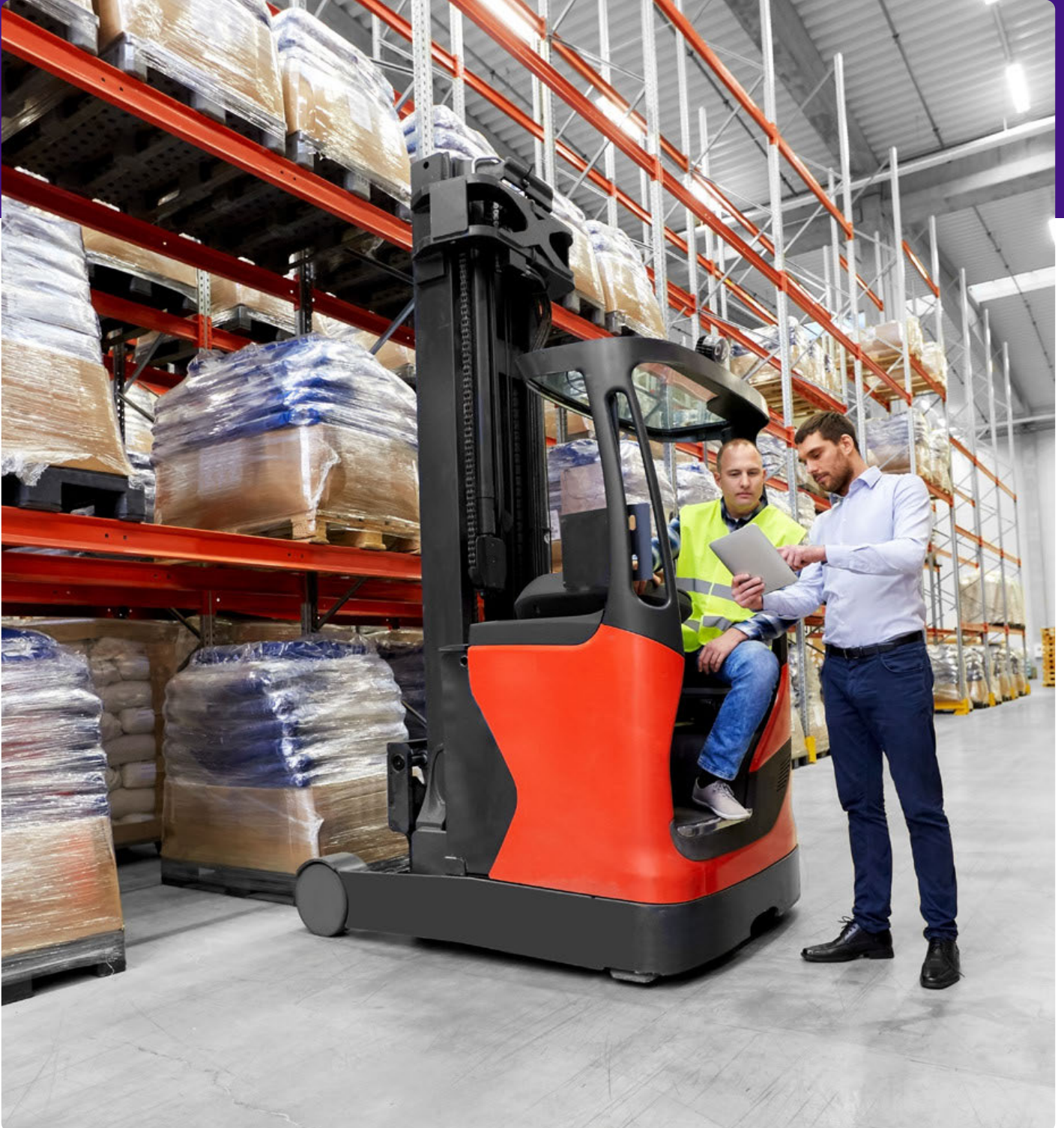


Introduction

As corporations continue to expand, globalize and mature, the importance to have a real time view of goods being manufactured, sourced, stored and moved through a complex maze of supply chain operations is ever increasing. The fragile nature of supply chains was exposed during the global pandemic and organizations have taken steps to make their supply chains more robust and resilient.

Corporations were already invested in Enterprise Planning Tools and the next wave of investment has led to adoption of a myriad of technologies ranging from blockchain, cloud, IOT, Metaverse, AI and GenAI. The introduction of these technologies has made the technology landscape more diverse and in order to reap the maximum benefit; put the importance of a "Supply Chain Control Tower" into focus.

This paper examines the challenges corporations are trying to address, the difficulties they face in adoption, the building blocks of an effective control tower and the business benefits that corporations reap through real time supply chain visibility,



Control Tower solves digital supply chain challenges

The primary challenge faced by corporations in strengthening their supply chains and implementing a Control tower is a hybrid underlying applications landscape comprising of multiple ERPs, Manufacturing Execution Systems, under-invested Plant Control systems, Point Solutions, Homegrown applications and variation of adoption of existing stack across plants, warehouses and supplier facilities.

Other challenges include in variations in processes prevalent in engineering, procurement, manufacturing and logistics functions. This leads to data being captured and stored in a siloed manner, isolated processes, redundancies and mistakes and omissions made as a result of these factors.

Supplier management without access to operations visibility further compounds the problem which corporations try to overcome with manual intervention.

All of these factors lead to decision making being made by critical functions in isolation often leading to inefficiencies that directly impact bottom line, speed to market, lower inventory turn arounds, inappropriate stocking levels and unfulfilled delivery schedules.



Visibility

To understand and leverage signals from digital ecosystems, organizations need to:

- Visualize the flow of goods (suppliers » factory » dcs » customers, distributors and retailers)
- Correlate events and exceptions impacting supply and demand
- Disrupt siloed systems that prevent all participants from viewing, understanding and acting on one version of the truth



Process

To understand and leverage signals from digital ecosystems, organizations need to:

- Predict delivery ETAs based on transportation delays (impact of weather, traffic etc.)
- Predict inventory positions accurately based on delivery ETAs
- Understand consumer sentiments and insights and correlate them with demand fluctuations



Respond

To manage exceptions and create an intelligent response framework, organizations need to:

- Prioritize current and predicted disruptions based on severity and impact
- Analyze what-if scenarios with real-time insights and trade-offs
- Collaborate with partners in real time to resolve exceptions and execute decisions across the network



Learn

To continuously learn about and respond to risks and opportunities, organizations need to:

- Leverage AI/ML to analyze data at scale and spot trends and anomalies
- Use insights to predict events, understand impact and provide recommendations
- Provide decision support that incorporates insights from past behavior

Shortcomings of disjointed supply chain



Unavailability of real-time data

Real-time data helps organizations make the right calls at the right time, which in turn improve organizational efficiencies, revenues and customer satisfaction.



Inability to process real-time signals from digital systems

Legacy systems don't accept real-time digital signals from external systems such as IoT, hampering organizations significantly.



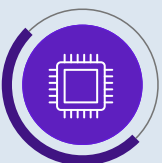
Inability to respond to real-time exceptions

Since legacy systems don't provide real-time data, they can't respond to exceptions when they occur, causing the organization to succumb to inefficiencies and loss.



Basic analytics

Legacy systems only support basic analytics, which aren't sufficient to meet today's challenges. Organizations need advanced analytics for timely resolution.



Inability to leverage AI and ML

Leveraging AI and ML technology is critical for any organization's accuracy and efficiency.

To overcome these challenges, Control Tower provides organizations with real-time monitoring, management and execution of the digital supply chain.

How Control Tower functions

Control Tower provides solutions that help organizations be more efficient and profitable.



Real time end-to-end data

The Control Tower dashboard provides users with visibility of real-time end-to-end transaction data in an organized manner. This helps organizations make the right decisions, making the ecosystem more robust and efficient. Control Tower also acts as a single source of truth in the digital supply chain ecosystem.



Graphical representation/ display of data

Control Tower graphically represents supply chain data, making it a powerful visual tool. It improves readability by giving users easy access to data and detailed information about each transaction.



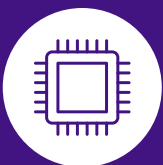
Capability to process signals from external devices

Control Tower can be easily integrated with multiple external digital devices. This feature makes Control Tower more robust, as it can accept multiple signals from devices and process them to derive meaningful information vital to any organization.



Act on real-time exceptions

Control Tower responds to real-time exceptions and communicates responses to external systems, which process and update the data.



Leverage AI/ ML and Analytic support

With AI and ML, Control Tower is more efficient and can handle exceptions with ease. It also makes systems self-learning with predictive capabilities.

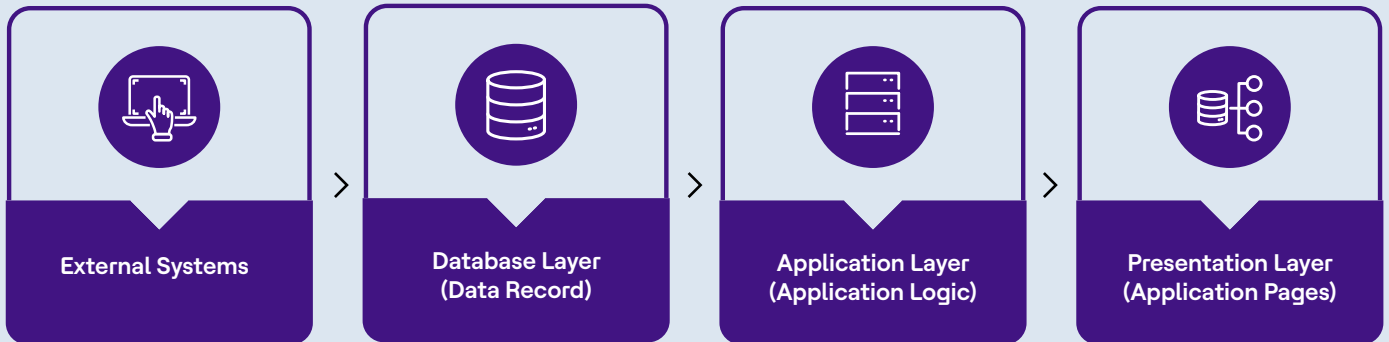


Control Tower also provides analytic/descriptive dashboards with a massive amount of data vital to senior management decision-making capabilities.

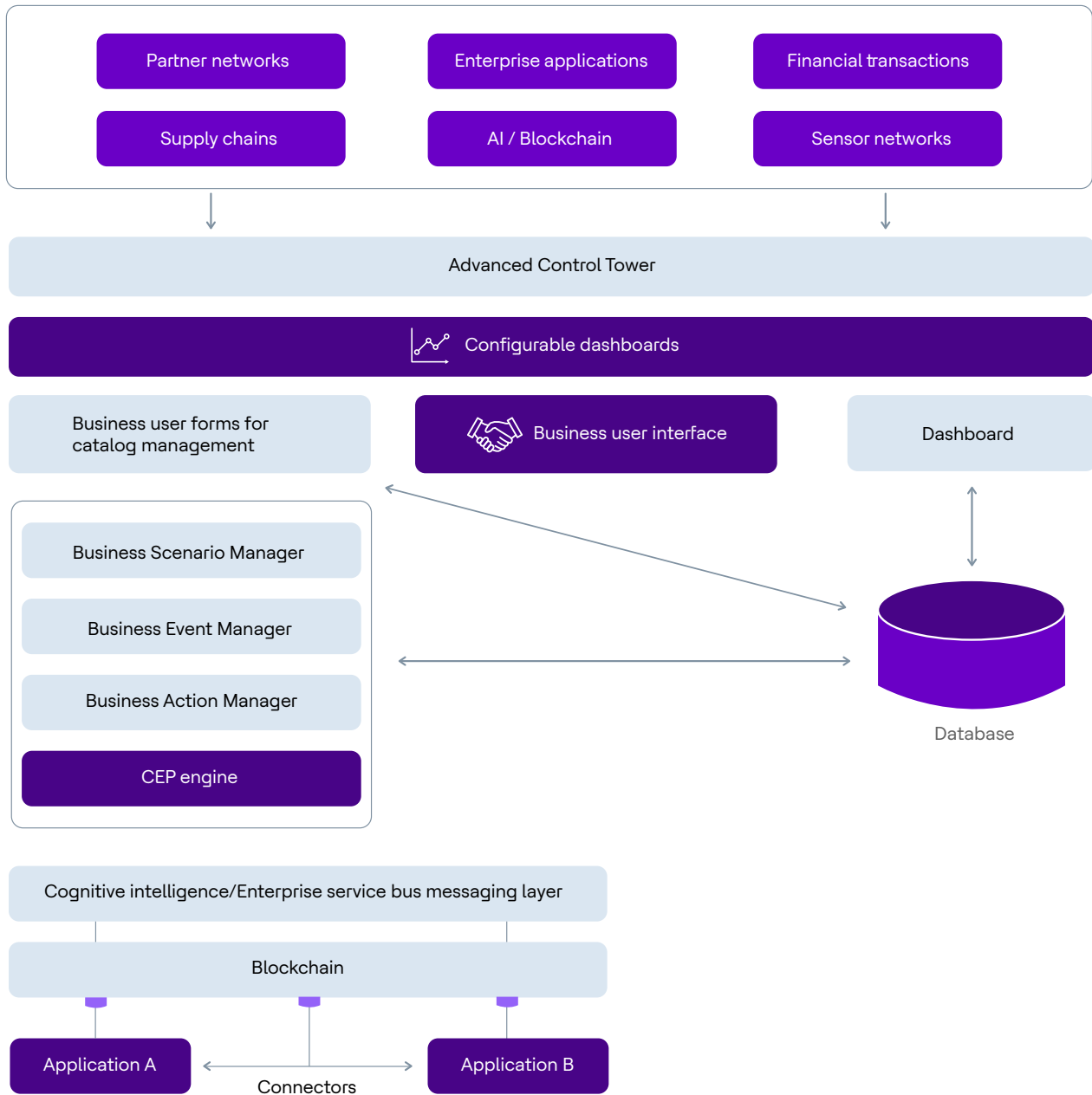
Control Tower functional architecture

Control Tower does not seek to displace existing execution systems. It attempts to integrate data sources already prevalent in the existing applications, remove redundancies and logically relate them with an objective to highlight exceptions and aid decision making for procurement, manufacturing, logistics, supply chain and operations functions.

It achieves these objectives by creating robust links to external systems (both inside and outside the corporation), existing applications and create a unified presentation layer to the end user. Furthermore, based on decisions taken by the user as well as transactions executed it populates underlying applications with clean and validated data which further improves visibility across the enterprise. The architecture diagram below lays out a logical representation of how a Control Tower functions.



Control Tower Technical Architecture



Control Tower leverages an organization's existing data by merging it with data from IoT devices, applications (which can be on premise or SaaS) and external partners.

The middleware layer can be used for authentication and authorization services. After a user is authenticated and authorized, the user can extract, validate and transform data. The data is then ingested into an event bus from which a dedicated micro-service picks up the data for further processing. The data is then made available via a distributed computation engine. The processed data is stored in the database. Control Tower also supports elastic search.

Control Tower uses exception-based handling to detect anomalies and specific cases that require analytical action. It spots issues, identifies root causes and routes alerts to stakeholders to resolve issues quickly and effectively using AI, ML and unique algorithms.

The final step is creating user-based insights. Once the data is analyzed, alerts and insights must be delivered in the right context to the right individuals. A user experience (UX) design team creates personalized visualizations, insights and views for specific functions and roles.

Areas covered by Control Tower

Procurement

- Seek alternative suppliers
- Review and enhance process efficiency, environment & quality

Monitoring Processes

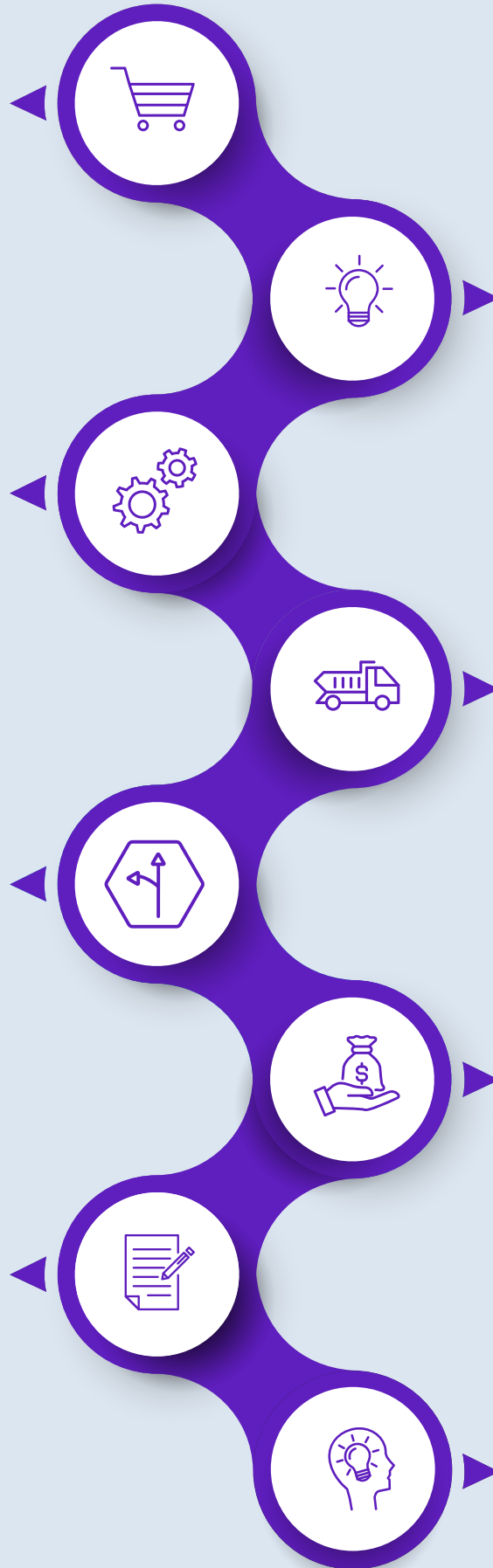
- Bookings
- Transport
- Transit times
- Delivery accuracy

Correct Deviations

- Fill capacity deficits
- Determine alternative routes
- Communicate to the parties involved

Evaluation

- Statistics
- Analysis
- Handle deviations, logging and follow – up
- Optimize the network



Planning

- Plan lead times
- Coordinate departure and arrival times
- Coordinate the effects of country-specific issues
- Plan loads

Transport

- Ensure that transport ops are optimised
- Responsibility in case of damage and loss
- Responsibility for on-time and in-full delivery

Payments

- Reconcile Invoice
- Invoice recipients

Capacity

- Ensure that capacity is available at the correct price

Corporations have systems that partly take care of these areas but often in a nonintegrated manner. Control Tower digitally threads these systems to provide a end to end real time decision support system. The use of blockchain and gen AI technologies extends the functional coverage and intuitive decision making support further as is explained below.

The future of Control Tower



Blockchain integration

A smart (self-executing) contract, blockchain's critical building block, is a set of intelligent logic based on rules that govern business transactions. The logic set is embodied in the software and distributed across a blockchain network whose nodes represent supply chain participants. When executed, the logic determines if and how a transaction is posted to the blockchain. For example, smart contract logic might check to see if an invoice from a registered agent has been reconciled via a purchase order and send payment to a supplier when a shipment is received, as signaled via a blockchain fabric.

Smart contracts require tremendous coordination, agreement and clarity on conditions and actions as to how they will be verified and enforced. The following are some components involved in creating a smart contract:



Contract composition

The contract originator creates a contract, which can be customized for different purposes. The software chain code must embody the rules of the agreement. The contract is created in a form similar to an extended finite state machine.



Deployment

The contract must be deployed on a selected blockchain fabric. Before implementation, users can test the contract for functionality flaws in a simulated environment. The Figure 1 illustrates the contract creation and deployment architecture.



Monitoring

Once the contract is deployed, the originator can monitor its status via a dashboard with standard user-defined KPIs. Agents report status to the originator – as well as other parties – based on information contained in the blockchain. Control Tower can be extended to accommodate blockchain-linked monitoring use cases.



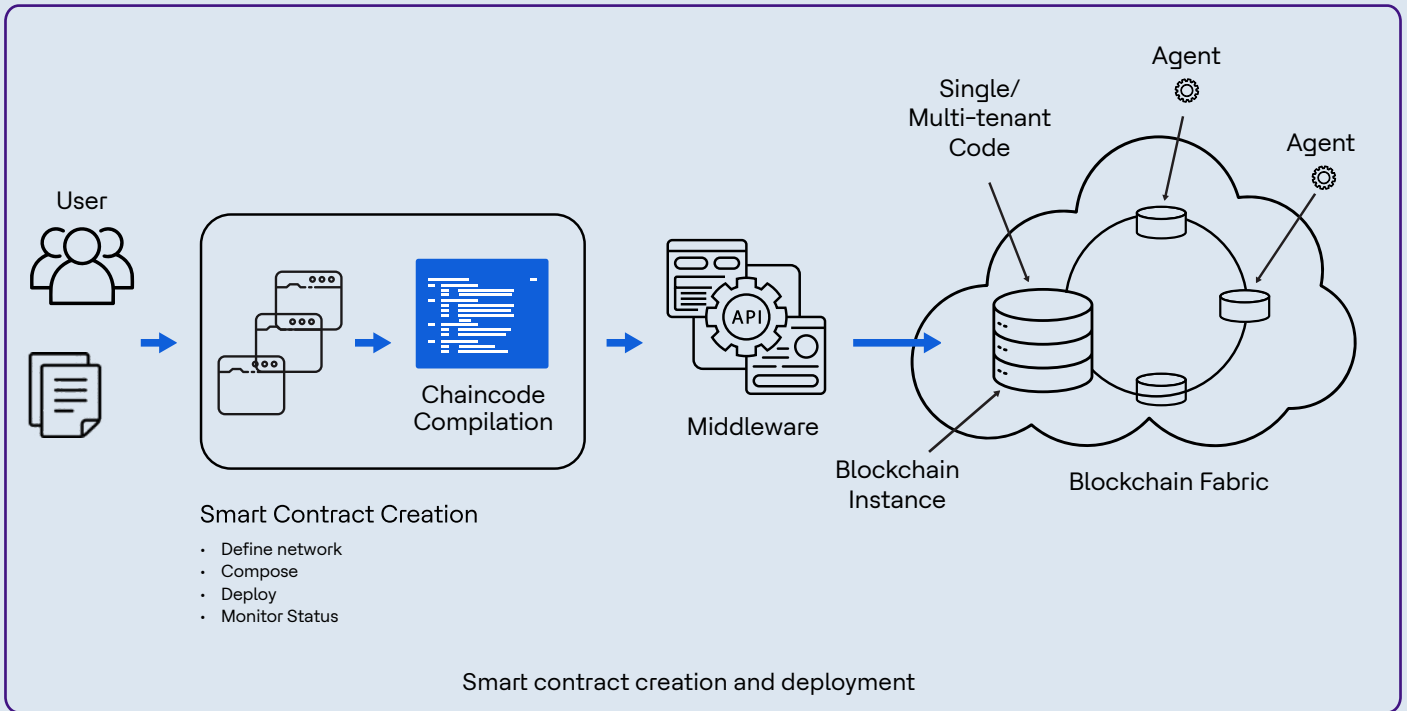
Agents

Once a contract is deployed, distributed applications, called software agents, which are dispersed across the network, must interact with the blockchain fabric of a party. Agents can be activated on their platform of choice, such as a computer, networked appliance or a cloud, based on the contract's use. Agents view the blockchain and update it based on events and conditions that they continuously monitor as defined by the smart contract.



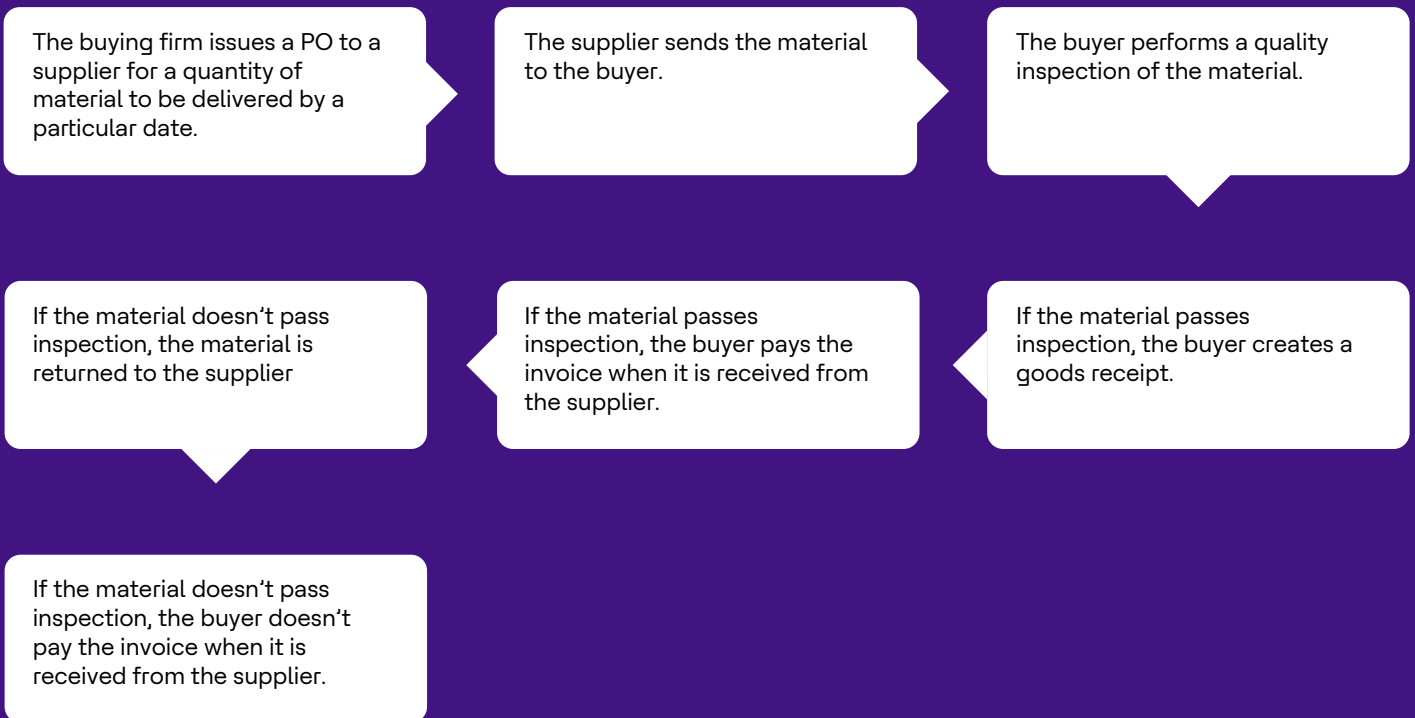
Network definition

Users must define the network of parties to be incorporated in the smart contract's execution.



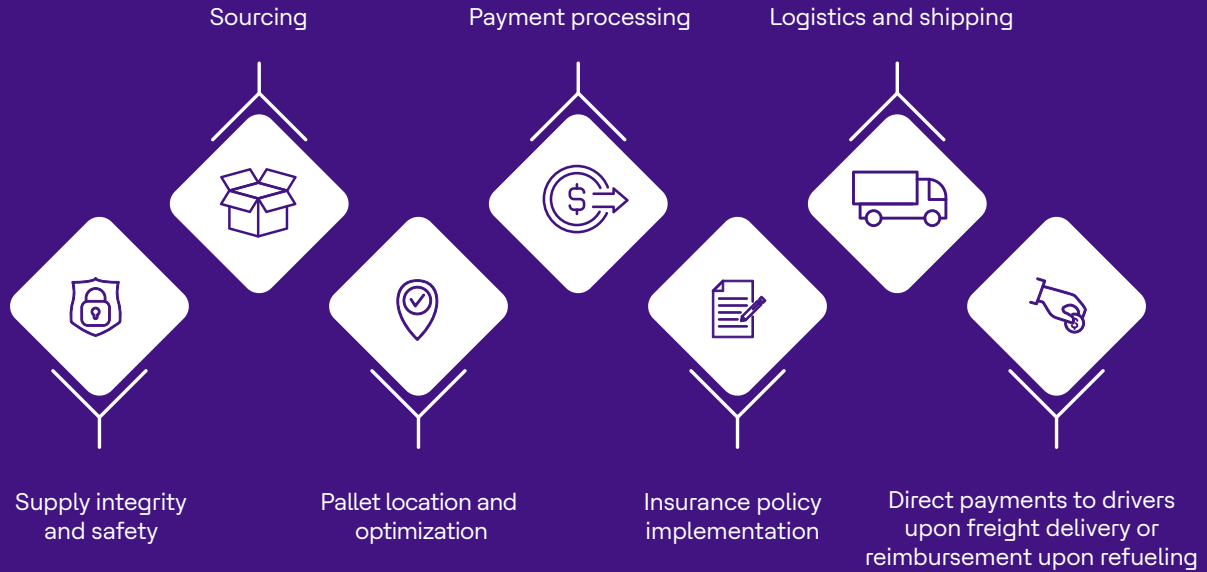
The following simple example entails the creation of a PO for raw materials from the supplier.

The transactions are modeled after those found in a typical ERP system. The process is as follows:



There could be other stipulations in the buyer-supplier agreement. For example, if the delivery is late, a monetary policy could be invoked. If the material doesn't pass inspection, the buyer may still accept it, but pay a lower price when the invoice is received due to downgrade in quality.

Existing Control Towers from leading product vendors can be extended for tracking:



Sourcing

Control Tower brings unprecedented visibility to stakeholders. The purchasing organization is in a position to evaluate supplier value and risk in real time based on detailed information about how their materials are sourced, manufactured and shipped. Since transactions between a vendor and its partners can be made visible to others in the chain, purchasing organizations can gauge a supplier's performance and obtain the knowledge to negotiate a better price.



Track and Trace

Information asymmetry and inconsistency are ever-present among supply chain participants, creating obstacles to tracking transactions and goods. Downstream participants often require product information, including its assembly process, material lists, and precautionary warnings. Quite often, the integrity of a product's transaction history requires extensive processes and controls that are difficult to achieve. Using a distributed ledger, the transfer of goods between two parties, identified as two addresses in the blockchain, can be recorded.

The transaction includes additional information such as location, date, price and quantity. The blockchain can render each transaction record irrefutable, enabling all parties who access the ledger to trace components to their place of origin. Serialization, the assignment of unique traceable numbers to individual items, facilitates tracking, tracing and verification at specific points as the items move through the supply chain



Logistics and Shipping

Offerings from leading Control Tower vendors address the visibility issue linked to tracking container shipments from origin to destination. The complex process involves nearly 30 entities, including importers, exporters, freight forwarders, clearing agents, shipping lines, haulage companies, intermodal operators, surveyors, banks, tax officials, health organizations and insurance brokers.

Blockchain can simplify shipping processes and significantly reduce shipment time by encoding insurance quotes, customs clearances and duty information directly to a shipment. A distributed digital ledger can maintain blockchained transactions. Transactions and information such as packing lists, invoices, certificates of origin, export approvals, import licenses, delivery instructions, clearances, bills of lading, marine insurance and cargo inspection certificates can be loaded into the ledger. This information can provide full visibility of a container's documents and procedural transactions to clearing agents, shipping lines, haulers, intermodal operators and surveyors.

Generative AI

Control Tower is a transaction tracking and a decision support system. GenAI technology fits seamlessly into this definition and helps the adoption of the Control Tower in real time decision making and amplifies its impact to corporations. In a nutshell the power of GenAI and AI as it applies to Control Tower is explained below.

Supply Chain Optimizer Co-Pilot to provide end-to-end visibility of material in transit & availability across the network. Simulate ETA's, shipment delays and get notified on call to action. Gen AI and natural language processing to deliver actionable intelligence to identify & analyze the impact of material delays to production and customer schedule thereby providing feasibility analysis for best action



Integrated to the presentation layer of the Control Tower GenAI features natural language and chatbot like conversational agents to interact with the end user, dynamically building the queries and sourcing the data that is needed to support end user decision making. Furthermore, decisions taken by the end user are translated into accurate and unique transactions that are posted back into the system of records.

Summary

Supply chains are getting complex by the day and are an important determinant to the bottom line of corporations.

The leaders are adopting a wide variety of technologies to integrate systems to provide end to end coverage and real time decision support.

Control Tower helps with the integration journey and helps harmonize the data from internal and external stakeholders to provide reliable and real time data based on which end users can make the right decisions.

Emerging technologies like Blockchain further extend the coverage of Control Tower and GenAI provides advanced and intuitive analytical capabilities to support end user decision making.

In essence Control Tower is a tool that provides competitive differentiation to corporations and enables a smarter enterprise.

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