

# Why Digital Twin enabled Control Towers are the game changer for Supply Chain Leaders





# Executive summary

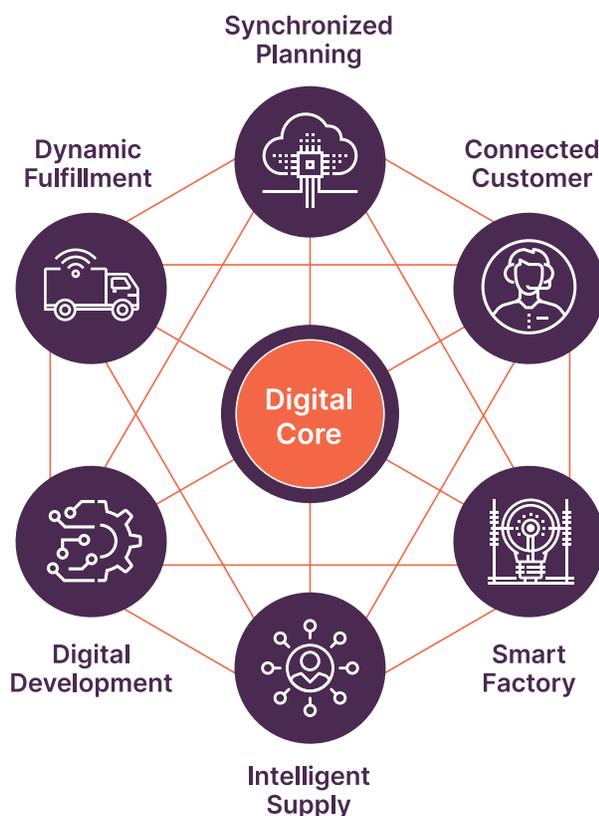
Many Organizations in the manufacturing and retail industries are currently facing unprecedented issues in supply chain, causing significant disruptions, plant shutdowns and margin losses. In this environment, organizations that can connect and orchestrate the entire ecosystem from suppliers to customers to build a digital twin of the organization (DTO) to create advanced solutions such as Control Towers will outpace and accelerate their top and bottom-line growth compared to others.

This paper provides answers to the following questions:

- Q What is a Control Tower?
- Q What are the different approaches to building a Control Tower for your organization?
- Q What business challenges do Control Towers solve in the supply chain space?
- Q How do you assess the maturity of your current supply chain Control Towers?

## Collapse of the Linear Supply Chain and the Rise of the Digital Supply Network (DSN)

Supply Chain management (SCM) is an integral part of any business as it manages the flow of products or services meant to satisfy the needs of its end customers. With the change of customer expectations, rise of digital channels, and increased competition, the traditional linear model of supply chain (develop, plan, source, make, deliver and support) is no longer sufficient. Companies will thrive in the future by adopting a digital supply chain network (DSN), an interconnected set of digitally enabled supply chain capabilities powered by a connected flow of information, as shown below.



“DSN digital core uses input from its multiple nodes to self-strengthen, thereby accelerating production, distribution and delivery to customers by providing real-time information to make informed decisions, anticipate risks and provide better end-to-end visibility.”<sup>1</sup>

Figure 1: Digital Supply Chain Network Components

The DSN model, enabled by new and disruptive technologies, creates the following outcomes that differentiate DSN from the traditional linear supply chain:

- **End-to-end Transparency** – enabling visibility across the entire supply network
- **High Levels of Agility** – driving flexible and proactive response of supply network layers
- **Connected Environment** – enhancing cross-functional collaboration across all partners and functions
- **Resource Optimization** – promoting a cohesive environment for humans and machines
- **Holistic Decision Making** – promoting optimal network efficiency, reduced cost and increased revenue

## Supply Chain Business Challenges

The job of supply chain professionals has always been challenging throughout the years. They are responsible for multiple functional silos across the organization and an increasingly complex ecosystem. While the current post-pandemic upturn and part shortages accentuate these challenges, these problems have been consistent and relevant for several years.

Supply chain professionals have several challenges as they work with people across various functions.

### They face three key challenges:

- Lack of real-time, **end-to-end visibility**
- Lack of **collaboration** tools that work within and across the organization
- Inability to **orchestrate** data, people and processes across the ecosystem

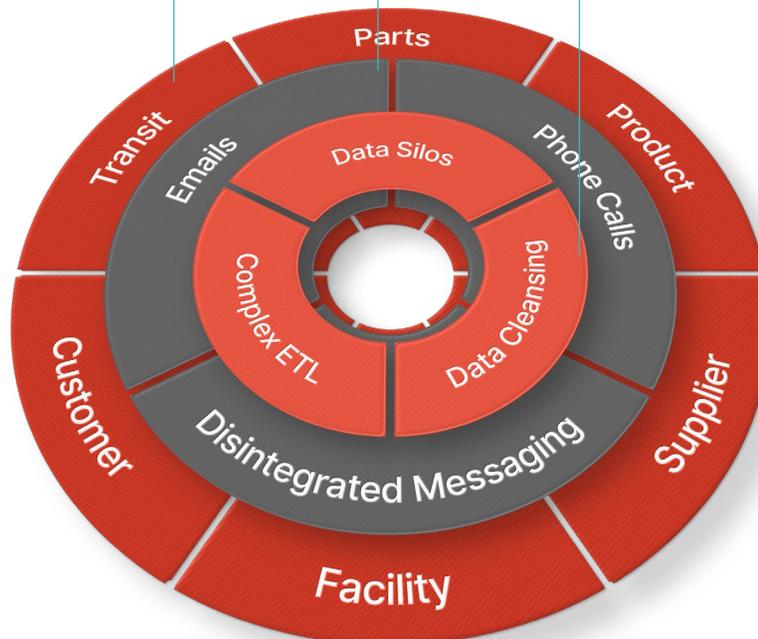


Figure 2: Supply Chain Business Challenges

## Real-time, End-to-end Visibility

One key challenge that supply chain professionals face is a lack of real-time, end-to-end visibility. This lack of visibility transcends in multiple situations. Here are a few use cases that planners, analysts and executives face daily:

- Lack of real-time location of assets in transit for multi-modal transportation segments
- No easy way to translate part shortage to production line impact
- No visualization of customer orders and parts based on the severity of implication
- Cannot review 15 days demand to understand coverage by on-hand and in-transit inventory
- Unable to look at 15 weeks demand to understand the status of uncovered demand
- Hard to understand supply chain status at a part, product, supplier, facility and customer level
- Cumbersome to identify a suitable carrier for the lanes based on capacity, costs and availability

## Lack of Collaboration Tools

Additionally, supply chain professionals lack proper collaboration tools to improve communication both within the organization and across the ecosystem. Today, many actions and decisions are made through emails and phone calls with multiple employees, suppliers and customers. These methods of communication are highly inefficient for the following reasons:

- Additional burden for suppliers, dealers and customers
- Struggle to keep up with phone call and email workload
- Unorganized actions due to ad-hoc communication tools
- Increased work due to messaging tools not integrated with the supply chain software

## Inability to Orchestrate Data, People and Process Across the Ecosystem

Finally, a critical challenge that most professionals face is orchestrating data, people and processes across the ecosystem on time. Organizations fail to deliver a good E2E solution in a short period for several reasons:

- Data resides in multiple disparate systems
- Users need to gather data that does not exist
- Current data cleaning and governance efforts are too cumbersome and time-consuming
- The skillset required to develop the Extract Transform Load (ETL) and visualization is expensive and hard to find
- Current legacy technology only allows for limited visualization, and collaboration remains manual
- Lack of mature Digital Twin technology with AI/ ML capabilities

These challenges around E2E visibility, collaboration, and orchestration make it hard for organizations to manage their supply chains effectively, and organizations are bleeding millions of dollars across the enterprise through unnecessary expedite costs.

## Need for Control Towers

Organizations have tried various ways to solve the above challenges for the past decade. Most of them start with relying on ERP systems, cumbersome spreadsheets or both to address these gaps. However, adapting ERP systems take a long time to implement and costs millions. On the other hand, spreadsheets are too manual and time-consuming. Professionals are spending more time putting them together than mitigating the risks. Control Towers are the way to solve these issues.

The term Control Towers has evolved over the years. Modern Control Towers address the above challenges more elegantly than their predecessors. This paper provides an overview of these Control Towers, discusses various approaches in the industry, and helps companies assess their current maturity levels.

## Control Tower Defined

A Control Tower or Command Center collects and analyzes multiple data sources and provides teams with visibility, root cause identification, predictions, alerts, response agility and performance management, shifting focus from reactionary management to responsive planning. Gartner defines Control Tower as:

*“the concept combining five elements – people, process, data and organization – supported by a set of technology-enabled capabilities for transparency and coordination”<sup>2</sup>*

The aim is to capture and use data — structured and unstructured, internal and external — to provide enhanced visibility for short and midterm decision-making aligned with strategic organizational objectives.

*“Next Generation Control Tower will be based on a Digital Twin of the Organization. At the later stages of a digital supply chain journey, a company will want to converge end-to-end decision making with end-to-end supply chain visibility. This will result in the coalescence of its digital supply chain twin initiative with its control tower initiatives. At this stage of maturity, there will no longer be a separation between the digital supply chain and the end-to-end control tower — just the digital supply chain twin.” Gartner*

### Essential Elements of a Control Tower<sup>3</sup>

- ✓ **Serves as an End-to-End Solution**  
Delivers real-time alerts, offers strategic insights, and enhances performance management
- ✓ **Stands Up New Enterprise Capabilities**  
Results in a new, better way of working, and often requires new processes and organizational structures
- ✓ **Breaks Traditional Functional Silos**  
Integrates disparate data sources, processes, and partners to deliver real-time connectivity, enhanced visibility, and prescriptive insights
- ✓ **Uses Advanced Analytics**  
Improves on a continuous basis via cognitive feedback loops and science-driven algorithms

### Control Towers are Not...

- ✗ **Physical Rooms with lots of screens**  
Frequently, the question is asked: “Can I come visit your Control Tower?”  
A Control Tower does not have to be a physical location
- ✗ **Transportation Management Systems (TMS)**  
Although TMS systems can form an important source of data, a Control Tower can perfectly function without a TMS in place
- ✗ **Good-Looking Analytics Dashboards**  
While dashboards (from data visualization tools) can be a substantial part of a Control Tower solution, just connecting dashboards alone does not define a Control Tower in the right capacity

# Functions of a Digital Twin Enabled Control Tower

As mentioned before, Control Towers synchronize supply and demand by combining people, process, data, organization and technology to create end-to-end visibility, collaboration and orchestration across the ecosystem. Figure 3 shows a comprehensive view of how Control Towers achieve the following objectives:

- End-to-end Visibility
- Data Integration
- Collaboration
- Orchestration

## End-to-end Visibility

By creating end-to-end visibility, organizations can connect the entire ecosystem and understand the status of every part and product from all aspects. This way, the company will have a pulse on their inbound transits, manufacturing, and outbound transits. In some cases, organizations can also monitor the health of the product in the field through various sensors and other connected devices.

## Data Integration

Creating end-to-end visibility is not an easy task. Your technology and data integration needs to be cutting edge so that the company can connect data from many different systems including but not limited to:

- Enterprise Resource Planning (ERP)
- HR systems
- Warehouse Management Systems
- Yard Management Systems
- Financial Systems
- Data Lakes
- Data Warehouses
- 3rd Party Logistics (3PL)
- Warehouses Systems
- Freight Forwarders
- Carrier Systems
- Customers
- Supplier Systems

On top of all these systems, organizations must also connect any other internet of things (IoT), 3rd party software they are leveraging as part of their overall supply chain solution suite. This process can take months, if not years, to deploy, especially if the organization has chosen the wrong technology in the first place. Sometimes, data integration needs to be bi-directional where updates across the ecosystem are automatically updated in the ERP systems. The industry recognizes this capability of bringing together disparate systems as a Data Fabric.

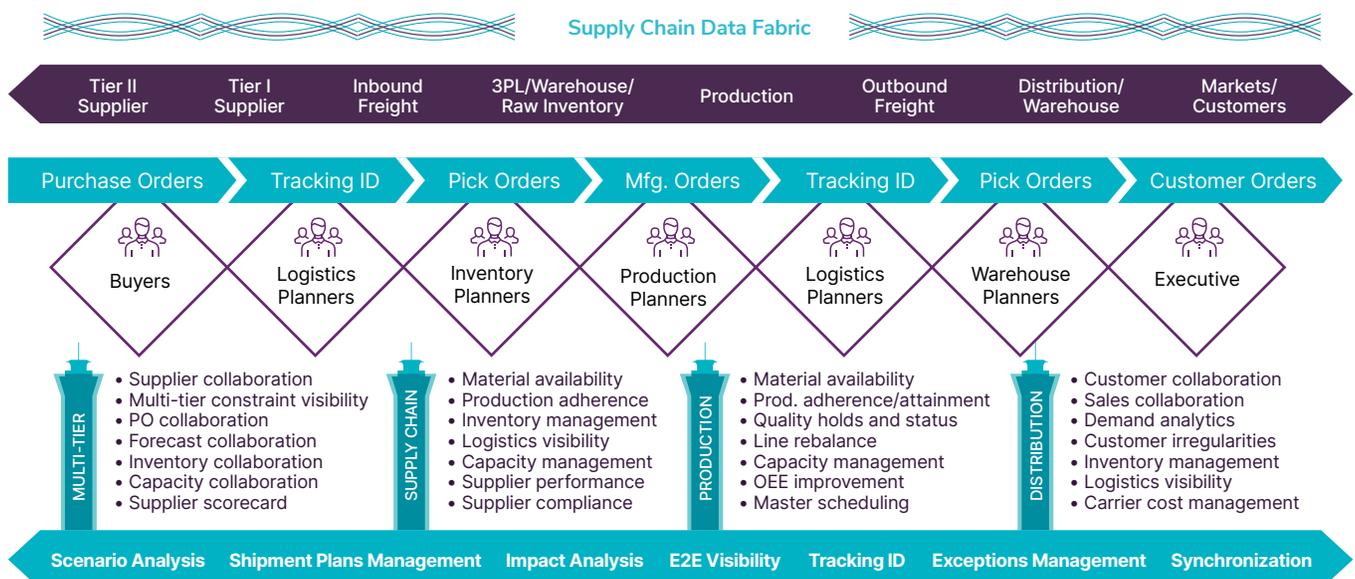


Figure 3: Control Towers Functions

## Collaboration

By improving collaboration, planners, suppliers and customers can minimize emails and phone calls by connecting via the Control Tower solution. This connection helps improve communication and trust across all parties, keep documentation structured, archive historical information, and track compliance on a real-time basis.

Well-designed Control Towers provide unique capabilities for cooperation using intuitive workflows that seamlessly integrate with analytics. Some of these collaboration tools such as project management, action plan management, issue management, messaging, notifications, reports, tasks and compliance play a vital role in ensuring that all stakeholders across the supply chain have their own metaverse and do not have to work around the system.

## Orchestration

All the above aspects are not possible without orchestrating processes, people and data. An effective Control Tower needs to create uninterrupted orchestration of these activities. Once the use cases are defined, it is essential to gain consensus on those processes from multiple departments and divisions, establish the proper workflows and procedures, and assign owners to each part of that workflow. Then, adding relevant AI/ ML algorithms will enable the right decision-making processes for the right users.

This step will save countless hours and reporting time, enhancing time allocation to mitigation and issue management. Finally, identifying the correct data needed, irrespective of the source is key to establishing a Digital Duplicate™ of the entire ecosystem that connects and efficiently integrates all data.

On top of tangible benefits, supply chain organizations can derive other benefits such as increased resiliency, improved collaboration, standardized processes, minimized risk, E2E visibility, and increased employee morale and retention.

## Technology Components

In order to create next generation of Control Towers, new technology components are needed. According to Gartner and many experts, building the next generation of Control Towers require the following technology components.

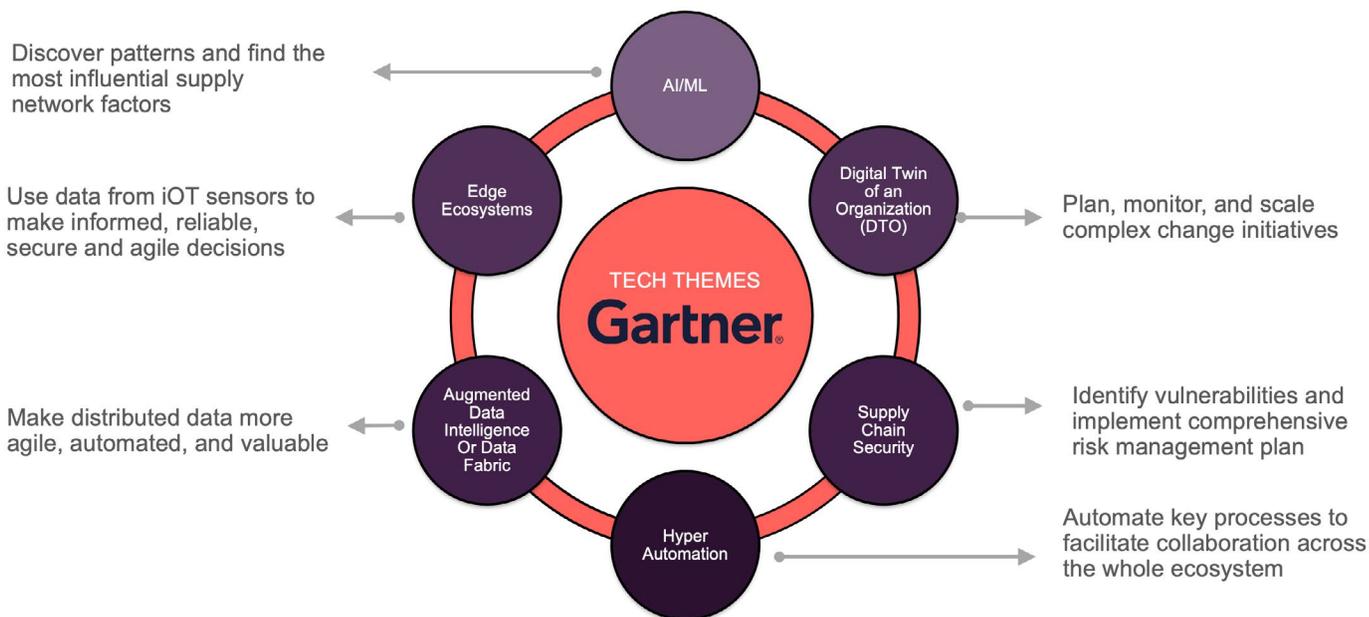


Figure 4 - Technology Components of Control Towers

Using the next generation of Public and Private Cloud Computing is recommended for building these technologies.

## Assess Current Maturity

Without a Control Tower, it is impossible to navigate through current complex supply chains. Most organizations have some version of a Control Tower today for their supply chain planning. However, the maturity of these control towers can vary widely from basic use cases to advanced solutions. Organizations must spend time understanding their current maturity levels as it relates to their existing Control Towers.

As organizations assess the maturity of their Control Towers, they need to think about various aspects associated with Technology, Data, Process, Analytics, Organization and Culture.

Appendix A provides a comprehensive checklist that can help organizations assess their current maturity levels.

## Solution Options to Implement Control Towers

Organizations can use one of the following options to build Control Towers:

- Build from scratch
- Buy existing software
- Leverage Digital Twin technology

### Build Solution from Scratch

Some organizations hire data analytics teams to build Control Tower solutions in-house. Usually, these teams consist of data engineers, data analysts and data scientists who use a multitude of existing technologies from different vendors that need to be integrated to work together. This is the traditional approach used by most companies for business intelligence. This creates fancy dashboards but lack actionable insights, real-time end-to-end visibility and need yet another system for collaboration.

Along with hiring talent with expertise across the entire stack of technology, organizations must ensure that the data used is real-time. They need to check to see if the solution can quickly scale with other applications and that the technology provides the resiliency to troubleshoot and address issues as they arise. Finally, Control Towers must keep data intact across the entire lineage. Organizations spend several years and millions of dollars cleaning their data to build the single point of truth, data credibility and trust across the organization, only to realize that the business conditions and data needs have changed since the start of the project.

Assuming organizations are still comfortable with this cumbersome and expensive approach, most traditional BI solutions are currently deployed as Control Towers to cover only primary analytic use cases such as dashboards within the organization. Control Towers have use cases that far exceed basic analytics as identified in the self-assessment tool shown in Appendix A.

### Buy Existing Software

There are a few vendors in the market that offer standard Control Tower solutions. These solutions contain common use cases across multiple industries to help organizations leverage best practices and past courses of action. The advantage of this approach is that these companies have deployed similar solutions for other customers and can provide out-of-the-box solutions. The downside to this approach is that these solutions can take anywhere between 12 to 18 months to deploy and can be very expensive, and difficult to configure and scale, especially for organizations built on legacy systems.

Another critical issue with these solutions is that they are built for specific use cases and cannot configure to include broader use cases or company-specific needs. These systems are not conducive to changing and adapting in today's fast-changing market and therefore limit organizations' ability to be agile, as demonstrated by the failure of many companies to keep up with the demand and supply fluctuation caused by COVID-19.

## Leveraging Digital Twin Technology to build Control Towers

Before discussing this approach, it will be helpful to provide an overview of the Digital Twin technology and how it can help bring agility to an organization's supply chain.

## Introduction to Digital Twin Technology

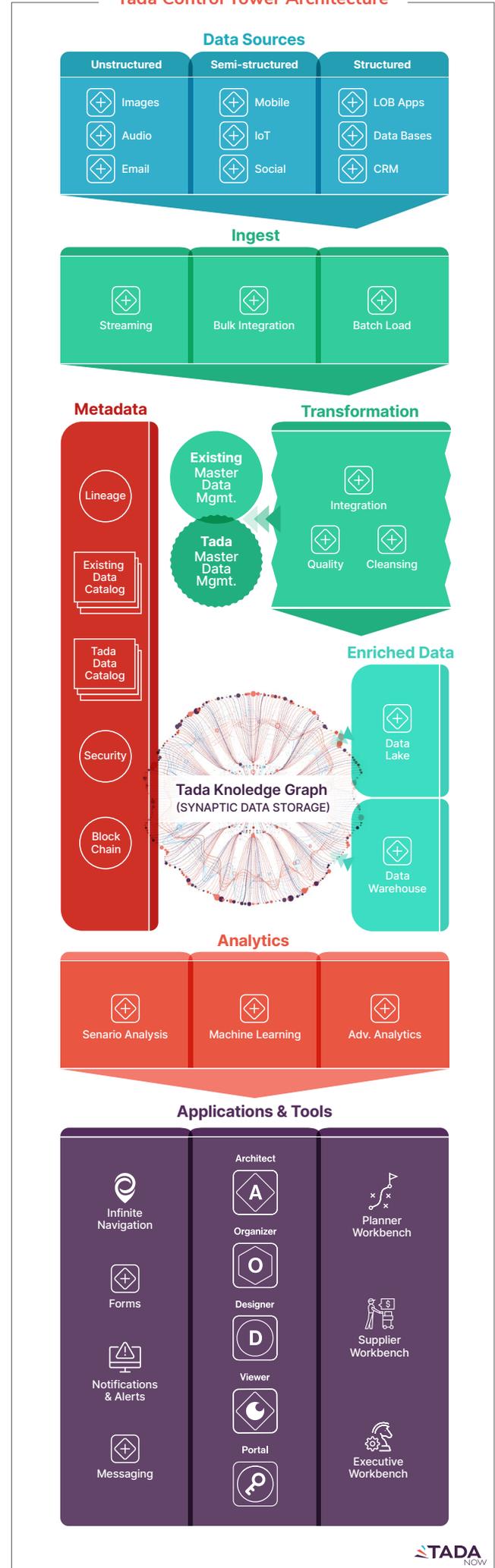
New emerging technology increasingly used to build the next generation of Control Towers is the Digital Twin Technology. A Digital Twin was first defined by NASA in 2010 as “an integrated multi-physics, multi-scale, probabilistic simulation of a vehicle or system that uses the best available physical models, sensor updates, fleet history, etc., to mirror the life of its flying twin”<sup>4</sup>.

While Digital Twins are more commonly used in IoTs and product simulations, this technology has evolved to create a Digital Twin of the Organization (DTO). Gartner defines DTO as “a dynamic software model of any organization that integrates operational and contextual data to understand how an organization operationalizes its business model, connects with its current state, responds to changes, deploys resources and delivers customer value.”<sup>5</sup>

DTO can create Digital Twins of plants, suppliers, containers, trailers, distribution centers and part numbers on a secured cloud, which connects to various systems across the ecosystem to create a sophisticated Data Fabric of the organization. Once the Data Fabric exists, these technologies help build actionable insights, simulated outcomes, recommendations, and action plans management to create a metaverse for supply chain professionals. Gartner also notes there should not be a separation between the digital supply chain and the end-to-end control tower. Instead, these may just be called the digital supply chain twin.<sup>6</sup>

Tada Cognitive Solutions has a patented Digital Twin technology called Digital Duplicate™ that can orchestrate data from multiple disparate systems across the ecosystem, including manually entered data, to create a semantic layer of the entire supply chain of an organization in just weeks. This layer allows for data to be configured for tailored use cases efficiently.

Figure 5  
Tada Control Tower Architecture



## Control Towers built with Digital Twin

Advanced Control Towers have use cases that help create end-to-end visibility across the ecosystem by connecting internal and external data from disparate systems. More importantly, they use advanced analytics through ML and AI algorithms that draw intelligent, actionable insights for the users. Furthermore, advanced Control Towers also provide capabilities that help users collaborate across the ecosystem. This way of building Control Towers outperforms most home-grown Control Tower solutions. Systems, such as Tada Cognitive Control Towers, have all the components needed to build an advanced data analytics stack along with data fabric and collaboration tools as shown in shown in Figure 5.

## Benefits of Control Towers

Control Towers, whether used for supply chain or production or distribution offer end-to-end visibility, orchestration and collaboration across the whole ecosystem. Control Towers can reduce a lot of unnecessary costs across the entire supply chain. Using data from some of the installations, Control Towers provided the following benefits when implemented correctly:

**60%**

**Expediting Costs Improvement**

**40%**

**Enhance Planner productivity**

**30%**

**Increase Revenue & margins realization**

**20%**

**Improve Inventory optimization**

**20%**

**Increase Manuf. throughput**

## Conclusion

Many organizations in the manufacturing and retail industries are currently facing unprecedented issues in supply chain, causing significant disruptions, plant shutdowns and margin losses. Some of these organizations have Control Towers built using traditional approaches that are not agile enough to provide the technology, flexibility and scale needed to create the needed business value or solve the complexity involved in supply chains as was evidenced by their failure during and after Covid pandemic.

Advances in technology such as DTO, Data Fabric and AI/ML algorithms have enabled creation of next generation of Control Towers that provide real-time end-to-end visibility, orchestration and collaboration across the whole supply chain ecosystem from Multi-Tier Suppliers to OEM to Production to Distribution to Customers. It is time to evaluate the maturity of your existing Control Towers (see Appendix A) and, if needed, upgrade to the next generation of Digital Twin enabled Control Towers to make your supply chain resilient.

### Reference

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# APPENDIX A

## Control Tower Use Cases – Self-Assessment Tool

The purpose of the tool below is to help you assess the maturity of your current control tower solution. Whether organizations use the term control tower or not, the following capabilities and use cases are essential to help organizations manage their supply chains daily.

Select the right maturity level for each question below and tally up the total score at the bottom.

### Explanation of scoring:

**Selection** – Select the one item that apply. For example, in Continuous Intelligence, you connect to ETL then the score will be 3 added in the Selection column

**Tally** – In this select all of the items that apply and then add their scores. For example, under Multi-Tier Supplier Control Tower, if the choices include Supplier Collaboration and Forecast Collaboration, the score under Tally will be 2.

## TECHNOLOGY CAPABILITIES

### 1. Continuous Intelligence

1	2	3	4	5	Selection
Download data to spreadsheets intermittently through multiple steps	Extract data to excel by refreshing	Connect via ETL	Set contract schedule to daily or weekly to data lake/ data warehouse	Capture data in real-time and continuously	

### 2. Scenario Modeling

1	2	3	4	5	Selection
Static data and outcomes with no scenario modeling capabilities	Basic scenario modelling with single variable scenarios	Multiple variable scenario modelling and outcome review	Multiple scenarios modelling with ability to compare	Simulating different scenarios and recommended best scenario	

### 3. Collaborative Response

1	2	3	4	5	Selection
Emails and phone calls to collaborate within organization	Manual collaboration with customers and suppliers	Basic collaboration tools such as SharePoint and used across ecosystem	Ecosystem collaboration leveraging web tools	Ecosystem collaboration leveraging cloud tools*	

## DATA

### 4. Data Maturity

1	2	3	4	5	Selection
Data in disparate systems	Data lake (unstructured)	Data warehouse (structured)	Data cleansed and governed	Data fabric (Digital Twin) connected	

### 5. Data Refresh Frequency

1	2	3	4	5	Selection
Ad-hoc	Monthly	Weekly	Daily	Real-time/ concurrent	

### 6. Data Scalability

1	2	3	4	5	Selection
Data gathered from scratch for every solution	Data available via data lake of warehouse to connect	Only incremental data needed to scale or build new solution	Data scalable within the organization as all data on a fabric	Data scalable across ecosystem as ecosystem data fabric connected	

**ANALYTICS**

**7. Advanced Analytics**

1	2	3	4	5	Selection
Run ad-hoc reports on Excel and PowerPoint	Create dashboards using tools such as Pivot tables	Create dashboards that show current status	Predict risks using predictive analytics using AI/ML algorithms	Prescribe options using prescriptive analytics using AI/ML algorithms	

**8. Impact Analysis**

1	2	3	4	5	Selection
Understand PO receive date impact based on inventory on-hand	Plus understand PO receive date impact based on shipping data	Plus understand line schedule impact based on supplier data	Plus understand line and financial impact based on customer data	Plus understand end-to-end schedule and financial impact from customers to suppliers	

**USE CASES**

**9. Multi-tier Control Tower (select all that apply)**

1	1	1	1	1	1	1	Tally
Supplier scorecard	Supplier collab.	PO collab.	Forecast collab.	Inventory collab.	Capacity collab.	Multi-tier constraint visibility	

**10. Supply Chain Control Tower (select all that apply)**

1	1	1	1	1	1	1	Tally
Material availability	Production adherence	Inventory mgmt.	Logistics visibility	Capacity mgmt.	Supplier performance	Supplier compliance	

**11. Production Control Tower (select all that apply)**

1	1	1	1	1	1	1	Tally
Material availability	Production adherence	Quality mgmt.	Line re-balance	Capacity mgmt.	OEE improvement	Master scheduling	

**12. Distribution Control Tower (select all that apply)**

1	1	1	1	1	1	1	Tally
Customer collaboration	Sales collaboration	Demand analytics	Customer irregularities	Inventory mgmt.	Logistics visibility	Carrier mgmt.	



**ORGANIZATION**

13. Organization Structure

1	2	3	4	5	Selection
Functionally arranged with no data visibility and collaboration across functions	Functionally arranged with limited data visibility and collaboration across functions	Functionally arranged with limited data visibility but structured collaboration	Functionally arranged with good data visibility and structured collaboration	Value based structure to maximize speed and collaboration across all functions	

14. Ecosystem organization

1	2	3	4	5	Selection
Collaboration with ecosystem partners such as customers and suppliers non-existent	Good customer collaboration (orders, inventory, demand, service)	Good supplier collaboration (orders, forecast, inventory, capacity, quality, multi-tier)	Good supplier and customer collaboration	Excellent commercial relationship with ecosystem partners	

15. Cultural (select all that apply)

1	1	1	1	1	TALLY
Learning organization: Employees, suppliers and customers open to changes	Incentives to create value: Team incentivized to create value and accept change	Leadership sponsorship: Executive leadership supports and sponsors new solutions	Collaborative environment: Team works together to solve complex problems that cut across functions	Capital allocation: Organization is willing to allocate capital to build next generation solutions	

Please add up your scores to see where you fit on the assessment scale

16 to 30	31 to 45	46 to 60	61 to 75	76 to 88	TOTAL SCORE
Ad-hoc	Emergent	Structured	Transformed	Cutting Edge	

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