anyLogistix
supply chain software

Supply Chain Digital Twins

definition,
the problems they solve,
and how to develop them

Contents

Introduction

This paper outlines how digital twins and control towers are resolving challenges in supply chain. Using example scenarios, it shows how they help short- and mid-term supply chain decision making, how they can be constructed, and how they integrate with existing tech operations.

In the first part of this paper, we provide a point of view on how to define digital twins, identify the problems they can help solve, and highlight the value they can provide. In the second part, we describe how a supply chain digital twin can be embedded into your IT infrastructure as part of a supply chain control tower.

From reading this paper, you will deepen your knowledge of supply chain digital twins, learn how they work in a control tower setting, and understand the value they offer your supply chain.

Defining a Digital Twin

So, what exactly is a digital twin? According to Gartner, a digital twin is "a digital representation of a real-world entity or system."

> Siemens make use of a digital twin from decisionLab to enable informed decision making concerning a deployed fleet of gas turbines. The twin captures turbine performance, repair and overhaul capacity, and spares inventory from the real-world and feeds the information into its dynamic simulation model so that it can forecast engine removals, the need for spares, and repair and overhaul demand. [full case study]

> In another example, CNHi worked with consultants Engineering Ingegneria Informatica on a digital twin of a factory production line to help better inform maintenance decisions. The solution regularly captures key performance and financial indicators and uses them, combined with machine learning and agent-based modeling, to give a 'control tower' view of processes on the production line. [full case study]

That's a good start, but there's a problem: those words could describe nearly all computer models. We need to narrow things down, and we can get a much better idea by looking at digital twins already in operation.

From these two examples, we can understand that a dynamic model is needed, and that it needs to be kept up to date with data from the real-world counterpart. In both cases, the purpose of the digital twin is to inform decision making by promoting

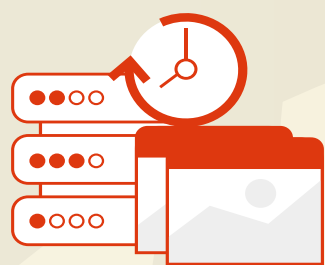understanding, learning, and reasoning for the decision makers involved with the system at hand.

If we boil all this down, we can refine Gartner's definition and say:

A digital twin is a detailed simulation model of a real-world entity or system which uses real-time data to predict its dynamics and enable understanding, learning and reasoning.

Supply Chain Digital Twin

A Supply Chain Digital Twin is a detailed simulation model of an actual supply chain which uses real-time data/snapshots to forecast supply chain dynamics. From this, analysts can understand a supply chain's behavior (understanding), predict abnormal situations (learning) and work out an action plan (reasoning).
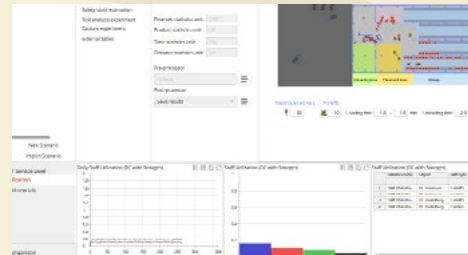

Real Time **Data/Snapshot** → **Detailed** Supply Chain Simulation Model → Supply Chain **Dynamics Forecast**

‣ Understanding

‣ Learning

‣ Reasoning

Supply Chain Digital Twin

Applying this definition to the supply chain digital twin gives us the following picture

That's a valuable definition. But the real value that a supply chain digital twin offers organizations is a way to make better short-term and mid-term decisions.

- Mid-term decisions are mostly related to how a supply chain should work, such as design, optimization and master planning. A digital twin helps you to review and improve your supply chain and all its underlying processes, resources, and logic. These tasks may require you to simulate a **few months** of operations.

- Short-term decisions are mostly related to the identification of potential problems and the analysis of solutions. For instance, with transportation planning, or the quantification of the bullwhip effect from an external disruption. Usually, this kind of decision making will only require the simulation of a **few days or weeks**.
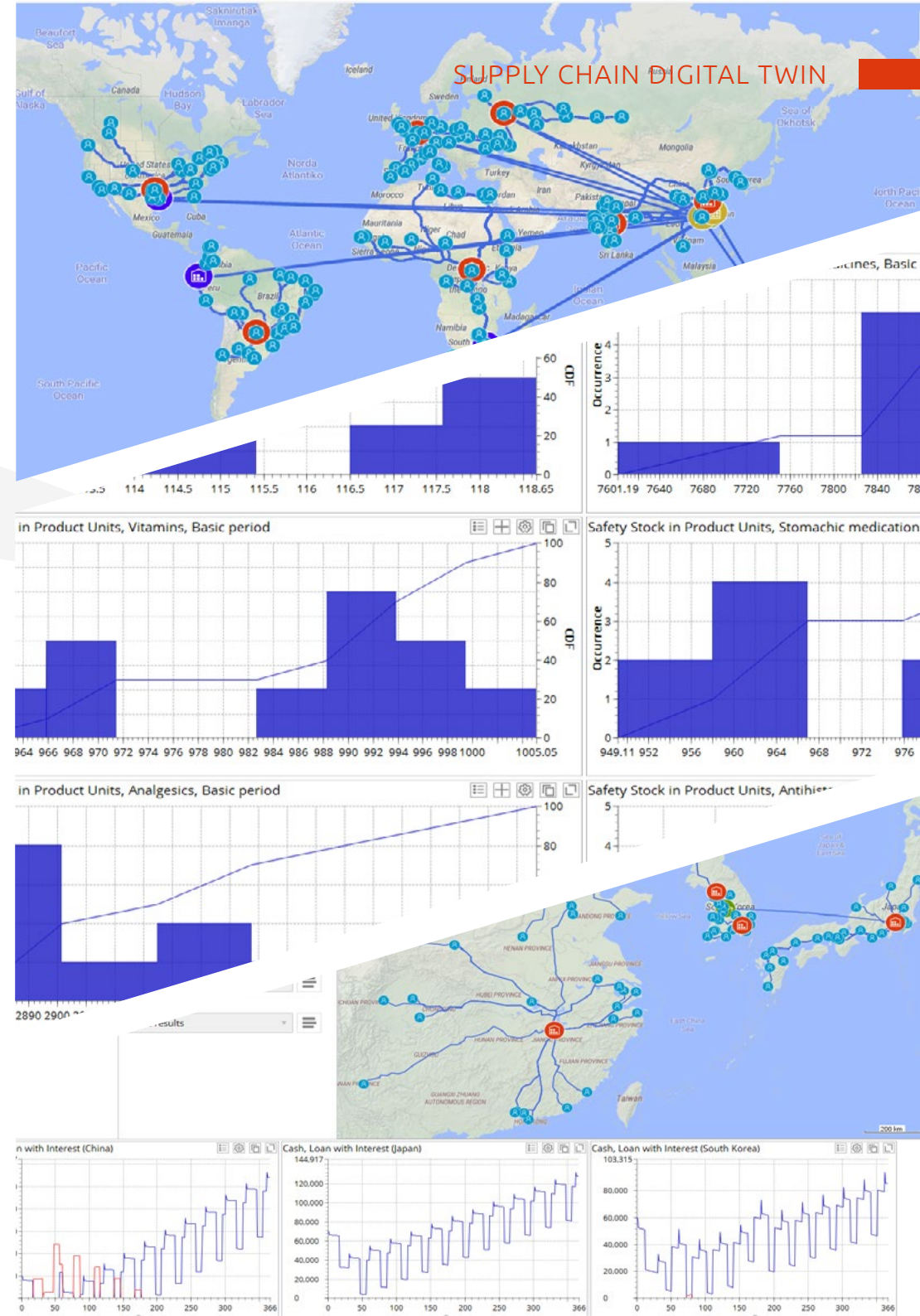
What Makes a Supply Chain Simulation Model a Digital Twin?

As we have seen, a digital twin requires a detailed simulation model. But does that mean any detailed simulation model of a supply chain will be a digital twin? Let's review the criteria we use to decide.
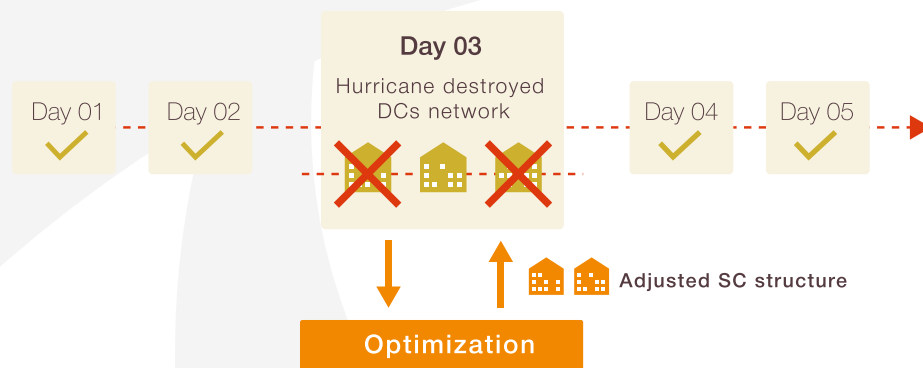
A supply chain digital twin should:

- Be detailed enough to analyze the supply chain interactions, from macro changes in demand down to inside the four walls of facilities. It should enable functions such as the prediction of financial and SKU flows, demand variability identification, and scenario testing.

- Use live information feeds, such as incoming shipment schedules, vehicle locations, and inventory levels, to assess the supply chain's current state and provide updated forecasts. For example, quantifying the bullwhip effect from lost inventory.

- Offer configurable notifications, alarms, or alerts to inform you of abnormal situations such as service levels falling below thresholds.

- Provide triggers you can use to set up custom actions that will automatically take place when selected events occur, such as potential stock outs.

- Allow you to develop action plans to help you address abnormal situations, and test those plans to ensure they are effective.

- Be part of a "bigger thing" – such as a supply chain control tower – and integrate with the surrounding IT environment of databases and business intelligence tools.

What about Optimization, AI, and Analytics?

Many people ask us how a digital twin works within a larger drive for supply chain improvement. It's a good question, and we'll use the following example to show just how well supply chain digital twins can work together with optimization, artificial intelligence, and analytics:

Detailed Supply Chain Simulation Model

In the digital twin, the model verifies parameters such as KPI and service levels. In response to disruption on day 4, the supply chain configurationis adapted, with the help of optimization, to continue best meeting targets.

Let's assume we use our digital twin of a supply chain every day to create a two-week forecast. If it identifies an abnormal situation, it automatically tests, develops, and implements the most effective action plan.

Here, on the fourth day of forecasting, the supply chain digital twin reads the supply chain's current state and correctly identifies the loss of several distribution centers to a hurricane.

After the digital twin identified the distribution centers were out of action, it used optimization (it can also be AI or other analytics tools) to determine the best alternate supply chain structure, update the model with this information and resume its daily forecasting. Such action ensures business KPIs continue to be best targeted as quickly as possible.

In short, optimization, AI, or other advanced analytics can be a part of an effective supply chain digital twin. A digital twin can use optimization, AI or other analytics tools to make forecasts and even perform decision making.
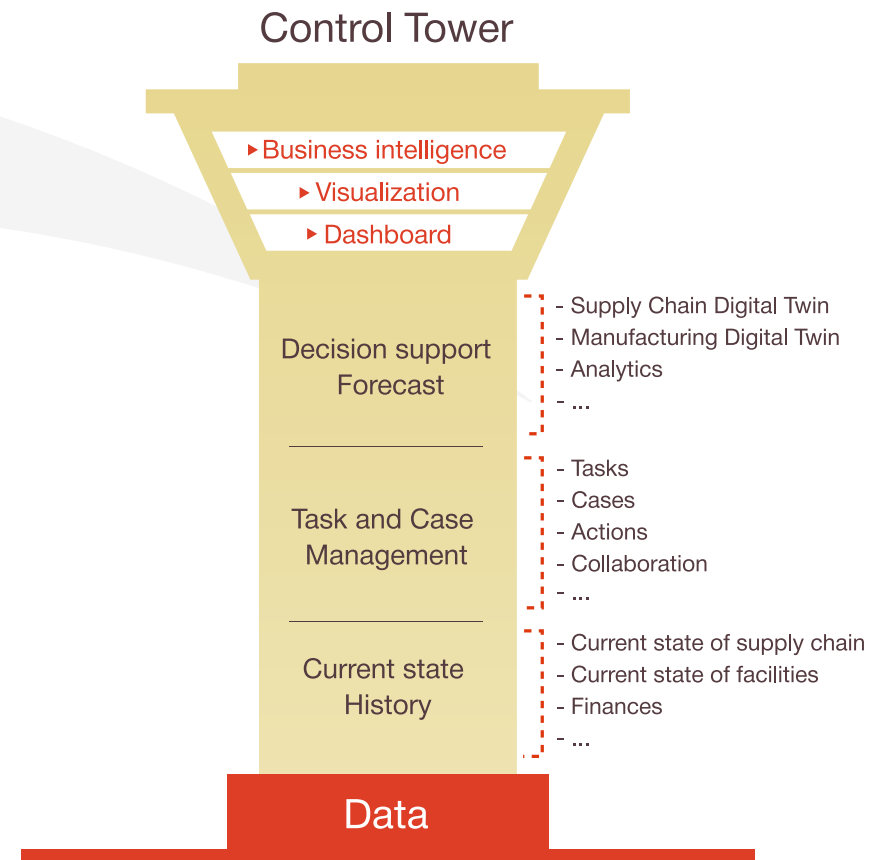
For example, an inventory policy might use AI to decide how many products to order and when to order them. At the same time, optimization can help create a master plan and simulation can reveal the best means of transportation to use.

You can read more about Simulation and Optimization in supply chain in our paper: Supply Chain Optimization and Simulation: Technology Overview >>

Supply Chain Control Tower and Digital Twin

Developing the digital twin concept further, a control tower is a central point which gives enhanced visibility for short-, mid- and long-term decision making. While you'll typically see this term used in connection with supply chain, it can also work well for any business activity, or even an entire company. A control tower usually has a:

- **Data module** that connects to your business's data silos and ensures your model's decisions are relevant and up to date.

- **Visualization module** for aiding data analysis, insight, and presentation.

- **Current state/History module** so, for instance, you can see if service levels are being met and perform historical analysis or ensure compliance.

- **Decision support/Forecast module** that can be used for exploring 'what-if' scenarios, avoiding potential problems, and developing action plans.

- **Task and case management module** that allows you to implement and track an action plan

Control Tower

- ▸ Business intelligence
- ▸ Visualization
- ▸ Dashboard

Decision support
Forecast

- - Supply Chain Digital Twin
- - Manufacturing Digital Twin
- - Analytics
- - ...

Task and Case
Management

- - Tasks
- - Cases
- - Actions
- - Collaboration
- - ...

Current state
History

- - Current state of supply chain
- - Current state of facilities
- - Finances
- - ...

Data

A control tower encompasses a broad range of systems, including digital twins, to provide end-to-end supply chain visibility. Current, historical, and future activities can be analyzed.

A control tower may include multiple digital twins which it uses to forecast a system or entity's dynamics. You can apply the control tower concept to supply chains as well as to other company activities such as manufacturing and finances, or across the whole company.

anyLogistix Digital Twin Support

You can use the anyLogistix software tool to develop digital twins and integrate them into your IT environment with:

- **Detailed supply chain simulation model**
  Add detailed logic and behavior to your supply chain models so, for example, you can accurately capture your inventory policies, or model inside the four walls of facilities to assess factory or warehouse inner workings.

- **Initial state to simulate supply chain behavior**
  Automatically gather data about your supply chain's initial state and use it to parameterize the supply chain model with data including financial accounts, warehouse inventories, and vehicle locations.

- **Notifications and alerts**
  Create notifications to inform users of possible critical situations which may happen in the future such as service level reductions, low inventories, increasing lead times etc.

- **Triggers**
  Define the actions the system will take when certain events occur. For example, when an inventory policy change will cause a customer delivery service level KPI to be missed.

- **Develop and test action plans**
  Use the experiments provided by anyLogistix (e.g. optimization, risk analysis, safety stock estimation, transportation optimization, etc.) to create and test an action plan. Get detailed feedback on ideas and test proposed changes in multiple scenarios with performance forecasting.
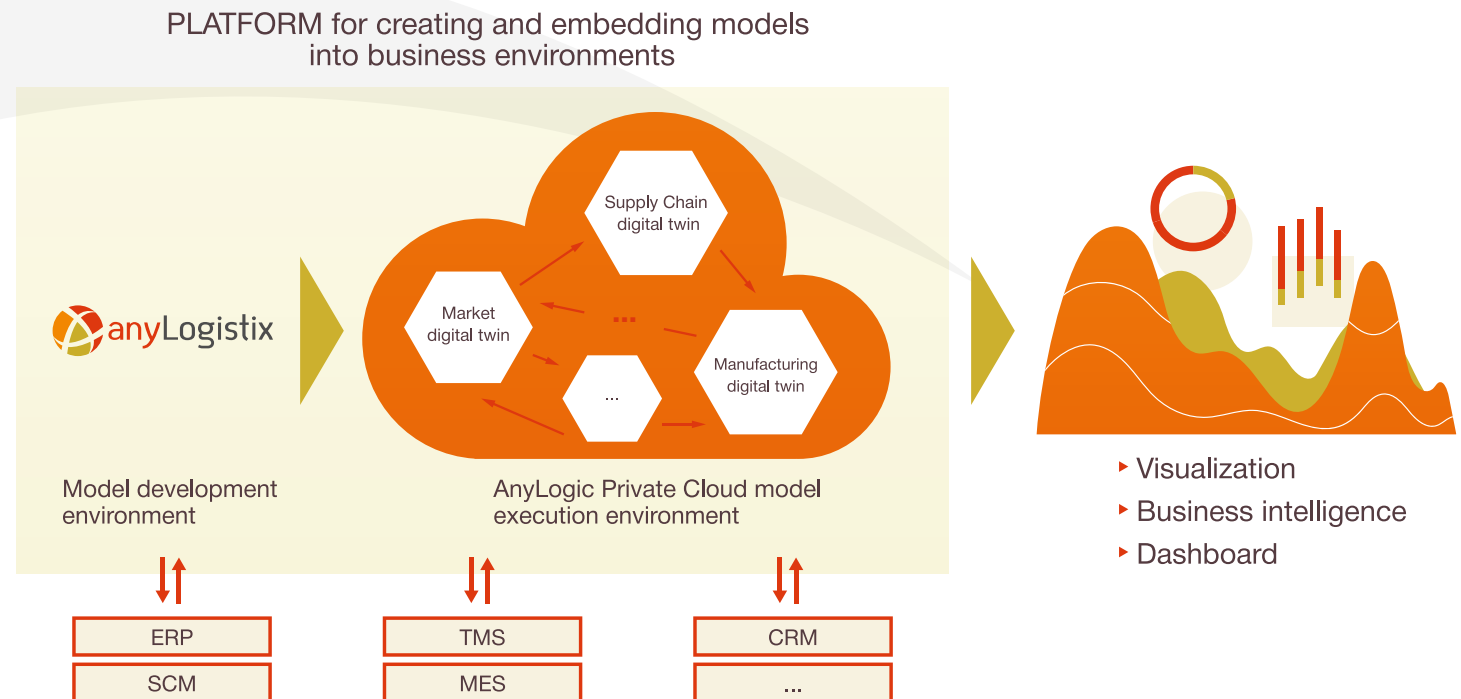
- **Integration with IT infrastructure**
  Integrate with your IT infrastructure by allowing anyLogistix to read data from your ERP and external sources. For example, deploy across an organization from the cloud and use the API to connect with Power BI or Tableau.

Embedding an anyLogistix Digital Twin into your Business Environment

Every business will already have various parts of what is needed to develop a supply chain digital twin, such as data silos, KPIs, emergency plans, and data collection. The crucial part is to bring these elements together.

The anyLogistix supply chain software platform offers a comprehensive solution for organizations that want to take advantage of the many opportunities that digital twins offer.

PLATFORM for creating and embedding models into business environments

Model development environment

AnyLogic Private Cloud model execution environment

Supply Chain digital twin

Market digital twin

Manufacturing digital twin

....

...

ERP
SCM

TMS
MES

CRM
...

‣ Visualization
‣ Business intelligence
‣ Dashboard

anyLogistix supply chain models interact with company databases and platforms to provide up-to-date analysis and forecasting that can be presented through systems such as Tableau and Power BI.

10

By making use of the AnyLogic Private Cloud, you can embed your digital twin into your business environment.

When your model is complete, you can export it to the cloud, read data from external sources, link it to other parts of your IT environment – such as enterprise resource planning systems (ERP), supply chain management (SCM), and manufacturing execution systems (MES) – and use your preferred tools, like Tableau and Power BI, or custom charts, to visualize the results.

The AnyLogic Private Cloud is a secure platform for hosting simulation models in your data center or at a cloud platform provider. It is natively supported by anyLogistix.

An Example: Supply Chain Digital Twin

Let's use an example to better understand how you might use a supply chain digital twin. Our Decision Support/Forecast module has the following parts:

- A supply chain model created with anyLogistix software that serves as a digital twin that has been exported to the AnyLogic Private Cloud model execution environment.

- A supply chain database that provides an overview of the supply chain's actual state each morning.

- Tableau, which uses the business intelligence (BI) database to visualize the digital twin's forecast.
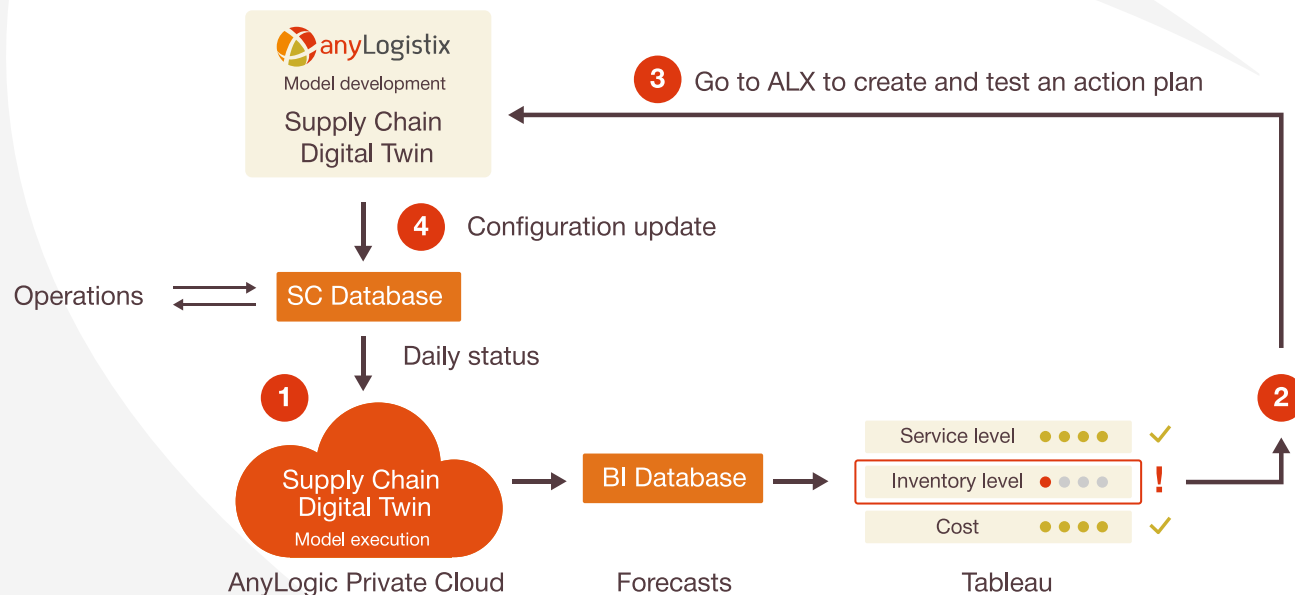
How a digital twin enables analysis and problem resolution. For more details read the digital twin usage scenario below.

We use anyLogistix to create the supply chain model that will be the core of our digital twin and then export it to AnyLogic Private Cloud. This helps integrate the digital twin into the surrounding IT infrastructure and make it part of our company's decision-making process.

1. The execution of a digital twin for providing forecasts can be done in different ways. In our example, Tableau queries the digital twin each morning. This triggers the creation of a two-week customer service level forecast that we can then view in Tableau. If this forecast predicts those levels will change, anyLogistix also sends us an alert.

2. On day 1, our digital twin reviews the supply chain's state and uses this information to create a forecast that accounts for randomness. Our performance on day 1 and day 2 is acceptable. On day 3, an alarm informs us that the service level may fall below the acceptable level we set.

3. When we receive the alarm, we use anyLogistix to analyze the supply chain, determine the reason for this issue, and develop and test a solution.

4. After we have a solution, we update the configuration of the supply chain ready for execution.

To dive deeper into this topic, see our webinar: Supply Chain Digital Twin and Control Tower with anyLogistix >>

Conclusion

Digital twins are a powerful concept in supply chain. As a dynamic simulation model of a supply chain, fed over time with detailed data from a real-world twin, a digital twin facilitates learning, understanding and reasoning. They can provide insight into past, current, and future operation, they enable 'what-if' experimentation, and can support action plan development. Overall, a supply chain digital twin supercharges a supply chain, helping to deliver more efficient operations and better meet service level KPI.

A supply chain digital twin does not stand alone. It integrates with company systems, uniting data flows and stores, and provides users with a universal window on supply chain workings.

Analyze and develop your supply chain with:

- Simulation visualizations for presentation and verification purposes

- Business intelligence reporting for easy analysis

- Notifications and alerts to help maintain smooth running

A supply chain digital twin can become a control tower from which you can ensure your supply chain achieves its best in the real world.

Companies are already making use of supply chain digital twin capabilities to manage global networks of products, from sourcing to servicing, and beyond. We believe that digital twins will become more widely deployed and in greater numbers, a trend that will only increase as the benefits are realized.

How The AnyLogic Company Can Help

The AnyLogic Company provides a comprehensive set of tools, including AnyLogic and anyLogistix, that you can use to develop digital twins. AnyLogic Private Cloud then enables you to integrate these digital twins with your tech environment for better decision support. For more information, please contact any of our global offices or visit anylogistix.com

Additional resources

- [White Papers](#)

- [anyLogistix Webinar Recordings](#)

- [anyLogistix Demo Video](#) – tutorials

- [anyLogistix PLE](#) – free version for self-study and education

- [Tutorial Book](#)

- [Case Studies](#)

Contacts

The AnyLogic Company

Choose your local office >>

info@anylogistix.com