Deloitte. | Google Cloud

SUPPLY CHAIN DIGITAL TWINS
AT SCALE FOR THE BIOPHARMA INDUSTRY

Achieve new levels of efficiency, resilience, and visibility across the biopharma supply chain

1 Summary

As innovations in technology become more disruptive, global dynamics more turbulent, and environmental sustainability more imperative, supply chain leaders across various industries face unprecedented challenges. In the biopharmaceutical (biopharma) sector, these challenges can be especially complex given the traditional dependence on siloed data, which can lead to limited visibility and reactive responses to supply chain disruptions.

New advancements in digital twin (DT) technology can equip biopharma organizations with powerful new tools and insights that simulate alternative supply chain strategies and enable teams to fundamentally improve and optimize supply chain operations. This technology fosters a more proactive and predictive approach to manage shifting supply chain dynamics.

In this paper, we will examine how Deloitte's Digital Twin/Flash (DT/Flash) solution, developed on the Google Cloud Platform (GCP) , can assist biopharma organizations in tackling business challenges and achieving objectives. It does so by swiftly and economically generating dynamic, highly precise digital twins of an organization's physical assets, systems, and processes. These digital twin models utilize DT/Flash's universal Digital Twin Modeling Language and Digital Twin Process Logic, along with customized Generative AI (GenAI) features and a fully integrated, top-tier graph database technology.

Through the powerful capabilities of these digital models, teams can attain real-time insights, simulate, test, and confirm the efficacy of new business decisions, and deploy fixes, new initiatives, and products with higher levels of confidence and accuracy.

2 *Applications of digital twins in the biopharma supply chain*

Biopharma supply chain challenges

Many biopharma companies grapple with disruptive supply chain challenges that stem from demand surges, capacity reduction, coordination failure, labor shortages, logistical bottlenecks, geo-political conflicts, and more. These disruptions can have far reaching operational, financial, and brand-related consequences, including production delays, quality control, revenue loss, increased costs, write-offs, investor confidence, legal and regulatory penalties.

In its 2022 "Building Resilience into the Nation's Medical Product Supply Chains" report, the National Academies of Sciences, Engineering, and Medicine suggest "medical product shortages can represent a significant threat across the landscape of public health and health care delivery by undermining the ability to provide timely and high-quality care to patients."

Digital twins, which are virtual replicas of physical systems, can significantly enhance visibility across the biopharma supply chain. By creating digital mirrors of their supply chains, companies can monitor real-time data and simulate various scenarios. This capability allows for predictive analytics, where potential disruptions such as equipment failures, delivery delays, or demand spikes are forecasted before they occur. As a result, companies can proactively manage risks by adjusting their supply chain strategies in advance, minimizing the impact of disruptions.

Let's examine a few of the top supply chain disruptors for biopharma organizations and how mitigation measures enabled by digital twins can help resolve them.

DEMAND SURGES:

Demand surges can significantly disrupt biopharma supply chains, leading to a cascade of challenges, including inventory depletion, increased lead times, capacity constraints, quality control, price fluctuations, supplier resilience, and more. Biopharma companies attempt to address these challenges through a series of mitigation strategies that include demand forecasting, capacity planning, inventory management, risk management and supplier collaboration. However, in many cases, reactive rather than proactive, rigid supply chains, poor demand forecasting, lack of historical data, ineffective data analysis, and inadequate contingency planning can result in mitigation efforts often falling short.

Digital twins can help solve this issue of demand surges by integrating data from various sources (e.g., sales, epidemics, weather) to provide a full view of demand patterns. By analyzing historical data and real time data, digital twins can help forecast demand surges, including real-time tracking, risk identification, optimized resource allocation, scenario modeling to accelerate and improve decision-making, and more. In essence, by providing improved demand surge management, digital twins can help organizations reduce costs, improve customer satisfaction, and increase market agility.

CAPACITY REDUCTIONS:

Similar to demand surge issues, biopharma companies' capacity reduction challenges can have far reaching consequences, including production delays, inventory shortages, increased lead time, and higher costs. These challenges can result in sales and revenue losses, customer dissatisfaction, market share erosion, and more. Mitigation strategies to diminish the impact of these challenges include capacity optimization, flexible manufacturing and inventory management. Despite careful planning, challenges such as siloed operations, resistance to change, logistics bottlenecks, product complexity, lack of data and analytics, and other factors can diminish the efficacy of mitigating initiatives.

In these scenarios, digital twins can play a pivotal role in helping biopharma companies mitigate their **capacity reduction** issues by providing a powerful tool for real-time capacity visibility. This helps teams optimize resource allocation by providing the ability to simulate resources and allocate tasks by tracking and documenting the lifecycle of a product. From production through to delivery, each step can be monitored and recorded. This detailed traceability can not only aid in confirming compliance with stringent regulations but also enhance quality control. Deviations from the norm can be detected and rectified, which can significantly reduce the potential risk of non-compliance and product recalls.

COORDINATION FAILURES:

Coordination failures are another area that can have implications on a biopharma company's supply chain. These challenges could surface as stockouts and overstocks, delayed deliveries, increased costs, financial losses and more. Common causes of coordination failures include poor communication, systems integration issues and demand forecasting errors. Improved communication, advanced planning and scheduling, demand forecasting accuracy, and other similar steps are some of the mitigation strategies applied in reducing coordination failures.

Digital twins can significantly improve how effectively biopharma companies manage supply chain coordination failures. By creating a single source of truth via integration with various sources, digital twins allow for a full view of the supply chain, highlighting potential coordination issues. In addition, by enabling real-time data sharing, digital twins facilitate communication and decision making among different departments and partners. Specifically, digital twins help reduce coordination failures by aligning supply and demand, modeling transportation routes, facilitating communication and collaboration between suppliers, and identifying potential coordination challenges related to changing regulatory specifications and requirements.

SUSTAINABILITY:

As an increasing priority in the biopharma sector, driven by both regulatory requirements and consumer demand, sustainability is another critical area of focus

Digital twins can help by simulating the environmental impact of various supply chain activities, which companies can then use to make data-driven decisions that reduce carbon footprints (such as optimizing delivery routes to decrease fuel consumption or selecting suppliers who adhere to sustainable practices). Moreover, digital twins can aid in designing sustainable packaging solutions by assessing materials and methods before physical prototypes are made.

Similar to other challenges referenced earlier, siloed structures, resistance to change, data integration issues, lack of advanced analytics and a series of other limitations also reduce mitigation impacts.

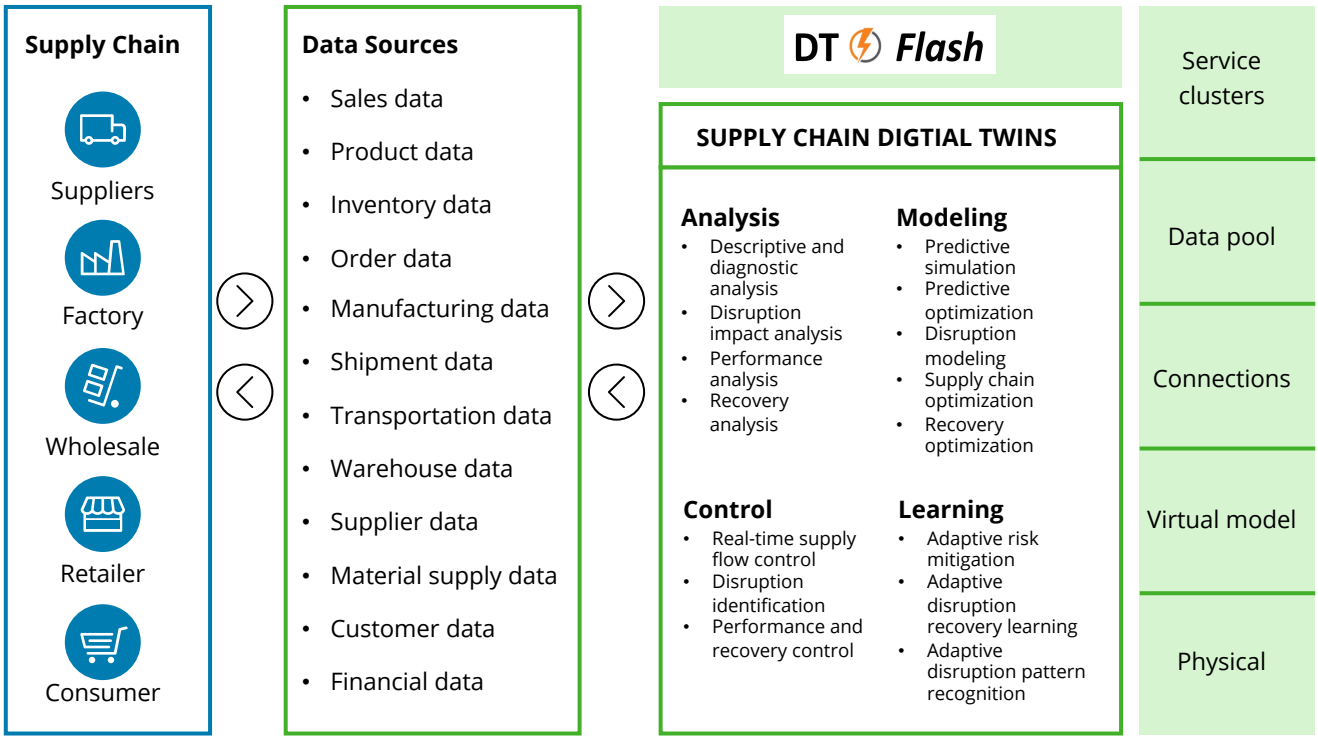
Digital twins offer a powerful tool for biopharma companies to address complex supply chain challenges. By providing a broad, real-time view of operations and enabling detailed scenario analysis, digital twins can enhance decision-making, improve efficiency, confirm compliance, and promote sustainability. As the technology matures, its adoption is also likely to become a critical component of effective supply chain management in the life sciences industry.

3 *Introducing Deloitte's Digital Twin/Flash (DT/Flash) platform*

3.1 Solution overview

How Deloitte's DT/Flash platform helps organizations address challenges associated with implementing and maintaining highly scalable, precise, cost effective, and manageable digital twin environments

Figure 1. Digital Twin/Flash capabilities



In the biopharma sector, where precision, safety, and compliance are essential, companies stand to gain much from using digital twins to optimize their supply chains. However, implementing digital twin solutions presents a particular set of technology challenges that requires careful planning.

Top challenges include:

1. *Data quality and availability*
2. *Complexity of biopharma supply chains*
3. *Integrating digital twins with existing legacy systems*
4. *Resources and costs associated with implementing and maintaining digital twins*

1 *Data quality and availability*

To create complete representations of organizations' supply chains, digital twins require vast amounts of real-time data. The data often originates from diverse sources, including manufacturing facilities, distribution centers, and transportation networks. Determining data consistency, accuracy, and completeness is important for the effectiveness of digital twins. Moreover, data privacy and security regulations in the industry impose stringent requirements, making it imperative to protect sensitive information.

Additionally, acquiring and integrating the vast amounts of data required to build a digital twin can be daunting, often involving aggregating data from disparate sources including sensors, IoT devices, and legacy systems, while endeavoring to provide data quality, integrity, and security.

Deloitte's DT/Flash solution is designed to address a number of fundamental digital twin design, deployment, and maintenance challenges, including those referenced earlier. By providing a standardized framework for representing complex supply chain processes, **DT/Flash's DTML (Digital Twins Modeling Language)** helps organizations overcome challenges of **data quality and availability.** DTML helps define the structure and relationships between different data elements, helping to deliver consistency and accuracy. It can also facilitate data integration from diverse sources, reducing the risk of errors and omissions. By establishing a clear data model, organizations can enhance data quality and availability, which are critical factors for digital twin effectiveness.

2 *Complexity of biopharma supply chains*

Unlike traditional manufacturing industries, biopharma supply chains involve a multitude of manufacturing components, including raw materials, intermediates, finished products, and regulatory compliance. The intricate nature of these supply chains makes it difficult to closely model and simulate the relevant factors. Additionally, the dynamic nature of the biopharma industry, characterized by frequent product launches, regulatory changes, and supply disruptions, necessitates continuous updates and adjustments to digital twins.

Through **DT/Flash's** innovative integration with advanced graph database technology, DTML can provide **a visual representation of complex supply chain** environments, making it easier to understand and analyze data. By breaking the supply chain into manageable components, organizations can identify potential bottlenecks, inefficiencies, and risks more effectively.

3 *Integrating digital twins with existing legacy systems*

Many biopharma organizations use outdated systems that may not be compatible with the advanced technologies required for digital twins. Upgrading and replacing these legacy systems can be time consuming and costly, while also introducing risks of disruptions. Therefore, careful planning and execution are essential to provide a smooth integration process.

DT/Flash with its DTML and processing logic can serve as a bridge between legacy systems, providing a **standardized interface for data exchange and integration**. By defining clear data mappings and transformation rules, organizations can integrate digital twins with existing systems without compromising their functionality.

4 *Resources and costs associated with implementing and maintaining digital twins*

Another specific challenge associated with digital twins and where DT/Flash offers an effective solution relates to **cost of digital twin design, implementation, and maintenance.** The development and implementation of digital twins requires expensive and specialized skills and experience. Data scientists, engineers, and domain specialists are needed to build and maintain these complex systems. In addition, the upfront and operating costs associated with implementing and maintaining digital twins could be expensive. Some of the costs include the need for high-performance computing, 3D visualization software, on-going maintenance in the form of regular updates, validation, calibration, security, and more.

DT/Flash can streamline the development and deployment of digital twins by providing a reusable framework. In fact, anyone within the organization and/or vendors can use DTML to create reusable models and make them available across the organization. These models can be pre-vetted and pre-certified by organizations' SMEs and held in digital twins repositories. By automating certain tasks, such as data integration, digital twin instantiation, and model validation, organizations can reduce implementations required time and efforts. Additionally, employing DTML and associated processing logic, DT/Flash can facilitate ongoing maintenance and updates, as changes can be made more efficiently and with less risk of errors.

The challenges above underscore the significant effort required to develop and sustain digital twins effectively over time. However, the rewards could justify the effort when the implementation is carried out using well planned strategies and appropriate tools and collaborators.

Deloitte's Digital Twin/Flash solution leverages an array of advanced, innovative, and established technologies and capabilities to unlock various benefits for biopharma organizations. These benefits include the ability to establish an effective and reliable digital twin environment with customizable and high-accuracy modeling, rapid digital twin instantiation paired with ETL acceleration capabilities, and efficient data acquisition and integration required to build digital twins. In addition, DT/Flash enables organizations to skillfully represent dynamics of complex physical assets and processes, providing scalability and interoperability across a large set of assets, systems, and environments, and maintain complex digital twin environments throughout the digital twin lifecycle with automated version control and frictionless updates.

Figure 2. Digital Twin/Flash solution overview

A feature-rich, vastly scalable, and highly cost-effective cross-industry digital twin platform built on top of ***Google Cloud.***

Cost Effective
Allows for highly cost-effective Digital Twins PoCs and experimentation

Universal Modeling Language
Single model can instantiate Digital Twins, generate device-specific telemetry, and define twin-to-twin relationships

Reduce Risks
Reduces risks in adoption, application, and deployment of new Digital Twins technology

Rapid Design and Deployment
Accelerated the build and deployment of simple to complex Digital Twins projects

Massively Scalable Graph Database
Easy to use and highly scalable graph database-200 billion nodes and 100 trillion+ relationships

Deterministic and non-deterministic Twins
Full support for physics-based, statistical, and probabilistic simulations and analysis (e.g. physical assets, processes, organizations, humans)

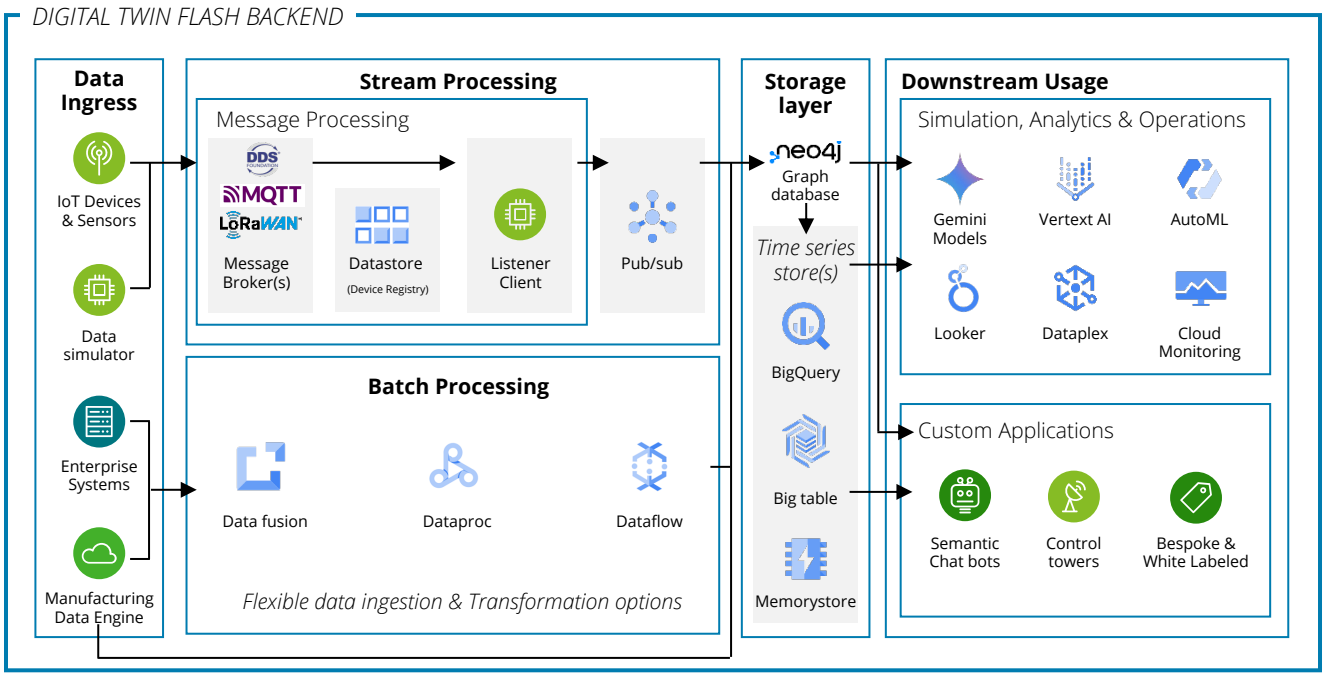
Figure 3. Additional DT/F differentiating capabilities

Challenges with traditional approaches to digital twin solutions	***The Digital Twin / Flash impact***
NOW	*NEXT LEVEL*
COST	
Digital twins require high quality data. Acquiring and cleaning the data can be expensive. In addition, integrating data from various sources, modeling nonlinear interactions and regulatory compliance, and training, maintaining, and updating digital twins could also pose significant costs.	DT/Flash helps reduce the development, deployment and management of digital twins by providing a standardized language that provides consistency and interoperability across different systems and components and effectively reduces the need for custom integrations. Additionally, DT/Flash's pre-built templates and modular design allows for reuse of components across different digital twins, version control, and centralized management and automated updates to help reduce costs across the digital twin life cycle.
STANDARDIZATION	
Digital twins are a concept with no current standards in regard to modeling, instantiation, and materialization. Digital twin approaches often differ drastically, and are held captive within vendor-specific software and/or technologies.	DT/Flash's Digital Twin Modeling Language (DTML), a specification for defining digital twin components, entities, and processes, is open to the community enabling collaboration for clients, industry, and manufacturers.
SHAREABILITY	
Vendor-specific digital twin technologies and platforms have currently flooded the marketplace, resulting in siloed solutions and stagnated innovation. Digital twins, along with complementary technologies and solutions are difficult to share within and amongst organizations and communities.	DTML-based models and associated custom applications can be shared and deployed across environments, organizations, and communities. Models can be source controlled and collaborated with various technical solutions. Open-source and closed-source communities can develop extensions and new capabilities based on the foundational technology and framework that DT/ Flash provides.
EXPERIMENTATION	
Digital twin simulations and deployment scenarios lack a uniform orchestration framework/methodology. This results in bespoke, one-off, simulation designs that are often costly, time-intensive, and restricted to run only in their target environment.	Digital Twin Experiments (DTX), a uniform template for running digital twin and IoT simulations within DT/ Flash, enable rapid deployment of customizable and pre-configured simulations
DIGITAL TWIN DERIVATION AND INSTANTIATION	
With lack of adept frameworks and technologies, digital twins are often constructed using one-off methodologies. This can result in lengthy derivation and inconsistent/unportable instantiation of digital twins.	DTML accelerates digital twin derivation, instantiation, and integration with other systems' operations while enabling programmatic/AI-driven workflows otherwise not possible.
UNLIMITED AND SIMULTANEOUS FULL OR PARTIAL SIMULATION	
Simulations often run and are observed in silos, and can be difficult and costly to duplicate, dissect, and compare.	DT/Flash allows simultaneous simulations, based on actual, generated, or augmented data. Digital twins and digital twin environments can be duplicated and altered to enable multiple simulations running based on augmented/alternate scenarios and realities.
SUPPORT FOR COMPLEX FEDERATED DIGITAL TWINS AND DIGITAL THREADS	
Digital twins exist in and amongst disparate technologies and frameworks, consequently, they are often limited in their connectivity and compatibility amongst themselves and other systems.	Digital twins are modeled, defined, and materialized in a consistent and data structure focused domain. This methodology enables digital twins to collectively form federated digital twins, facilitate digital threads, and interoperate with external systems, technologies, and frameworks.

3.2 Value with Google Cloud

Built on top of Google Cloud, DT/Flash leverages Google Cloud's scalability, advanced analytics, powerful GenAI and AI agents, and high-speed data processing to enhance its accuracy and efficiency. The main components of DT/Flash include:

Figure 4. DT/Flash architecture on the Google Cloud Platform



Data ingress
Data can be ingested directly via real and/or simulated IoT telemetry sources, as well as via integrations with existing enterprise systems, including Google Cloud's Manufacturing Data Engine (MDE).

Stream processing
Telemetry is streamed according to its source and desired twin fidelity. Typically, streaming records are ingested into DT/Flash via Google Cloud's Pub/Sub documentation messaging service.

Batch processing
Batch data processing may be needed to ingest metadata and historical records, instantiate DTML models derived from source systems, and to accommodate other scenarios. DT/Flash leverages Google Cloud's Data Fusion, Dataproc, and Dataflow tools for this purpose.

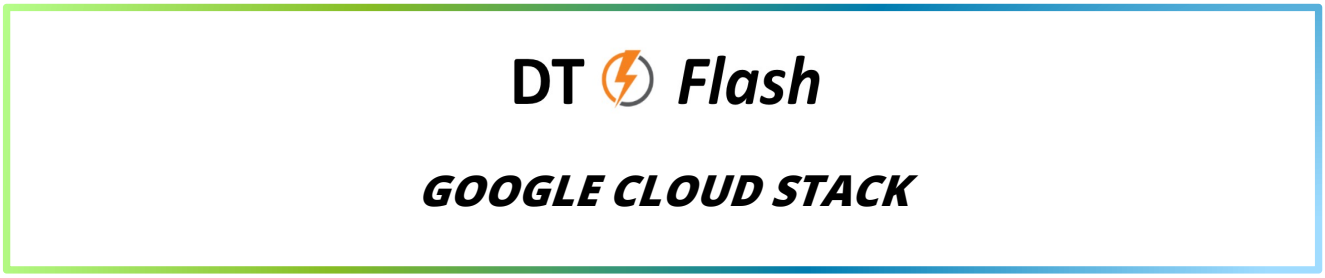
Storage layer
The DT/Flash storage layer can include graph database, time series telemetry, and optional metadata datastores. The graph database was designed leveraging Neo4j deployed to Google Cloud and acts as the "digital twin graph," where DTML models are instantiated and live. The time series datastore acts as a historic store of the telemetry ingested into a DT/Flash instance, where data is often leveraged for analytics as well as model training.

Analytics, operations, and alerts
Google Cloud-native tools like Gemini, Cloud Monitoring, Looker, and VertexAI can be effectively leveraged with DT/Flash, as well as other third-party technologies.

Business applications
DT/Flash is designed to facilitate downstream business applications that might otherwise not be technically feasible or cost permissive. It can also be leveraged to build a multitude of custom applications across an enterprise.

Gen AI / Agentic AI:
DT/Flash is tightly integrated with Google's Generative AI and agentic technology to deliver more value through multimodal capabilities by creating highly detailed and adaptive simulations that provide deeper insights and automated optimizations for complex systems.

Figure 5. Illustrative technology stack to deploy DT/Flash on Google Cloud



Visualization and automated reporting	*Looker, Looker Studio, Tableau, Grafana, Power BI, Qlik, ML/AI & Gemini*
Digital Simulation & Recommendation	*Gemini models, Vertex-AI (AI Agents)*
Optimization	*Visual Inspection AI, Machine-level Anomaly Detection, Predictive Maintenance, Root Cause Identification, Inline Quality Control*
API management	*Apigee, API Gateway, Cloud Endpoints*
Modeling language and common data model	*DT/Flash DTML*
Graph database	*Neo4j*
General and time series data storage and processing	*BigQuery, BigTable, Memorystore, Cloud Storage, Cloud SQL, Spanner*
Data ingestion	*PubSub, Kafka, MQTT (for Real-time message processing)* *DataFusion, Dataproc, Dataflow (for Batch data processing)*
Data sources (IT/OT)	*Google MDE (Manufacturing Data Engine)* *IIoT Monitoring* *ERP, MES, PLM, SCADA, SCM*

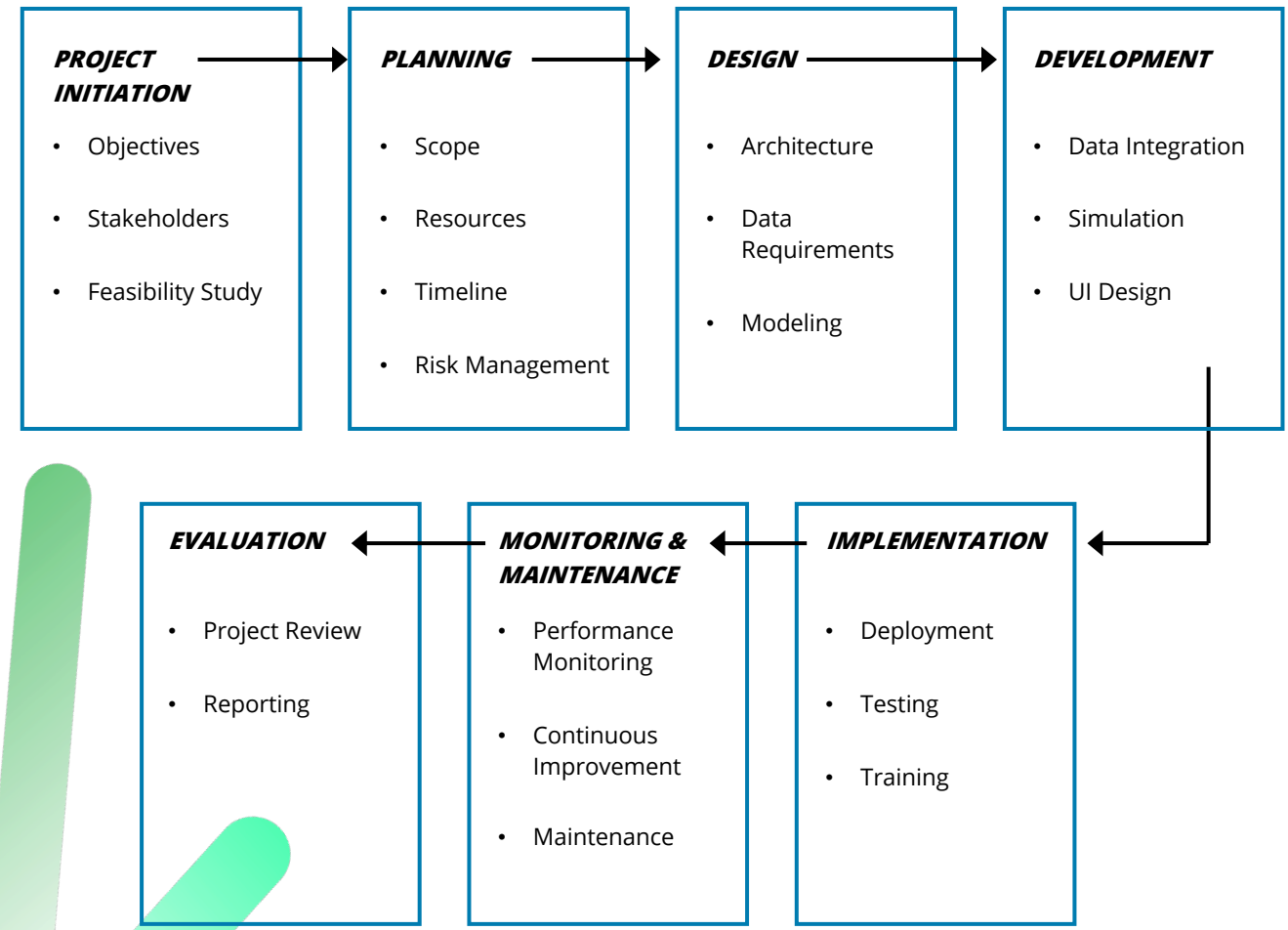
4 A biopharma company's digital twin journey using DT/Flash

In the competitive and highly regulated world of biopharma, maintaining an efficient and reliable supply chain is essential. A prominent biopharma company faced significant challenges in its supply chain operations, including inventory mismatches, delayed shipments, and quality control issues. To address these challenges, it embarked on a transformative journey to implement a digital twin solution.

The company's supply chain complexity was exacerbated by its global reach and the sensitive nature of its products. The company struggled with real-time data integration and visibility, which often led to operational inefficiencies and increased costs. The leadership team identified the need for a digital twin solution that could mirror its physical supply chain operations, enabling predictive analytics and real-time decision-making.

Understanding the intricacies of digital twin technology and its potential impact on its operations, the company collaborated with Deloitte. This collaboration aimed to leverage Deloitte's digital twin solution, DT/Flash, and its experience in digital transformation and deep industry knowledge in the life sciences sector to develop an effective and purpose-built digital twin solution.

Figure 6 : Building digital twins using DT/Flash



Project kickoff phase: Work began with a full analysis of the company's existing supply chain processes. Deloitte's team worked closely with the company's team to understand the full supply chain, identifying data points and processes that could be critical to the digital twin model. The design phase focused on creating a scalable model that could simulate its supply chain dynamically under various scenarios, helping the company anticipate issues and adjust strategies proactively. Using DT/Flash, the company was able to conduct a large set of simultaneous simulations, each with different variables settings, helping to identify local maxima and the global maximum, affording the company the ability to make more effective optimization decisions.

Data integration phase: The data integration phase involved ingesting data from a myriad of systems, including the company's SCM, WMS, IMS, and ERP. In addition, the project team deployed sensors and IoT devices across the company's supply chain network to collect real-time environmental, location, asset condition, operational, and event data. Using DT/Flash, the data was integrated into a centralized graph database repository.

Development phase: The next step involved the Deloitte team developing a digital twin of the company's supply chain, encompassing virtual representation of manufacturing facilities, distribution centers, and suppliers. Transportation networks were considered in the subsequent stage. The digital twin allowed for various simulation scenarios, such as demand fluctuations, supply disruptions, and operational changes. Furthermore, the company was able to forecast future trends and identify potential risks, and simulate strategies and actions that addressed challenges and set the stage to achieve high-quality performance.

Deployment phase: The digital twin was deployed in a phased manner, starting with a pilot project focused on the company's distribution center and inventory optimization. The solution was integrated with existing systems and workflows to provide effective integration.

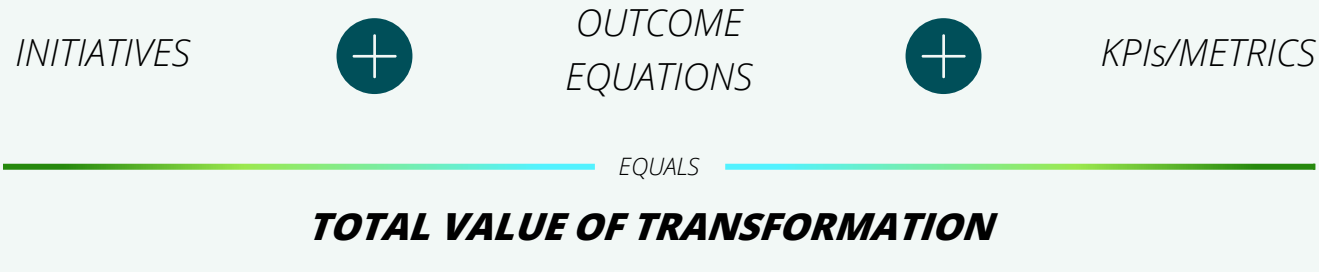
The **results and benefits** gained from the digital twin initiative included 20% optimization of inventory levels, 15% increased forecast accuracy, identification of potential supply chain disruptions and proactive mitigation measures, and actionable insights for informed decision-making across the supply chain.

5 *Quantifying the value and measuring the impact of digital twins using DT/Flash*

Quantifying and measuring the value of digital twins can be tricky, but focusing on cost savings and efficiency improvements is a good starting point. Metrics such as inventory reduction via optimized forecasting, decreased transportation costs from route optimization, and fewer stockouts through proactive management are important details in measuring digital twin efficacy. By quantifying cost reductions and operational improvements, businesses can demonstrate tangible financial benefits associated with supply chain digital twins.

To properly quantify DT/Flash's benefits, Deloitte's value quantification methodology, known as Value(T), considers and calculates value outcomes across a wide spectrum of transformation initiatives. ***Value(T) is based on the following formula:***

Figure 7 : Deloitte value quantification methodology - Value(T)



Initiatives represents the initiatives being explored. **Outcome Equations** involves the financial outcomes of initiatives and how they are calculated, and **KPIs/Metrics** point to the metrics that feed the equations.

Following are a few example use cases of how DT/Flash can improve supply chain and operations:

USE CASE 1

Operations:

Optimize inventory management

Combined with optimization algorithms, DT/Flash can provide a powerful data-driven approach for optimizing inventory management, particularly in helping businesses find the specified spot between minimizing stockouts and holding costs, resulting in leaner and more efficient inventory operations.

Equipped with optimization algorithms, DT/Flash can help reduce inventory levels by 1.5% to 3%, resulting in reduced inventory holding costs.

USE CASE 2

Operations:

Reduce product/parts recalls

Combined with computer vision, DT/Flash enables manufacturers to detect physical defects, foreign objects in the product, missing components, packaging consistencies, and other anomalies, and subsequently trigger quick interventions such as stopping production to address the problem(s), and/or isolating and quarantining potentially affected product(s).

Paired with computer vision models, DT/Flash can help businesses to reduce their product and parts recalls by 50% to 80% by allowing for proactive approach to quality control.

USE CASE 3

Planning and fulfillment:

Enhance regional/global demand planning

By offering a dynamic and data-driven approach, DT/Flash can improve businesses' demand planning by 30 to 50% and create a more responsive and flexible supply chain.

DT/Flash can anticipate regional and/or global demand fluctuations and enhance demand forecasting, proactively manage inventories, allow for powerful scenario planning and simulation, and improve collaboration between stakeholders involved in demand planning.

DT/Flash can enable businesses to reduce risk of stock-outs, leading to higher customer satisfaction and improved business outcomes.

The following two scenarios demonstrate how to quantify and measure the impacts of DT/Flash in regional and global demand planning (use case 3 above).

SCENARIO 1

Objective
Reduction in inventory holding cost due to better demand planning

KPI
Percent reduction in addressable inventory holding cost

Improvement measure
10 to 12%

Financial impact calculation
% reduction in addressable inventory holding cost X addressable inventory holding cost

Estimated financial impact
Reduced holding cost

SCENARIO 2

Objective
Increase in revenue due to fewer stock-outs enabled by enhanced demand planning

KPI
Percent of lost revenue, percent of stockouts due to incorrect planning, percent reduction in stockouts

Improvement measure
4%, 28%, 75% (associated with above KPIs)

Financial impact calculation
% of lost revenue X % of stockouts due to incorrect planning X % reduction in stockouts X Addressable revenue

Estimated financial impact
Increased revenue due to fewer stock-outs

6 DT/Flash in action: Inventory optimization and predictive analytics at a biopharma company

Challenge: A large biopharma company sought to revolutionize its operations by infusing data science into its supply chain for improved planning, forecasting, and scenario simulation. The organization aimed to transition from traditional step-wise, sequential models to an integrated network and warehouse operations model for enhanced cost efficiency, inventory turnover, and on-time service performance.

Solution: Deloitte facilitated the client's sustainable analytics transformation in two phases, first by developing a proof of concept (POC) for a subset of the network, products, and stores, and then deploying a full-scale, end-to-end supply chain simulation model across the network. This model incorporated capabilities for "what-if" scenario planning, improved demand forecasting, risk indicators, and end-to-end business planning levers.

Impact: The approach resulted in real-time visibility and monitoring of the distribution network, data-driven scenario planning, enhanced resource allocation, predictive analytics for demand forecasting, and improved distribution operations. It also led to enhanced inventory optimization, increased supply chain efficiency, better supplier relationship management, compliance with regulatory requirements, and improved quality control, thereby transforming the client's operations and achieving its goals.

7 Getting started

As the use cases, studies, and scenarios explored in this paper reveal, whether you need to enhance operational efficiency, reduce costs, or help provide a more reliable supply of medical products, Deloitte's DT/Flash solution has the versatility needed to help biopharma companies address numerous life science circumstances.

In life sciences supply chain management specifically, Deloitte's DT/Flash solution offers a depth of analysis, modeling, control, and learning tools and techniques to help your organization realize improved performance analysis and disruption modeling, real-time supply flow control, adaptive risk mitigation, and beyond.

Learn how we can help address your particular needs by contacting our team today.

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