Thread-First Thinking

Staying in front of the immense wave of product data

Accenture Industry X

accenture

The Digital Thread and Twin Disruption

In almost every industry, companies are transforming product development with various Digital Twin and Digital Thread solutions —both of which aim to make much better use of their existing process, equipment, and product data.

A "Digital Twin" is a digital representation of at least a portion of the product's entire lifecycle—its hardware and software design, manufacturing processes, and its use by customers.

The "Digital Thread," on the other hand, is the "stream" of data that flows through the product's entire lifecycle—from ideation to requirements through design, manufacturing, and service while enabling a wide variety of benefits: simulation, testing, analytics, optimization capabilities, and many others.

Together, Twins and Threads promise to deliver a veritable step-change in engineering, manufacturing, operations, and beyond—a step-change that could significantly increase efficiency and flexibility while minimizing costs and risks[1]. They've even been shown to boost business' overall sustainability[2].

> **It's not surprising that companies are heavily investing in this space— it's exciting!**

Accenture's analysis shows that most companies are not realizing a total return on their digital twin investments.

Companies are possibly missing out on 35–65% of the value of their digital thread and twin data investments—and, therefore, often fail to meet their own return-on-investment expectations. At Accenture, we often hear from companies how they struggle with:
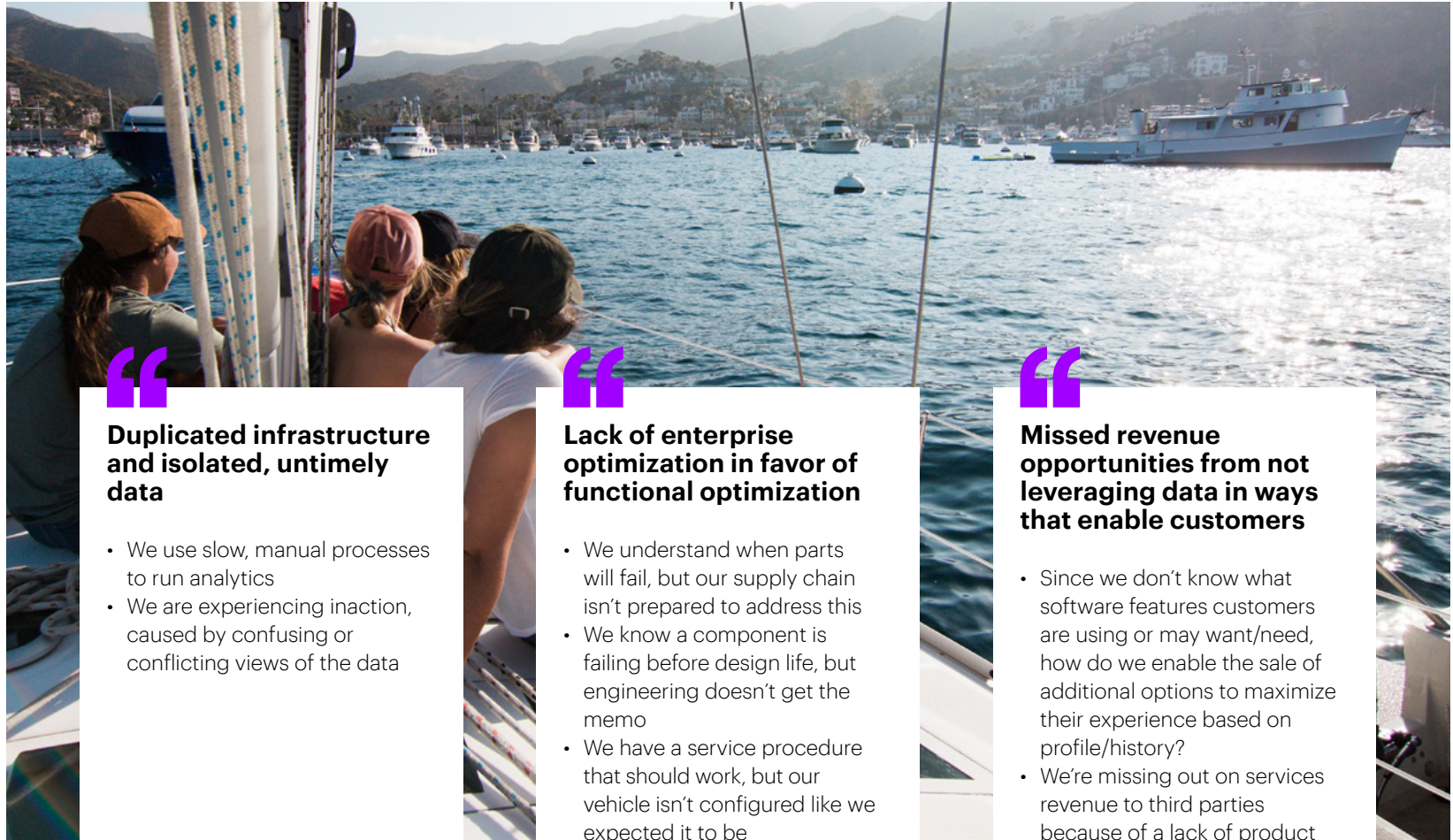
" Duplicated infrastructure and isolated, untimely data

- We use slow, manual processes to run analytics
- We are experiencing inaction, caused by confusing or conflicting views of the data

" Lack of enterprise optimization in favor of functional optimization

- We understand when parts will fail, but our supply chain isn't prepared to address this
- We know a component is failing before design life, but engineering doesn't get the memo
- We have a service procedure that should work, but our vehicle isn't configured like we expected it to be

" Missed revenue opportunities from not leveraging data in ways that enable customers

- Since we don't know what software features customers are using or may want/need, how do we enable the sale of additional options to maximize their experience based on profile/history?
- We're missing out on services revenue to third parties because of a lack of product knowledge

All of which poses the question: What went wrong?

Too narrow a view?— The issue with existing Digital Twin efforts

In our experience, it's all in how these companies approach their digital twin efforts in the first place, more specifically: In how they view their investments into digital twin solutions.

In almost all cases, these businesses focus on "standalone" digital twins for a single function. Instead of pursuing a comprehensive strategy for data integration and sharing, they merely opt for a function specific twin focused on either engineering, manufacturing, operations or "management" exclusively.

Combine that with the fact that they also tend to focus on the "twin"—or the front-end experience—of their effort, and you begin to see how a narrow view of digital twins might prevent these companies from capturing the full value of the Digital Thread and Twin:
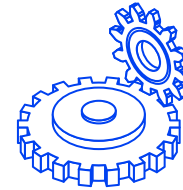
Operations twin

Overview
Focuses on Internet of Things (IoT) to capture data from connected equipment and products and to support near real-time reporting and predictive analytics
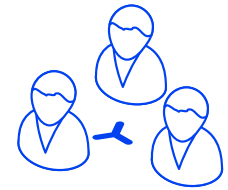
Typical Focus Areas
- Manufacturing Operations
- Supply Chain
- Asset Management

Engineering twin

Integrates data across the product development cycle but focuses more on engineering use cases and value

- R&D
- Engineering
- Design

Management twin

Integrates data across the enterprise to often solve real problems, but tends to bloat. Also faces challenges when scaling across functions and businesses

- Sales Performance, Finance
- Ideation
- ...

So; what if these companies pushed for a broader vision?

# Thinking bigger: How a "thread-first perspective" can help

With the tools and methods at their disposal today, companies can push for a much broader vision: The IoT, cloud computing, and modern data management techniques have matured to a point where companies can opt for much less constrained approaches to Digital Twin and Thread solutions, and pursue much bigger objectives around company-wide cost and risk reduction, efficiency and flexibility increases, and sustainability.

The objective of the Digital Thread—in its purest form—is to integrate data across all steps of the product development lifecycle, i.e., across engineering, manufacturing, operations, and management. Companies must look beyond narrow, function-specific definitions and broaden their discussions to include more data sources. And they must take advantage of cloud-capabilities (like cloud-powered Engineering or Manufacturing[3]) to facilitate the necessary integration.

By thinking like this, businesses can reimagine their digital twin efforts and shape a comprehensive "Digital Thread" strategy, which then …

1 takes advantage of all current twin concepts and expands beyond them—fully utilizing all of the data inside (and outside!) a company
2 factors in new technologies and development techniques; and
3 leverages cloud infrastructure to create and scale an enterprise-wide Digital Thread and Twin that can finally live up to the hype.

This isn't to say that there's no value in standalone Twins—there absolutely is. But in our experience, the best way of maximizing value is to think "Thread First."
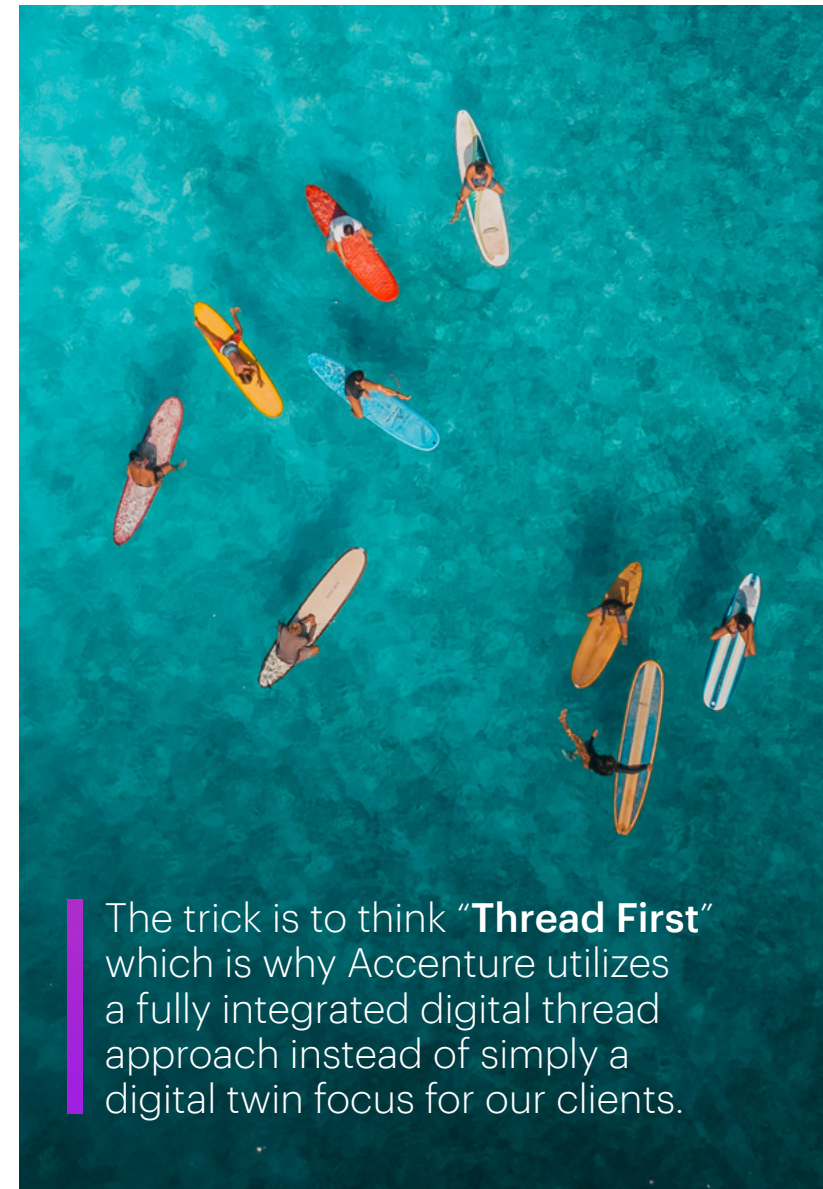
The trick is to think "**Thread First**" which is why Accenture utilizes a fully integrated digital thread approach instead of simply a digital twin focus for our clients.

How Digital Twin-led thinking might result in missed value—a hypothetical example:

Aircraft engine manufacturer

Situation
The company has a contract with a performance pay component based upon operational hours and plans to leverage a digital twin to optimize margins.

Opportunity
A Digital Twin that leverages engineering data, operational telemetry data, and structured flight data (day/time, location, flight plan, etc.) that would reduce uncertainty in availability and reduce costs associated with unplanned maintenance.

Transformation Benefits
Support Aftermarket/Services to recommend preventive maintenance activities that will:
- Improve engine availability by 10–25%
- Reduce unscheduled engine downtime by 40–70%

Missed Benefits
While the standalone Twin creates undoubted value; the data could also be used by:
- Engineering to improve design life algorithms to reduce unnecessary maintenance by 10–30%
- Supply Chain as demand signals to improve forecasting by 20–40%
- Marketing as an input to allow customers to see issues with their products

Reviewing your strategy—how to scrutinize your "standalone" Twins

To begin the shift towards a "thread first" strategy, companies can review their "standalone" efforts to fully understand which kinds of value they create—and where they're falling short.

Operations twin

What you get
- Edge computing capabilities
- Multiple solution providers to choose from
- Data infrastructure that allows the understanding of real-world asset data
- Optimized for moving large amounts of time-series data
- "Reflexive" asset monitoring and alerts

Where it falls flat
- Solutions tend to focus on specific assets or groups of assets
- Solutions are typically limited to link various external data elements
- Not geared for running cross-enterprise analytics and requires "local" infrastructure

Engineering twin

What you get
- Linked design information, virtual representations
- Real-world information linked to engineering designs
- Integrated engineering and manufacturing work processes

Where it falls flat
- Projects can be time-consuming and challenging to implement
- Value proposition is typically limited to Engineering/R&D or Manufacturing
- PLM architecture is not suited for massive amounts of data
- Certain software solutions (like platforms designed by PLM vendors) are restricted to Engineering and Manufacturing use cases

Management twin

What you get
- Agile development, supporting multiple data sources
- Flexible tools which enable citizen development (e.g., Tableau, Power BI, Qlik, Alteryx, Talend, Mendix, etc.)
- Manage massive amounts of data and analytics, integrate AI/ML capabilities
- Typically cloud-enabled (on-premises, off-premises)

Where it falls flat
- Pilot purgatory: quick proofs of concepts drag out over years and tend to experience bloat and scope creep
- Limited ability to act directly on the data and insights displayed
- Difficult to build standardized solutions

Don't view the "Thread-First approach" as negating your existing digital twins and architecture; see it as a new lens with which to view your investments and drive a more unified approach instead. "Thread First" thinking is all about using the right tools for the right job.

Building the case for "thread first"—with fully-integrated digital thread benchmarks

Once the benefits and shortcomings of individual digital twin efforts are clear, companies can strategize (and, eventually, work towards) weaving them together to form an enterprise-wide digital thread. Such efforts usually start with the build-up of a business- or value case – a task which, in our experience—often results in surprising numbers:

> In our analysis of companies that have merged the data supporting standalone Twins into a fully-integrated Digital Thread, typical value propositions are:

Cost Optimization*
- **20% – 40% reduction** in costs for data duplication and overlapping toolsets
- **Up to 5x the speed** of data capture and curation through thread automation
- **2 – 3x data re-use** through cross-functional access to data
- **15 – 40% improvement in time** to market via enhanced design team coordination
- **10 – 50% reduction** in product renovation activities through data-driven design

Post-sales revenue growth*
- **30 – 45% increase** in accuracy in predicting service or spare parts needs
- **10 – 25% reduction** in customer churn through more focused customer offerings
- **Up to 5x increase** in services revenue through new service offers targeted towards specific consumers
- **10 – 20% increase** in market share through superior service offerings

*(dependent on industry)

Realize more comprehensive value by supporting twins on a fully-integrated thread

Operations Twin

Management Twin

Digital Thread

Engineering Twin
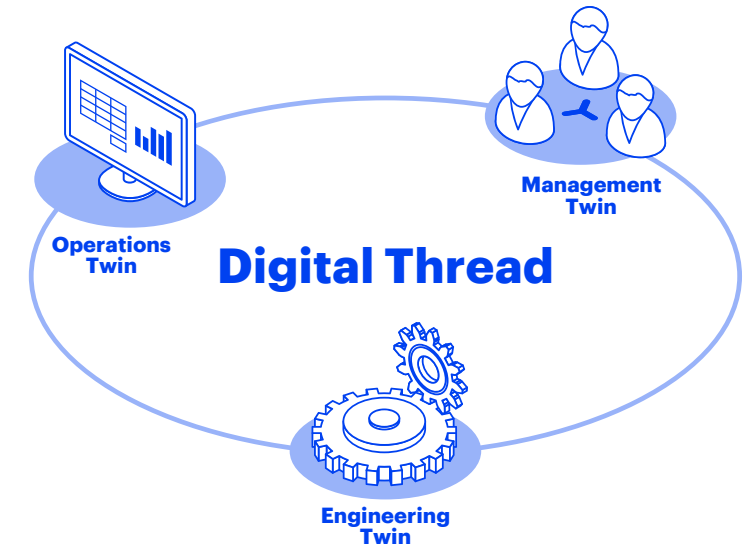
"Thread-first approach" to enable these scenarios

Imagine a world where ...

Situation
Airlines not only understand the near real-time status and location of individual assets, but they can also constantly evaluate the health of each system within an aircraft.

Opportunity
Avoid public incidents; meeting contractual "power by the hour" targets for bonuses

Transformation Benefits
- Applications supported by the thread that automatically recommend options (with the right context) for actions that support optimal outcomes at speed
- Sets up the supply chain to support those actions that are taken
- Triggers engineering to make design changes that reduce these issues in the future

Imagine a world where ...

Situation
Brand managers can see a consumer trend in near-real-time and respond with packaging changes in a matter of days and not months.

Opportunity
Understand the performance of their brands and portfolios and get machine-assisted product renovation recommendations

Transformation Benefits
- New trends are recognized in record time, allowing brand managers to hit the trend for the right products
- Product managers receive automated recommendations for these trends on packaging and formulation changes that allow them to move from insight to actions
- Tighter integrations to manufacturing and supply chain applications using the fully-integrated digital thread means no one is left behind

Imagine a world where ...

Situation
A semiconductor company is undergoing a PLM transformation and is able to both cleanse and analyze data—achieving real value prior to the data being migrated to the new platform.

Opportunity
Improve accessibility to key product information turning a typical PLM transformation project cost into a valuable asset and foundation

Transformation Benefits
- Parts are analytically evaluated prior to migration, allowing standardization and deduplication recommendations, reducing the burden on the new solution
- Engineering data forms the core of a new Digital Thread prior to the platform coming online creating new opportunities for value
- Data used for migration is made accessible to service teams that are now able to make better decisions and improve customer outcomes
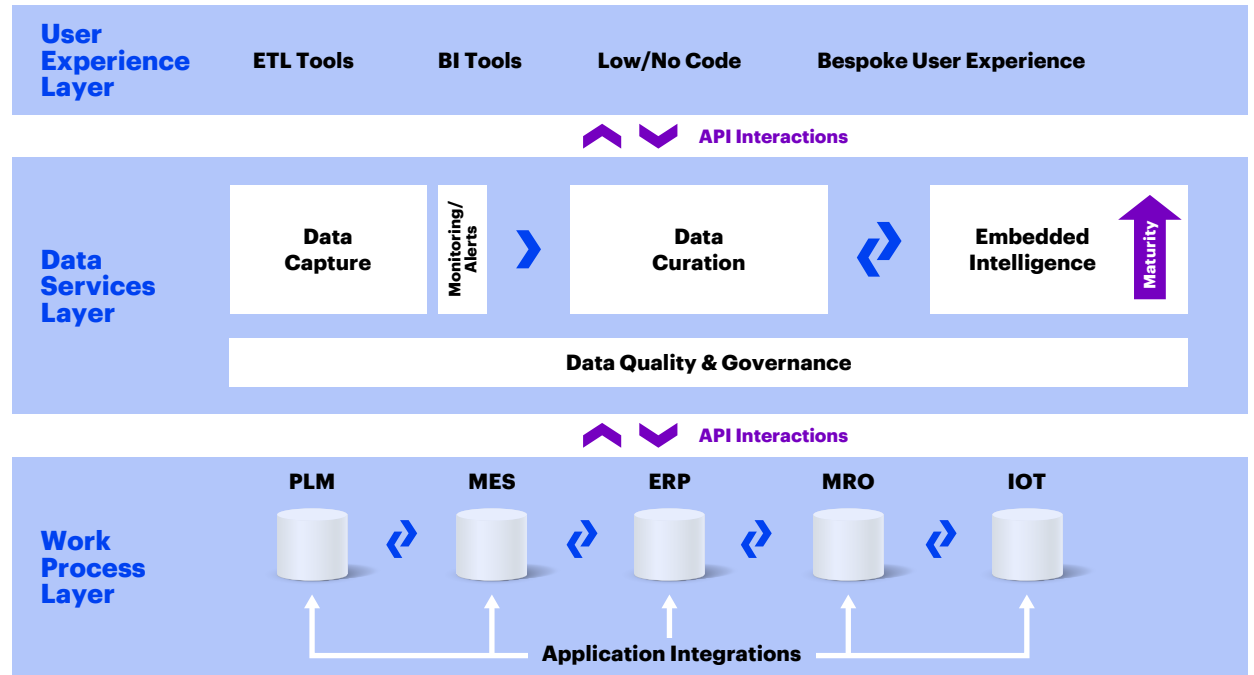
Weaving your thread together—Accenture's value realization framework

Through our Industry X and Applied Intelligence practices, Accenture has developed a solution—MyDigitalThread— to accelerate the creation of fully integrated threads.

Cloud-enabled and technology-agnostic, our solution allows us to quickly accelerate our clients' value realization for their twin—from years to weeks in some cases.

This approach is successful because it incorporates the elements of each of the digital twin categories into a holistic architecture that addresses everyday challenges. This enables a fully integrated, enterprise-wide digital thread. Each level of this framework offers different capabilities that often already exist at our clients and merges them to create the fully-integrated thread and support a variety of Digital Twins.

Connect all types of digital twins with flexible, API-driven interactions.

User Experience Layer   ETL Tools   BI Tools   Low/No Code   Bespoke User Experience

API Interactions

Data Services Layer   Data Capture   Monitoring/Alerts   Data Curation   Embedded Intelligence   Maturity

Data Quality & Governance

API Interactions

Work Process Layer   PLM   MES   ERP   MRO   IOT

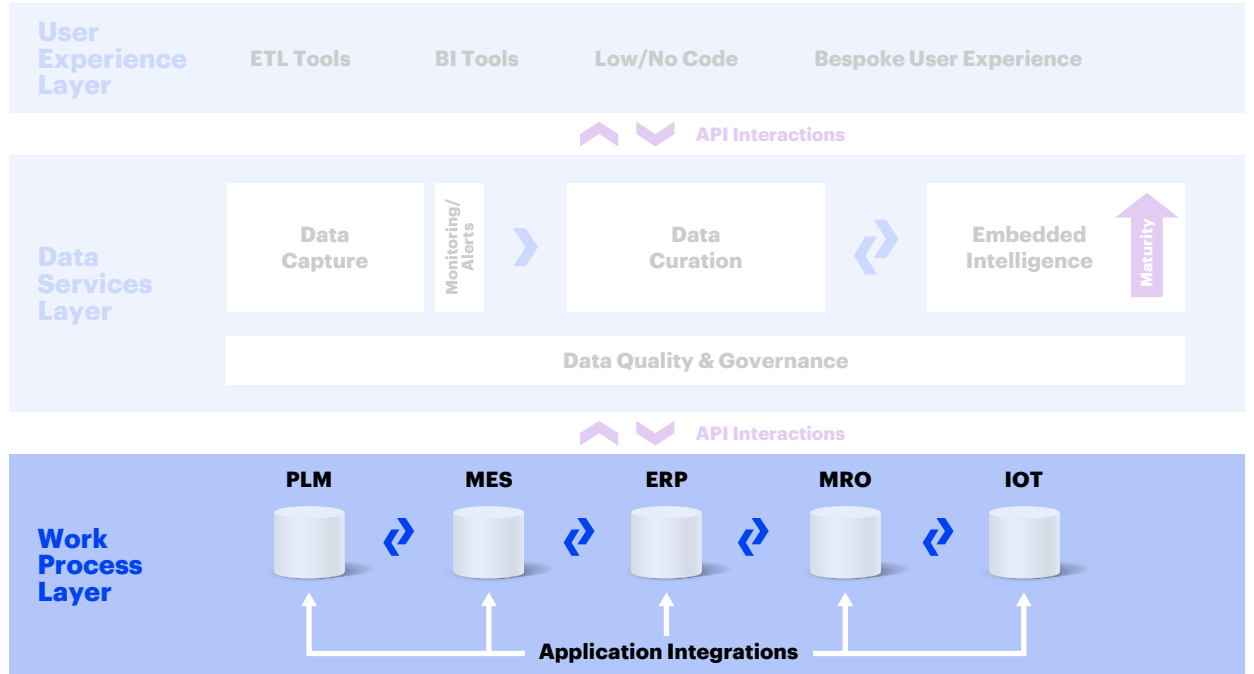Application Integrations

Source: Accenture

Work Process Layer—This is the "traditional landscape"—the basis of the Digital Thread and also many Digital Twin use cases. This layer supports the authoring and management of the product development process.

The application acronyms may be different in your organization, but the concept is the same: you author data in the Work Process layer, and integrate them here to support an optimal product development workflow. In particular, the PLM (Product Lifecycle Management), MES (Manufacturing Execution Systems), ERP (Enterprise Resource Planning), MRO (Maintenance, Repair and Overhaul), and IoT (Internet of Things—made up, for example, by your connected equipment and products) applications are critical to building the data that feeds the digital thread and twins.

Thread First Enables:

Data and insights that can be presented to users in the context of their daily work—for example:
- Flagging asset issue for maintenance
- Engineering work prioritization in PLM
- Alternative sourcing options in ERP

User Experience Layer — ETL Tools — BI Tools — Low/No Code — Bespoke User Experience

API Interactions

Data Services Layer — Data Capture — Monitoring/Alerts — Data Curation — Embedded Intelligence — Maturity

Data Quality & Governance

API Interactions

Work Process Layer — PLM — MES — ERP — MRO — IOT

Application Integrations

Data Services Layer—This is the core for the fully-integrated Digital Thread. Storing the data capture and curation in a separate layer prevents the complexities of "forcing" data into applications within the work process layer in an unsupported way. Pairing this with automated data pipelines and native analytics—AI/ML and simulation tools—enables faster development and iterations that mean our clients can focus on the valuable outcomes of digital twin investments instead of expensive and slow data manipulation/integration and bloated timelines.

Benefits of the Data Services Layer include (but are not limited to):
- Increased data automation and accessibility
- Increased transparency of the data—enabling governance
- Increased data quality (you can't fix data if you can't see it)
- Increased consistency and reusability of information

An added bonus: because this layer leverages cutting edge data management tools and capabilities—it can also be used to support complex data migrations across the value chain!
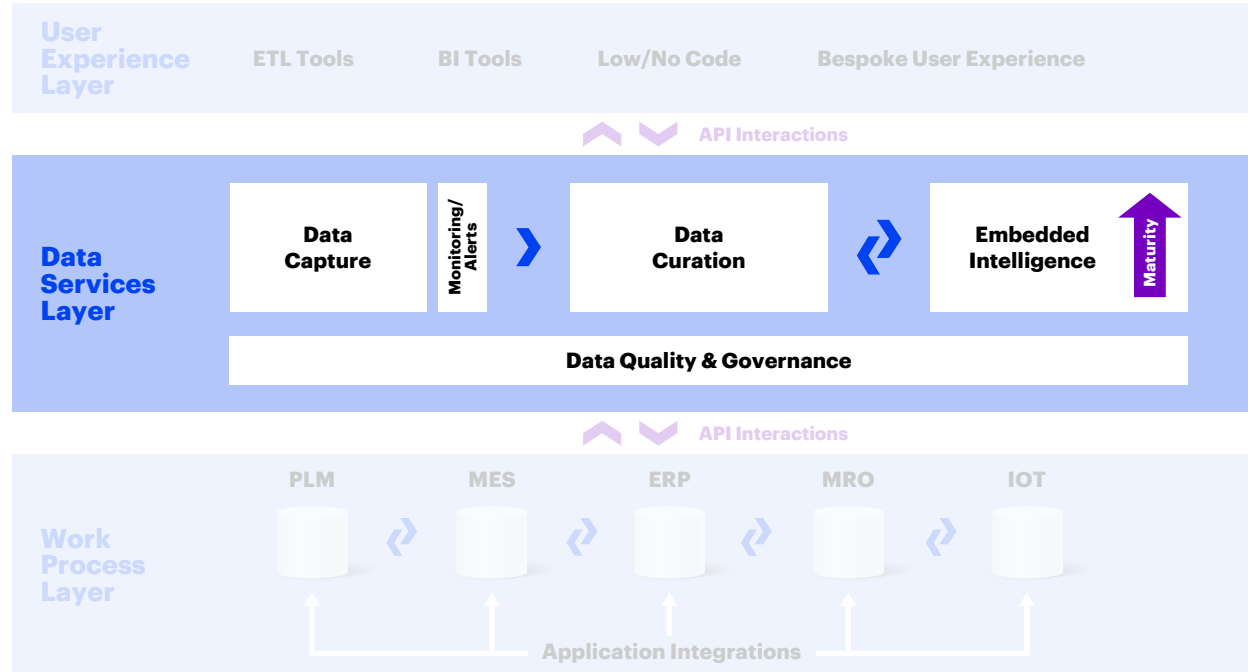
Thread First Enables:

Integrated data service layer that:
- Capture and storage of data as it is generated
- Development of data pipelines to automate and aggregate
- Integrated Simulation, Analytics, and AI/ML capabilities
- API/Microservices to support flexible and focused interaction with data and insights

Accelerated by Cloud
This data services layer can be accelerated through the newly mature technical capabilities offered by cloud platforms (such as Microsoft Azure, Amazon Web Services (AWS), and Google Cloud). On-premise tools may—of course—be used but can limit the speed of Digital Thread and Twin transformations. Using the cloud platforms means that virtually all of the data required to support the fully-integrated digital thread and twin can be more easily captured and curated using data pipelines in a timely manner from internal and external data sources.

User Experience Layer is where many (but not all) Digital Twins are developed. By sitting atop the thread and accessing data in a more standard way, the user experience layer provides an ideal foundation for agile projects and data discovery. Solutions in this space can be simple, like a basic data visualization (e.g., PowerBI, Tableau, Splunk, etc.) or detailed data analysis via user-friendly ETL tools or Low Code/No Code (e.g., Talend, Alteryx, Mendix, etc.). Solutions can also involve bespoke web applications (i.e. a complex Customer Portal that is available on the web or as an app).
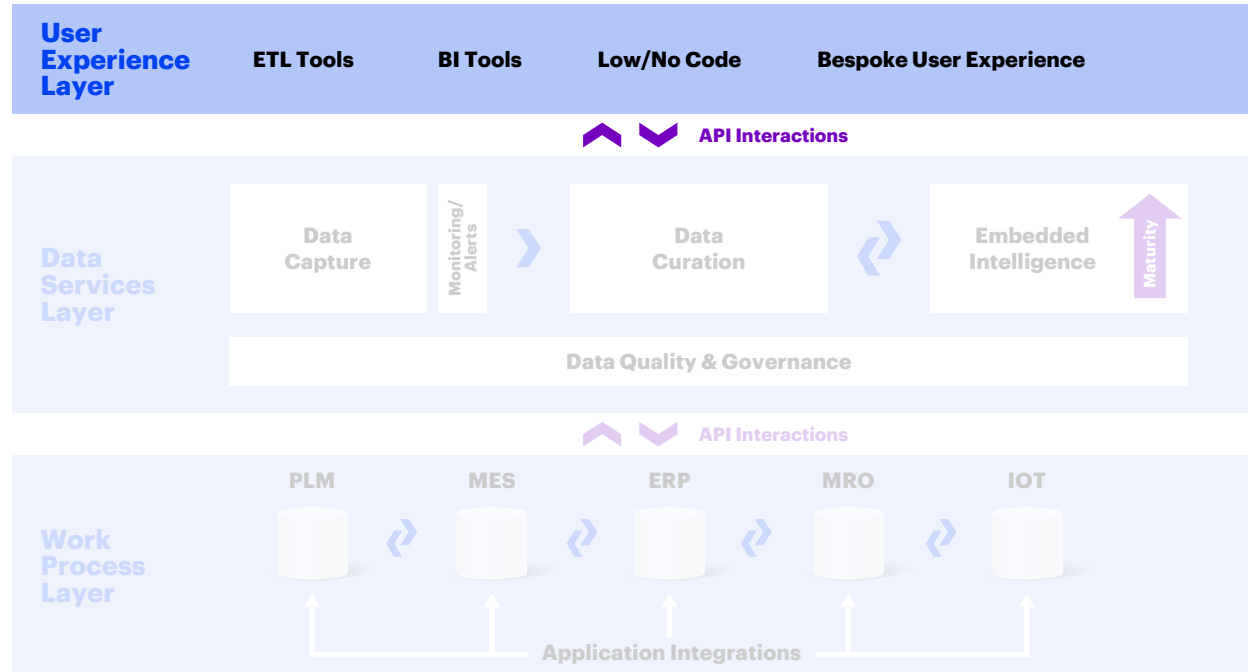
What matters here is that solutions built in this layer are built on a common fully-integrated Digital Thread that encourages the reuse of data. Done right, this can increase development velocity since the data is already there, and it can reduce data inconsistency across organizations.

Thread First Enables:

Persona-driven, value-oriented access to:
- Healthy, curated data
- Published proven models
- AI capabilities that facilitate decision making

The APIs standardize the ways in which data flows among all three layers. Additionally, APIs make more of the work reusable between an organization's different layers. Setting up the APIs can take additional upfront effort, but it offers advantages in security, flexibility and reusability for others within the enterprise.

User Experience Layer	ETL Tools	BI Tools	Low/No Code	Bespoke User Experience

API Interactions

Data Services Layer

Data Capture — Monitoring/Alerts — Data Curation — Embedded Intelligence — Maturity

Data Quality & Governance

API Interactions

Work Process Layer

PLM — MES — ERP — MRO — IOT

Application Integrations

The Supporting Cast: Managing the complexity of this landscape is a challenge – and while no single piece of the puzzle is out of reach for most of our clients—keeping all of the data flowing through the thread to support the different twins is a huge task. Every step has to be supported with the right toolsets and approaches (e.g., DevSecOps, Data Architecture/Security, Agile and waterfall methodologies, skilled human resources, etc.).

Understanding how these architectural elements fit together allows us to help our clients solve for a fully-integrated Digital Thread. By using this approach and the underlying technologies to fill in the gaps of each layer, they complement each other, enabling us to begin to achieve the promises of the Digital Thread and Twin.

How to get started: testing the waters for "thread-first thinking"

Some of our clients have started their journey and are on their way to the fully-integrated Digital Thread but are intimidated by the breadth of the challenge designed to achieve their vision. Other clients are just dipping their toes into the water and are wrestling with how they even define Digital Twin and Thread. However, most of our clients are somewhere in between—looking for help to build out their Twin and Thread vision and take transformational first steps.

Every company's transformation begins at a different starting point.

In all cases, Accenture can help. We use our proprietary MyDigitalThread platform to support exploration and to help clients choose the right track to their digital twins:

Track 1

Client concern
Should we build a digital twin and thread for our business?

Our recommendation
Thin Slice Pilot

Objectives
- Identify use cases
- Test and learn
- Identify risks
- Measure impacts
- Match what your competitors are doing

Track 2

How do we deploy the right digital thread and twin in our business?

Project/Program Accelerator

- Identify the right digital twin
- Deploy digital twin and thread with minimal disruption to the business
- Manage people change around the digital twin and thread

Track 3

How do we get the most out of digital thread and twin?

Offering as a Service

- Integrate digital twin with your existing systems
- Gather insights and recommendations from the digital twin and thread to help your business
- Identify security data considerations
- Extend digital twin and thread capabilities

Each of these approaches gives a fresh perspective on digital industrial environments—to help you make better decisions and realize total value faster.

Conclusion

Think "Thread First"

Avoid single purpose and "standalone" Digital Twins and focus instead on a fully functional thread as the foundation which will support your digital twin aspirations. This will unlock significantly more value for your organization by standardizing your approach and toolsets while avoiding data and solution overlaps.

Use the right tools for the job

Don't get locked into pushing a "standard" architecture that will be exceedingly difficult to achieve. Recognize that "ideality" and "reality" are different things and that the landscape for a typical company is ever-changing and heterogeneous. Balance investment in each part of the Digital Thread – existing and new applications as well as data services and new user experience capabilities. Create a digital framework that allows for solution flexibility; while retaining the ability to grow and learn using different toolsets.

Think big; Plan for the future of the Thread and Twin

Whether an organization is just starting its Digital Thread and Twin journey or tuning it, it should keep an enterprise architecture-driven perspective. Work to design a Digital Thread and Twin that can support what you have already done as well as what you're planning to do next or in the future. In other words, work to build an enterprise level Digital Thread for the entire organization.

Look at each Digital Thread and Twin effort to expand the reach of your common architecture in a way that can be leveraged by all. This can be done one step at a time, but each step should be in the same direction and should contribute its value across the organization.

Surfing the wave to a "thread-first future"

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