FIND THE BEST BALANCE BETWEEN QUALITY, STANDARDS & COST

Involving the Value Chain to Create a
Collaborative Quality Environment

STATE OF THE INDUSTRY

Across all industries, product quality matters. The American Society of Quality estimating that many organizations incur quality-related costs as high as 15-20% of sales revenue, it is no surprise that manufacturers are adopting Total Quality Management (TQM) as a strategic business initiative.

With advancements in Artificial Intelligence (AI), Machine Learning (ML) and Virtual Twin technologies, organizations can analyze massive amounts of quality data to detect patterns, find correlations and make evidence-based decisions, making TQM objectives more achievable than ever.

With so much at stake, why haven't more organizations achieved their quality goals? It is because the challenges working against total quality objectives are considerable:

- Increased in product and process complexity strain quality resources.
- Accelerated delivery schedules leave less time to ensure quality.
- Quality management consists of siloed systems and data sources.
- Disparate product development systems (design, simulation and manufacturing) inhibit using product data to identify and resolve quality issues proactively.

Enterprise business processes are mainly designed to support the so-called "happy path." Unexpected situations are very often handled aside from the standard operating procedures. Exchanges and issue resolution are not properly tracked and reported back into the enterprise process.

From both cost (recalls, warranties) and opportunity (customer loyalty, competitive differentiation) perspectives, it is clear why organizations view TQM as an essential component of overall business strategy. This eBook discusses quality challenges faced by product development organizations and provides valuable insight into how the **3D**EXPERIENCE® platform and its Virtual Twin capabilities uniquely address them.

Global demands differ depending on a country's level of economic development and cultural preferences, giving rise to complexity for global companies. The internet is driving Industry 4.0 with new regional regulations, demand for ever-higher quality and streamlined operations that can increase the capacity to deliver innovative products, control costs and maximize profits.

While regulators present challenges of their own, manufacturers are also pressured to appeal to their global customers' diverse wants and needs. To address this, manufacturers usually employ siloed solutions to solve challenges along the value chain.

That approach offers some level of quality management, but it is clearly insufficient to meet future demands with confidence — it is not total quality management.

To satisfy customers' expectations, total quality is imperative, and companies should be able to provide this level of customization across all their products. The expectation is that manufacturers will be agile and flexible enough to incorporate the latest technologies into existing product line-ups and offer new products at a rapid pace.

What is needed is a single, end-to-end solution that gives innovators the confidence to **find the best balance in quality, standards and cost** and deliver products that turn customers into brand loyalists.

ESCAPING THE SILOS

The cost of a failed or recalled product can put a company's financial position at risk. This makes Total Quality an essential component in protecting the bottom line.

Despite organizational efforts to embed quality, crucial data remains locked in silos. This leads to ineffective communication, late data, and poor decisions, with compliance becoming an afterthought.

Cost of Quality takes up to 4.3 to 8.6% of customers' total sales.

Despite efforts by some organizations to embed quality into their processes, the information and data required for effective quality management is still locked in silos.

Early in development, teams lack the information needed to plan for success due to disparate systems and ineffective communication. Later, teams struggle with late or incorrect data, which leads to poor decisions and wasted effort. Quality issues are often discovered during the launch process, and compliance is routinely treated as a reporting function toward the end of product development that leaves companies simply hoping that no non-conformances are discovered.
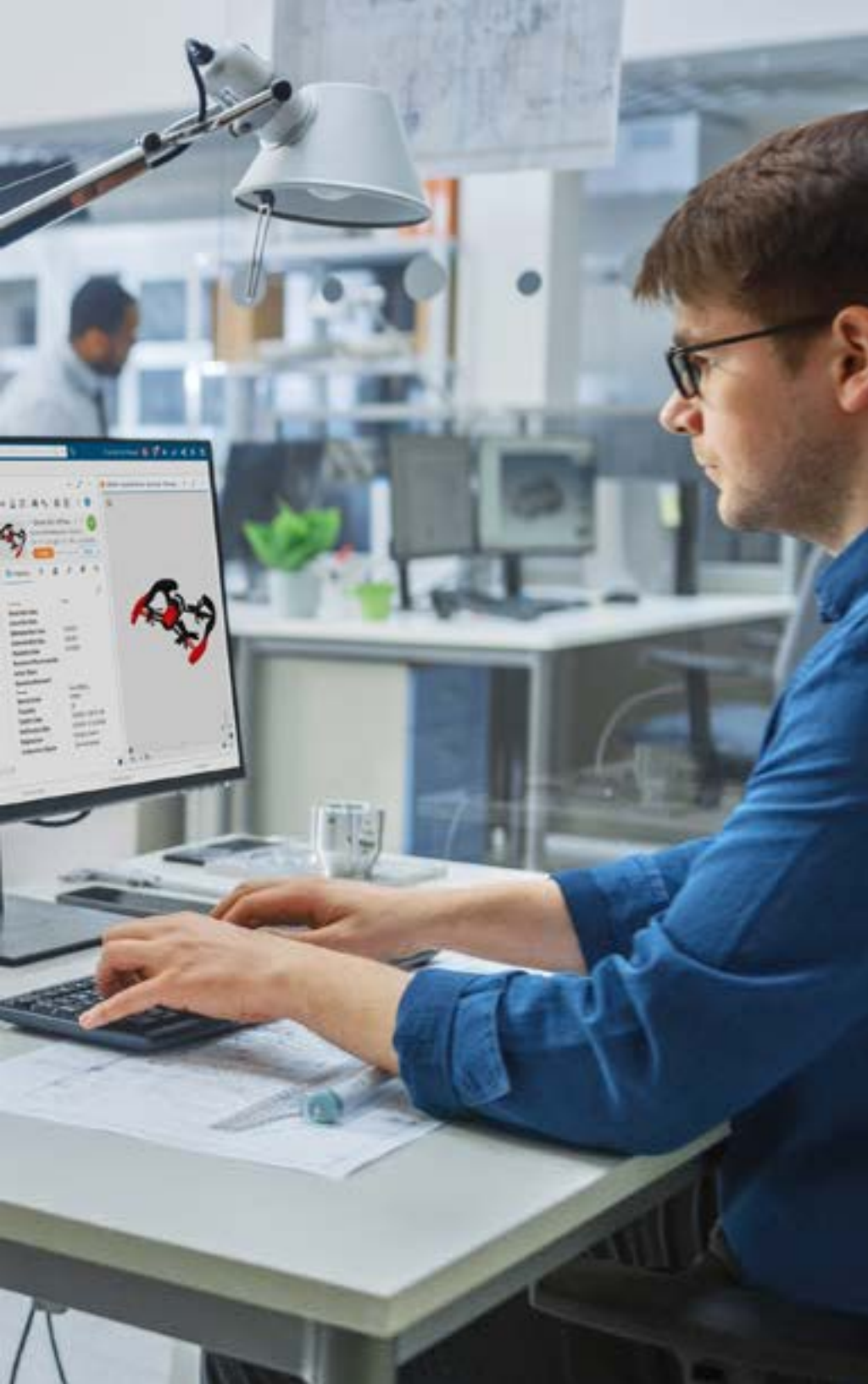
Silos, the obstacle to Total Quality.

The after-sales organization addresses quality issues reported by users, customers and consumers. This means quality organizations struggle to qualify individual issues and consolidate them to detect the emergence of a common problem.

These quality delivery failures lead to increased rework, prolonged time-to-market and poor customer satisfaction. Furthermore, these issues increase development and material costs and negatively impact sales and brand value.

Manufacturers and their suppliers cite a myriad of quality challenges as a result of operating in silos. These include:

- Lack of systematic problem-solving approaches result in continually repeating the same quality issues.
- No standard quality metrics to apply to customer-specific requirements because these often fall outside the scope of quality standards defined by third-party certification bodies (e.g. ISO/TS 16949, ISO 9001, ISO 14001, etc.).
- Insufficient flexibility in their Quality Management System (QMS) to accommodate customer-specific requirements.
- No ability to represent customer identified problems, issues or defects on the 3D product model.
- Methods and tools that do not support embedding quality into design and current processes per established best practices like Design in Quality, Design for Manufacturability and Design for Six Sigma.
- Loss of know-how, teachers and mentors due to a large number of retiring workers over the next five to eight years.
- Inability to effectively feed warranty and recall information back into processes in order to improve future product quality and reduce costs.
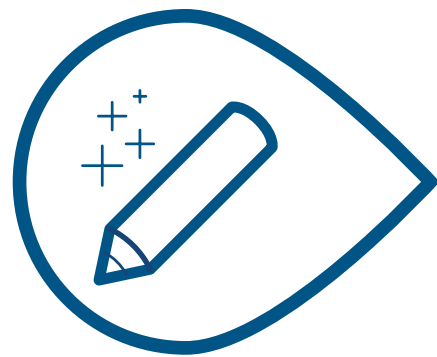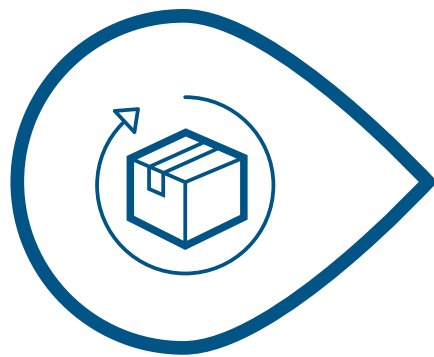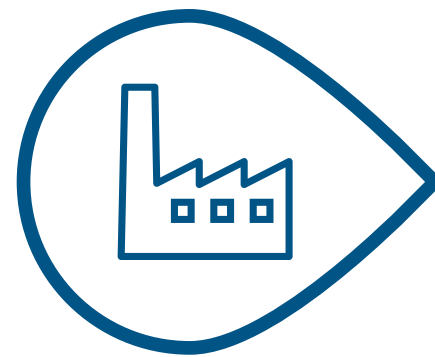
Designer ▸ **Supplier** ▸ **Manufacturer** ▸ **Consumer**
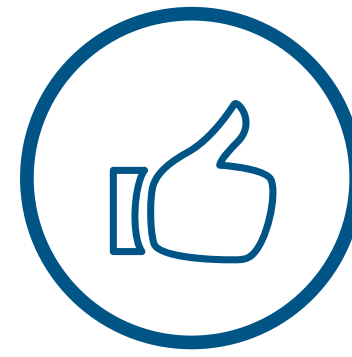
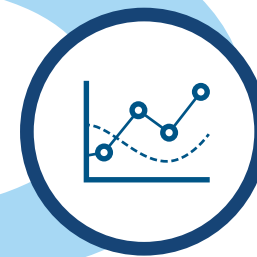**Regulations** — **Compliance, Rules, Guidelines** — **One Single Source of Truth** — **Process** — **KPI Performance**

True digital continuity begins with a single source of truth that keeps all stakeholders in sync, from end to end.

That way, regulation, compliance, design and safety issues are transparent across the entire value chain, allowing every stakeholder to ensure quality at every point and meet KPIs.

Total Quality is preventing inconsistencies in business processes and identifying shifts between procedures and their execution.

Voice of the Manufacturer
Validation/
Traceability

Voice of the Consumer
Complaints/
Warrenty Claims

Voice of the Supplier
Material/
Process Performance

Voice of the Business
Work Instructions
Quality Specifications

ACT · PLAN · DO · CHECK

Perhaps most troubling is that many quality issues are repeat problems that occurred in previous projects and, although they have already been investigated and corrected, have occurred again. One study found that 80 percent of issues encountered are repeat problems with known solutions.[2]

The ability to observe enterprise processes and then plan, do, check and act across the entire value chain from conceptualization to post-sale ensures the continuous and authentic experience of quality that product innovators want.
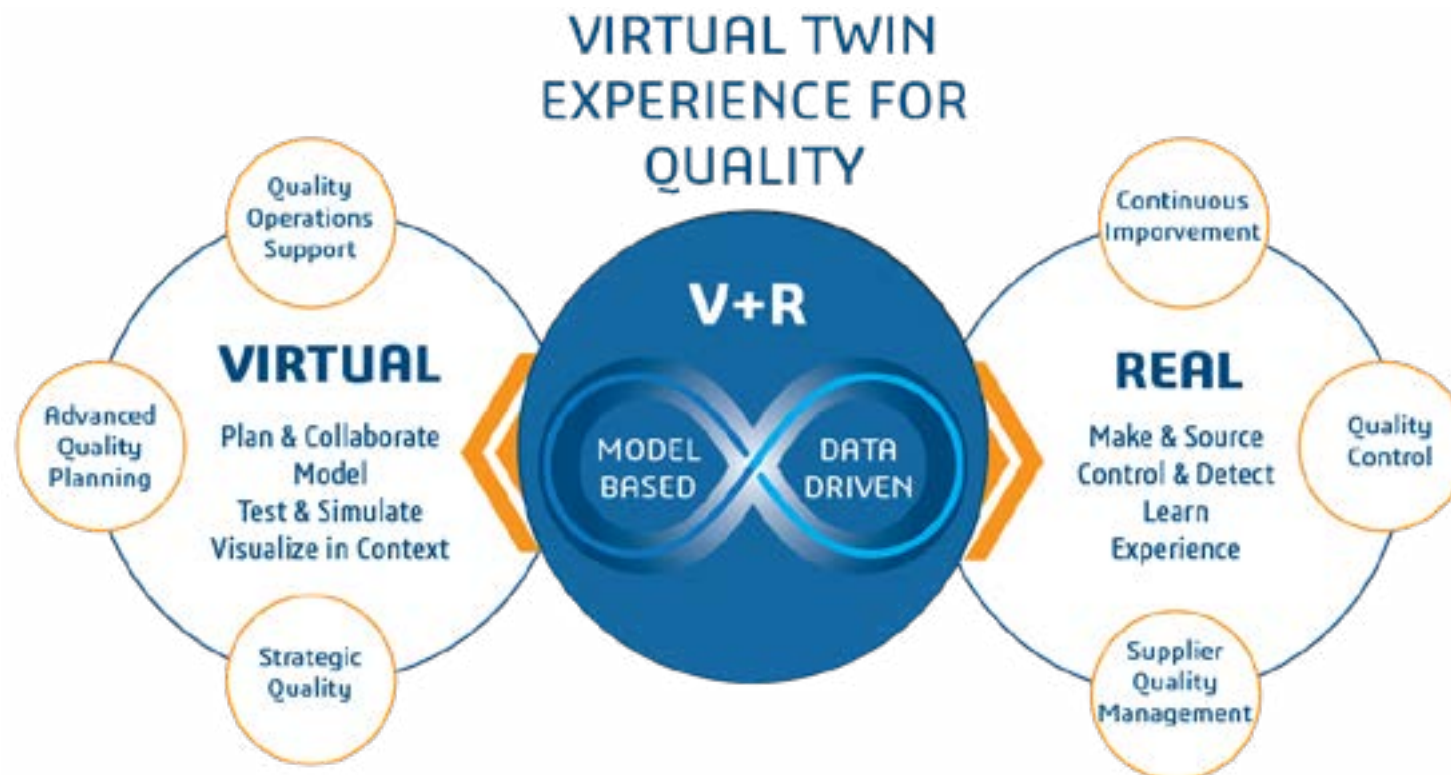
Companies have long been implementing QMSs and processes as a structured way of delivering a better product. This is done by documenting information such as procedures, work instructions, policies and forms that enable those tasked with quality execution to meet a company's quality requirements systematically. As a part of this effort, many manufacturers have focused on tools for quality issue prevention, such as Quality Functional Deployment (QFD) and Failure Mode and Effect Analysis (FMEA).

But, if these tools are designed to predict and prevent quality issues up front, and processes are in place to manage the closure of quality and compliance issues when found, why do companies still struggle with quality issues?

One main reason is that the vast majority of quality and compliance practices today are primarily reactive to issues in the product development process. In most organizations, quality management is a separate function that establishes processes for planning and assurance, control and improvement. Although the creation and execution of a closed-loop process has improved overall quality, it has provided only incremental gains and still often relies on the end customer to report issues.

Quality management must become a pervasive, holistic, enterprise-wide endeavor across the complete product lifecycle — it needs to become **total**. Teams must come together on a single innovation platform to predict, manage and meet the challenges of new product development projects that allow manufacturers to design in quality and compliance from the start. The Virtual Twin Experience for Quality becomes a backbone that enables users to project quality findings on one common referential.

VIRTUAL TWIN EXPERIENCE FOR QUALITY

V+R

VIRTUAL

Quality Operations Support
Advanced Quality Planning
Plan & Collaborate
Model
Test & Simulate
Visualize in Context
Strategic Quality

MODEL BASED X DATA DRIVEN

REAL

Continuous Imporvement
Make & Source
Control & Detect
Learn
Experience
Quality Control
Supplier Quality Management

TOTAL QUALITY IN MOTION

How can product innovators be better prepared to respond to changes in market trends, regulations and standards? It's a question of creating collaborative processes and the chosen platform. The answer lies in adopting a platform that enables manufacturers suppliers to validate Quality priorities and processes while responding to changing market opportunities.
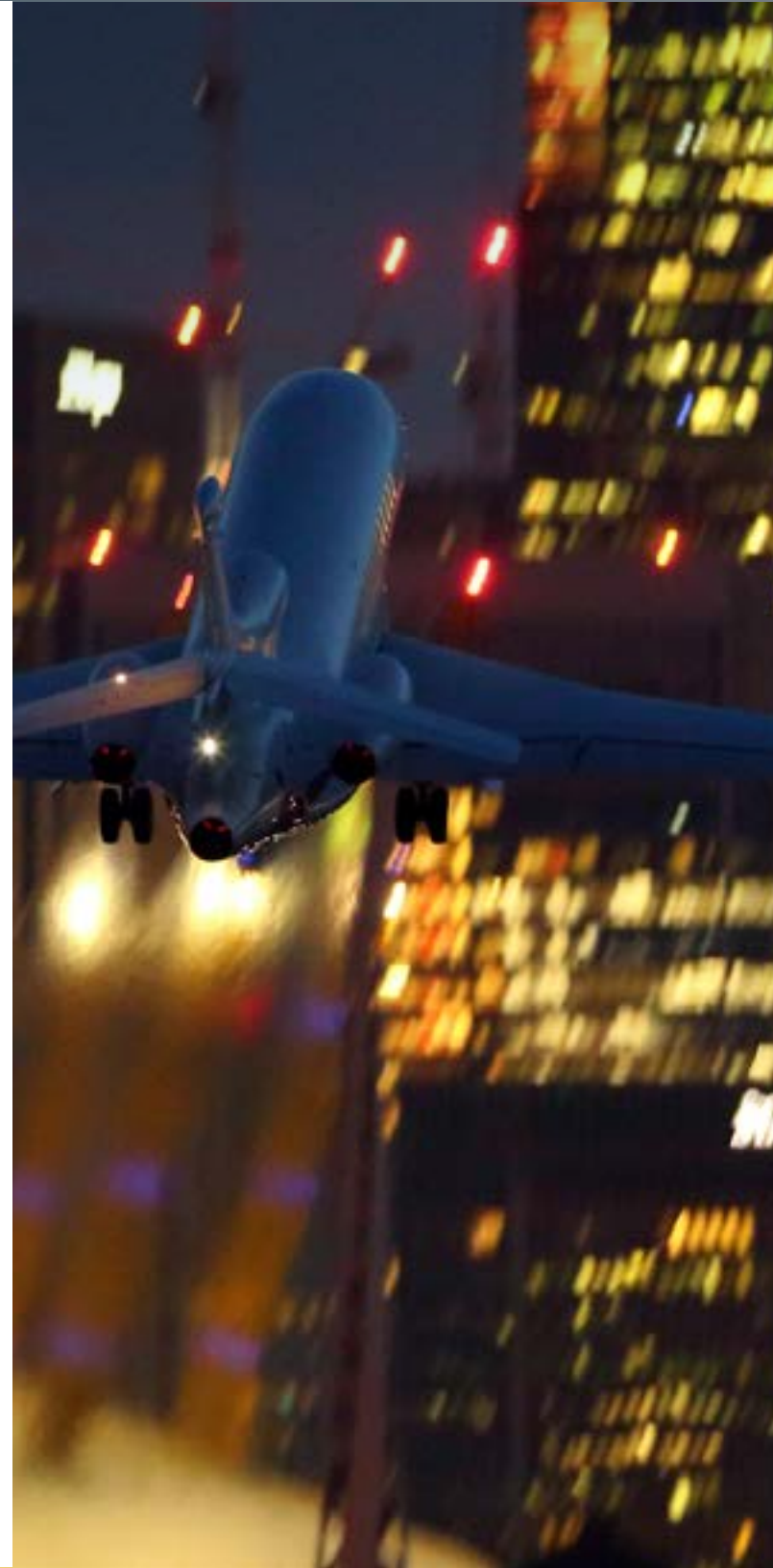
What if there was a way to create a quality environment where manufacturers and suppliers can collaborate in real-time to prevent issues as early as possible in the product lifecycle to reduce the cost of quality and time to market?

During the early stages of product development, cross-functional teams create product requirements based on market expectations. Functional definitions follow. Eventually, the value chain will be involved in supplying some components. The OEM needs to ensure that the supplier is capable of delivering. The supplier needs to understand their customer's requirements to completely fulfill expectations.

The Advanced Product Quality Planning Standard (APQP) defines this process. The OEM invites certified suppliers to bid for parts. Specs and requirements are shared on a portal, and responses are compared to select the best terms. The value chain is an essential component of product quality; hence, early-stage collaboration increases the possibility of success.

Manufacturers and component suppliers have their experts, processes and tools. What they need is to connect them all. The Virtual Twin is the enabler that connects the voice of the customer with the voice of the process, the voice of the suppliers, and the voice of the business.

Total Quality Management seamlessly embeds quality into every process.

In a nutshell, APQP is a multi-stage project where OEMs and suppliers collaborate through the complete product lifecycle. Undoubtedly, product complexity and the ever-growing amount of data that comes with it pose significant challenges for product manufacturers and suppliers regarding effective quality management.

The project manager drags and drops product or process requirements into a project task. The task is assigned to the supplier, who receives an instant notification of work that needs to be completed. The supplier uploads the expected deliverable, and the project manager can accept or reject the task.

The total quality management approach is best driven by a platform that enables digital continuity to connect all quality contributors across the value chain — within the organization as well as with partners and suppliers — in a way that transparently embeds quality into every process and action.
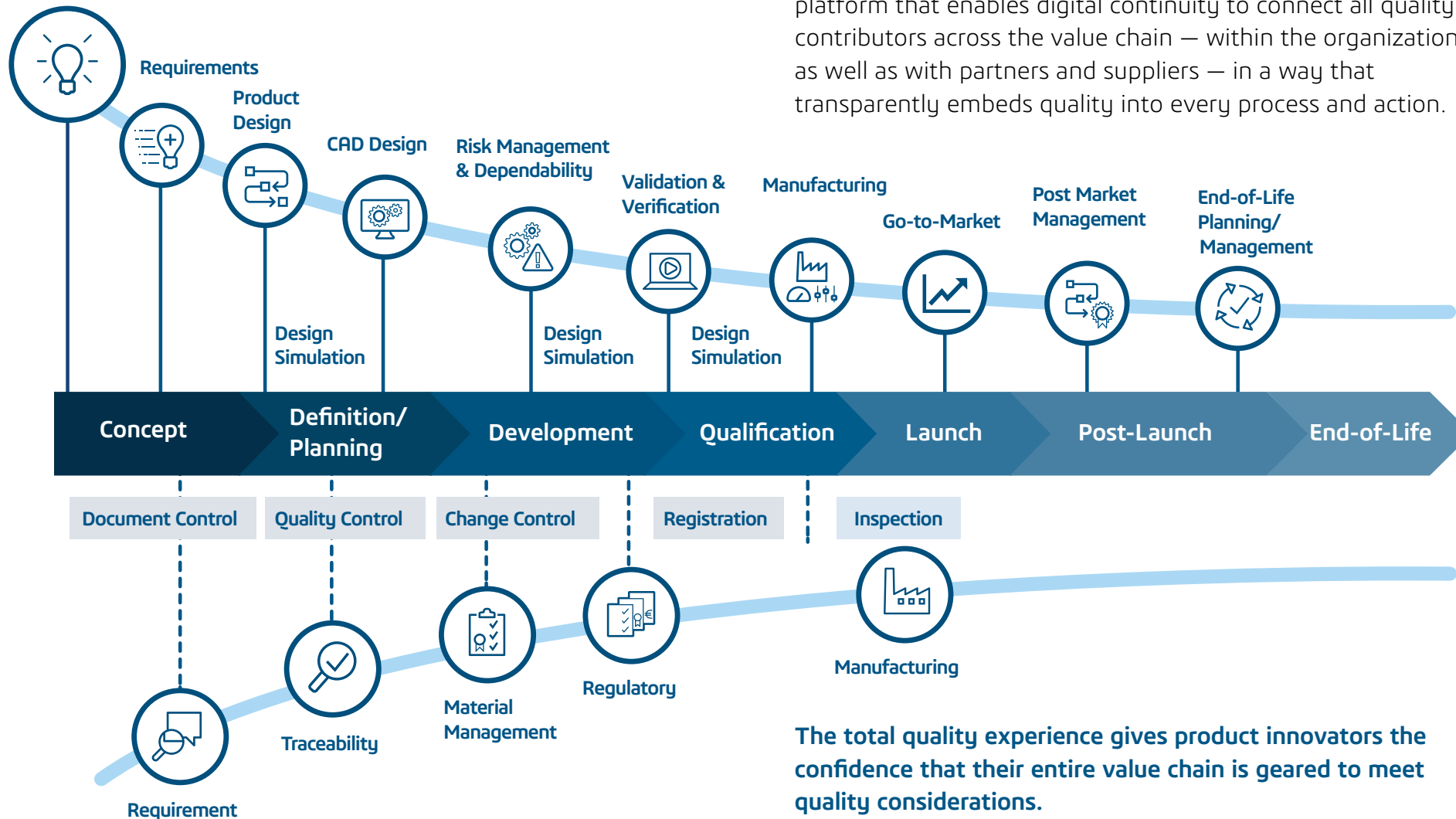
The total quality experience gives product innovators the confidence that their entire value chain is geared to meet quality considerations.

Every stakeholder in the product development process is connected when an innovation platform supports TQM. This environment enables fact-based decision-making and communication while allowing teams to predict, manage and meet the challenges of new product development projects transparently. This also seamlessly embeds quality every step of the way.

Digital continuity ensures knowledge can be shared consistently throughout the product lifecycle.

Issues happen throughout the product lifecycle. When quality inspectors detect a non-conformance (NCR) in production, containment and disposition actions are triggered to prevent the issue from leaving the affected process. The NCR investigation may recommend performing audits to find the root cause of the problem.

Process audits compare current practice against the standard operating procedure. Product audits allow the detection of additional nonconforming products in the facility. In addition, supplier audits help detect whether the partner is following the documented control plan before shipment.

When the root cause is unknown, a corrective and preventive action (CAPA) process is kicked in. A cross-functional team, which may include suppliers, collaborates to assign investigation tasks and implement actions to avoid reoccurrence. The system is tested to validate the effectiveness of the actions.

Once the product is purchased, customer complaints are analyzed to size the magnitude of the problem (e.g., single occurrence or potential recall) and appropriate actions are taken. The value of this feedback is immense, as the voice of the customer can help improve the product or generate ideas for introducing a new product.

In reality, a large amount of administration and paperwork is required to manage the process. The problem lies not just in the volume of documents involved but also in the fact that these various spreadsheets and project files often exist in multiple versions locally stored across various users' drives. The inability to share this information effectively means all involved parties cannot work collaboratively. Only by switching to a central E2E QM platform can manufacturers and suppliers track, re-use and leverage existing data.

Quality management doesn't stop there. When developing a new product, manufacturers can either begin from scratch or recycle data from previous projects. APQP project templates are improved with lessons learned to become a best practice for the next project. Whenever possible, it makes business sense to reuse 3D models of parts in new designs and to invite suppliers familiar with the product. This enables them to cut costs considerably, reduce market delivery time and appeal to customers who value reliability but also want high quality at an attractive price point.

Are you thinking about turning mass customization into a market advantage?

Imagine confidently releasing dozens of customized designs per week and calling upon hundreds of thousands of production parts in your database to customize many more. Reusing parts from a continuously optimized product data management database is key to quickly bringing high-quality products to market.

High-quality products turn customers into brand loyalists. Studies show that a 5 percent increase in customer loyalty can increase profits by 25 to 50 percent.3 You retain your customers by keeping them happy and gaining new customers through grassroots, word-of-mouth advertising from happy customers — this comes easily when you have high-quality products. The question is: How?

Data analytics offers significant value potential for TQM.

Analytics connect the Voice of the Process and the Voice of the Customer, helping to reduce the Cost of Quality:

- Using semantic analytics to detect quality issues in customer claims.
- Applying trained ML models to detect patterns and similarities between issues.
- Helping after-sales teams leverage previously acquired knowledge to solve similar cases.
- Enabling engineering teams to perform proactive root-cause analyses and establish preventive action plans.
- Utilizing knowledge-graph models to search for correlations between issues and shifts that happen in the execution of business processes.

The power of quality analytics helps teams drive continuous improvement across business processes, operations and products. In turn, this supports faster and more informed decision-making when issues are identified, ultimately improving customer satisfaction.

Combining data from physical and digital sources with AI/ ML capabilities enables organizations to learn from past events and predict possible future quality issues.

EXPERIENCE TOTAL QUALITY, DON'T MANAGE IT

How can product innovators be better prepared to respond to changes in market demands? The answer lies with selecting the right process and platform to better validate quality priorities and respond to global opportunities.

In today's markets, being innovative in product development isn't enough. Control is a critical part of any process. TQM, with a digital continuity platform, establishes the framework for control, automation and visibility that embeds efficient and effective quality management into all of an organization's processes and decisions. This includes providing the means for implementing predictive analysis across the entire quality management landscape.

When assessing the cost to obtain quality — the balance point between the cost of investment in quality and the cost of the defect — shifting to a TQM approach on an innovation platform allows your company to find and monitor this balance point. Product developers become quality leaders who protect their product investments and market access when they find this balance.

The Platform for Total Quality Management.

The **3D**EXPERIENCE platform uniquely provides the applications, collaborative processes and single data source to embed quality throughout the product development process. The platform enables digital continuity to ensure quality challenges are met and transformed into advantages.

With the **3D**EXPERIENCE platform, contributors across the extended enterprise better anticipate and mitigate errors rather than react to them. This supports the creation of a learning organization that doesn't repeat quality issues and delivers an authentic TQM experience.

The **3DEXPERIENCE** platform supports Design FMEA, Process FMEA and CAPA processes. Then, the platform enables you to validate and certify designs virtually, reducing the dependency on physical validation. Traceability from initial requirements to product delivery ensures consistency and completeness of all tests and verifications.

> " **The 3D**EXPERIENCE **platform helps us ensure compliance because we have all the documents secured in one place."**
>
> **- Hugues Le Cardinal,**
> **Head of Airworthiness, AeroMobil**

By automating the prototype testing process with virtual simulation, **3D**EXPERIENCE platform users can help customers reduce ten percent of their annual costs. When testing, simulation and prototyping can cost up to €1 billion for some manufacturers, that 10 percent savings constitutes €100 million in ROI through Dassault Systèmes' virtual simulation capability.

The **3D**EXPERIENCE platform offers the following capabilities to ensure that TQM is embedded from end to end:

- **A Lean approach**

  Digitalized Lean practices offer intuitive tools that leverage Lean methodologies to reduce or eliminate non-value-added work and ensure efficient processes.

- **Project management methodology**

  Quality methods are governed as projects with automated and event-driven tasks, change orders and actions, and a model-based enterprise approach for requirements and functions.

- **Risk-based thinking**

  As part of quality management (e.g., ISO9001/EN9100/AS9100), risks are managed, controlled and synchronized with controlling tasks throughout all design, manufacturing and services processes. Fully embedded tools, such as FMEA and FTA, link directly to designs, product definitions and process flows. All quality decisions are based on risk thinking.

- **Complaints, deviations and non-conformance management**

  Customer complaints and non-conformances are managed and directly linked to the product definitions, reusing past experiences either for efficient resolution or to enrich the know-how database.

- **Audits for compliance**

  A fully traced process — from ideation to go-to-market — with audit and inspection tools allows for continual and seamless compliance with regulations and internal requirements.

- **Analysis and reporting**

  Organizations can reveal and analyze multi-source, heterogeneous, structured and unstructured quality and compliance data to improve quality processes and gain competitive advantage. With digital analysis, future quality issues can be predicted and prevented before they reveal themselves.

- **AI/ML**

  Reduce the cost of non-quality by connecting and analyzing real-world data to provide insights into business operations and products. AI/ML analysis allows continuous quality improvement with the ability to detect, anticipate and resolve non-quality through early detection.

- **Virtual Twin Experience**

  Map real-world insights onto a common referential to reveal complex and/or invisible information on the 3D representation of products. Capture knowledge and know-how within a single platform to ensure continuous improvement.

VIRTUALLY OPTIMIZE DEVELOPMENT

How can product innovators be better prepared to respond to changes in the market, new regulations and updated standards? The answer lies in selecting an innovation platform that enables manufacturers to embed quality into the end-to-end product development process.

Manufacturers must continue to innovate to keep ahead of the competition and meet increasing customer expectations.

Delivering innovation requires early and ongoing collaboration from the design, simulation and manufacturing disciplines. It also requires active contributions from quality, costing and service organizations. Critical success factors from across all contributors must be captured for reuse in a systemic process to fortify your knowledge base and ensure sustainability in the innovation process.

Yet, this is often not enough to maximize quality. As products become more complex, product validation requirements increase beyond what is practical with physical tests. Addressing this gap requires connecting virtual and real-world product data via Virtual Twin experiences that can run enhanced failure mode studies that optimize designs based on 'what-if' scenarios.

Only Dassault Systèmes delivers industry-leading 3D design, simulation and manufacturing technologies on a single platform. Use the platform's integrated, automated solutions to:

- Synchronize and enhance multi-disciplinary design, engineering and production collaboration.
- Implement governance to integrate distributed programs for global synergies.
- Transform engineering processes with holistic systems engineering development and performance.
- Accelerate requirements fulfillment and regional reporting.
- Perform virtual testing to increase product performance and safety.
- Maintain traceability from ideas and requirements throughout the product lifecycle.

Surpass requirements, manage costs and ensure success.

Today's most promising and innovative opportunities aren't always aligned with your resources and priorities. They may also include complex global and local requirements that stretch your enterprise capabilities beyond their current limits.

The **3D**EXPERIENCE platform enables your teams to accomplish this with industry-proven tools and processes. You can analyze opportunities, win optimal new business, then design, engineer, validate, manufacture and deliver on target to your customers' satisfaction.

Explore your options at
www.3ds.com/industries/aerospace-defense/total-quality-management

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Our **3D**EXPERIENCE® platform powers our brand applications, serving 12 industries, and provides a rich portfolio of industry solution experiences.

Dassault Systèmes is a catalyst for human progress. We provide business and people with collaborative virtual environments to imagine sustainable innovations. By creating virtual twin experiences of the real world with our **3D**EXPERIENCE platform and applications, our customers can redefine the creation, production and life-cycle-management processes of their offer and thus have a meaningful impact to make the world more sustainable. The beauty of the Experience Economy is that it is a human-centered economy for the benefit of all – consumers, patients and citizens.

Dassault Systèmes brings value to more than 300,000 customers of all sizes, in all industries, in more than 150 countries. For more information, visit **www.3ds.com**.

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