IDC WHITE PAPER

End-to-End Traceability in Process Manufacturing: From Regulatory Compliance to Competitive Differentiation

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Authors:
Maggie Slowik
Lorenzo Veronesi

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Section 1: Why Traceability Matters Today

Why the urgency? Manufacturing supply chains face an era of accelerated disruption fuelled by major global events and challenges such as trade wars, environmental changes, political events and fast-changing regulatory requirements to name but a few. For process manufacturers in particular, this means additional pressure on top of the already complex business environment in which they operate, which is marked by fluctuating costs of raw materials, tight profit margins, increasing consumer expectations for detailed product information, and the management of quality, waste, and potentially hazardous products. In this environment, full accountability is critical for process manufacturers, regardless of whether they supply the food and beverage, plastics, rubber, chemicals, metals, or paper markets.

This is easier said than done. According to IDC's latest supply chain survey, 63% of process manufacturers admit that the lack of supply chain visibility and flexibility is a gap that will cause major issues in the future if not addressed appropriately, and 43% report that supply chain visibility is a focus from a supply chain risk management perspective (compared to only 35% in 2018). IDC research also shows that the vast majority (96%) of process manufacturers will focus on improving their visibility, with 57% particularly concentrating their efforts on the end-to-end supply chain.

These figures highlight that there are urgent improvements to be made when it comes to achieving end-to-end supply chain visibility, and therefore the ability to successfully drive traceability. More importantly, traceability is not just a matter of regulatory compliance to ensure product quality and safety, but gradually becoming an enabler of business or competitive differentiation. In fact, for a multitude of reasons, which this white paper will discuss, process manufacturers have to demonstrate an increased focus on preventing problems before they arise.

However, the reality is that only 40% have officially automated traceability, whereas 44% still have manual processes in place. But even more worrying is the fact that 16% do not manage

AT A GLANCE

KEY STATS

Recognising the risk, 96% of process manufacturers focus on improving their visibility, with 57% particularly concentrating their efforts on the end-to-end supply chain.

Only 40% of manufacturers in this space have managed to automate traceability, 44% have a manual approach in place, and worryingly, 16% do not manage it at all

KEY TAKEAWAYS

Consider moving from a reactive (regulatory-driven) to a proactive (value-add) approach, which requires appropriate digital technology investments.

Process manufacturers that have a higher commitment to traceability and invest in it actively can reap the full scale of compound benefits that traceability can generate.

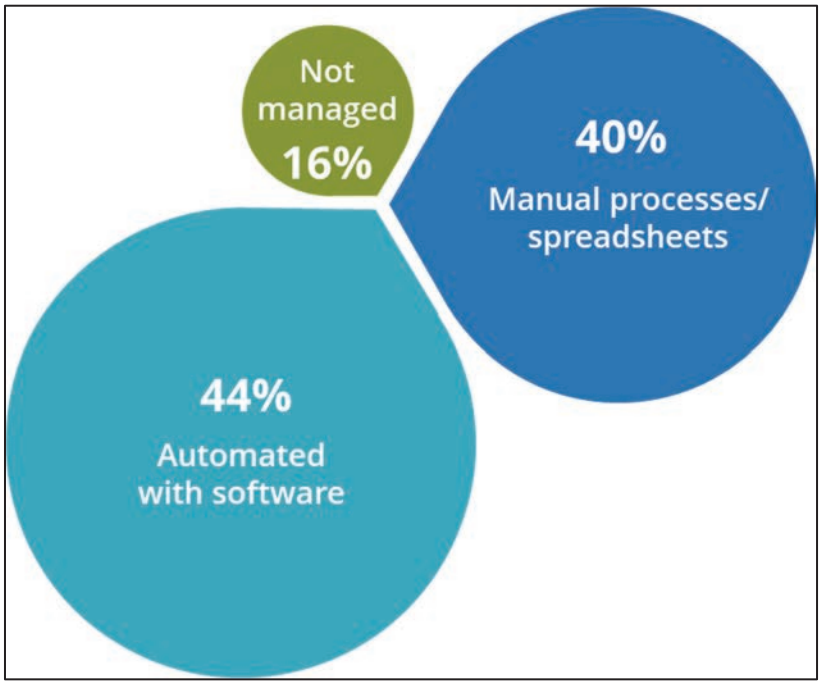
traceability at all (Figure 1). This puts process manufacturers behind their discrete manufacturing peers. It also highlights that given the inherently different nature of the value chain and of the final product involving investment-intense production assets, traceability is often seen as an even more challenging activity in process manufacturing. What it does not mean, however, is that there is less at stake for process manufacturers if a quality or process issue comes up. Quite the contrary in fact—the impact of any such incident could potentially be hazardous to both humans and the environment alike.

Given the inherently different nature of the value chain and of the final product involving investment-intense production assets, traceability is often seen as an even more challenging activity in process manufacturing.

The IDC study mostly features medium to large-sized organisations, but also observes that better traceability does not relate to company size. Larger organisations are not necessarily better at traceability. Nonetheless, given the situation at scale that process manufacturers are facing, the business case for traceability could not be more urgent than it is now.

FIGURE 1
Approach to traceability in process manufacturing

Q. Which of the following strategies does your organisation leverage or plan to leverage for traceability?



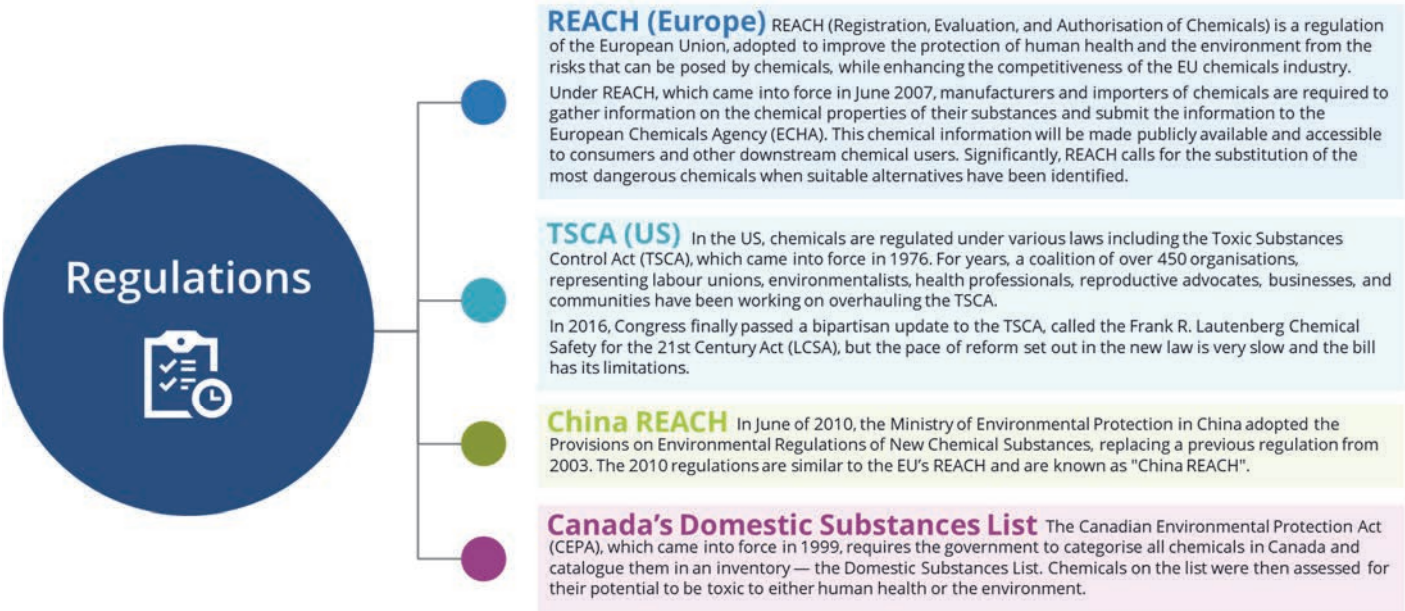
Source: Industrial EH&S Survey, IDC, June 2020, Process Manufacturer Sample = 140

Regulations. A key requirement for all process manufacturers is the ability to keep up with environmental and safety standards and successfully achieve compliance with changing regulations. Many regulations require the traceability of problematic substances contained in raw materials or final products. Take chemicals producers for example, which face a plethora of regulations and directives. However, compliance management is not part of the core business for many chemicals companies, so it can be perceived as an overwhelming task. This is where

technology solutions offer opportunities to establish a systematic approach to transparency and traceability.

Figure 2 provides some of the most prominent regulations for chemicals producers around the world, each of them highlighting complexity. This is further amplified for those multinational chemicals producers that have to comply with regulations in all the regions where they operate.

FIGURE 2
Chemical regulations across the world



Source: IDC analysis

The cost of not investing enough in traceability. Traceability is more than just a capability for quality and safety; it also meets customer demands for more information and is key to building trust and ultimately enhancing brand value. Process manufacturers operate in both the B2B (chemicals, rubber, metals, plastic, etc.) and B2C (food & beverage, personal care products, etc.) markets, but regardless of who the ultimate customer is, the appetite for detailed information on demand has become a given, detrimental even, to the point at which customers are willing to switch to another brand or product if this requirement cannot be fulfilled by the manufacturer.

Traceability is key for building trust and ultimately, enhancing brand value.

The cost related to quality issues inflates when they turn into serious enough incidents, at which point they create long-lasting effects for the brand. These cases commonly involve a large number of product recalls, reports of injury or even death, and extensive media coverage.

In 2016, UK-based sandwich shop franchise chain Pret a Manger got embroiled in a food scandal when a teenager died from an allergy reaction to sesame, which was not properly labelled on the food item. Pret not only spent an estimated £10 million in legal costs, but in 2020, invested a further £20 million for a food safety overhaul, introducing full labelling and changing recipes to

remove allergens completely from many products. However, the reputational damage to the food chain still lingers in consumers' minds.

The impact of any quality issue in process manufacturing first and foremost affects those manufacturers that are customer facing. For example, in 2007, toy maker Mattel had to recall approximately 100,000 toys due to a lead paint alert. Similarly, in 2018, US sports apparel and equipment company BSN Sports issued a recall of 31,200 toys with surface paint colors containing hazardous levels of lead. Both cases show how even B2B customers that use process manufacturers' products as an input or ingredient (e.g., paint) in the production of their own goods, ultimately take the brunt from a reputational point of view.

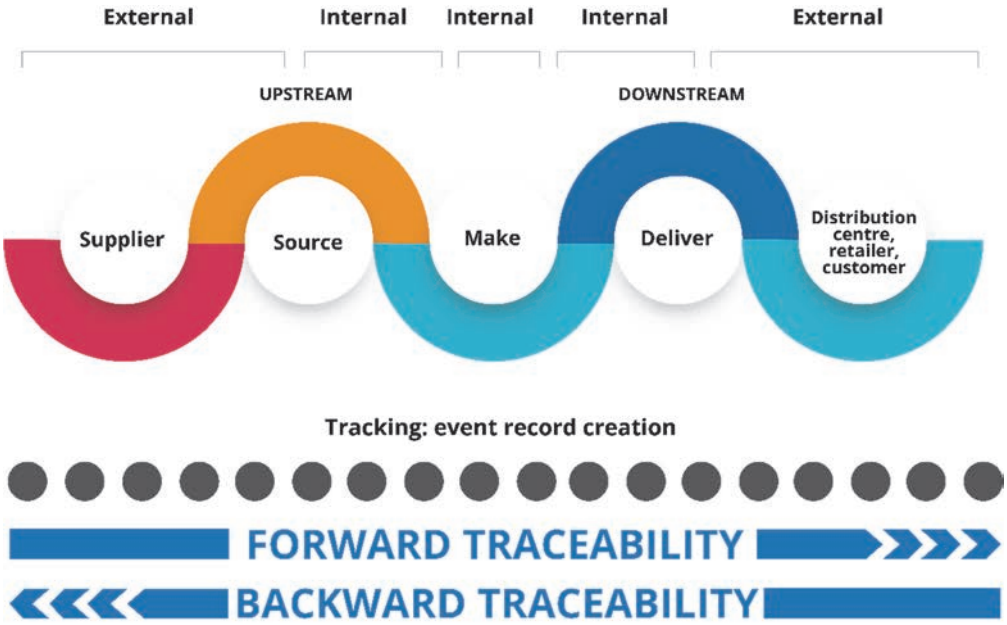
What traceability entails. Traceability is the process that provides the identification of all relevant data (and data relationships) for the ingredients, substances, and materials used in the production and distribution of finished products. Traceability is composed of two essential steps — tracking and tracing.

- Tracking: creating/logging events at a granular level
- Tracing: retrieving information leveraging the tracking log

Good traceability is only possible if 1) enough tracking information is available and 2) systems covering different process steps are connected and integrated ("talking to each other").

Traceability can apply to the entire supply chain of a company, from the upstream section that focuses on tracking the receipt and intake of raw materials to manufacturing processes, then downstream as finished goods are distributed through the channel to their final destinations (see Figure 3).

FIGURE 3
Traceability explained



Source: IDC Manufacturing Insights

IDC also distinguishes between external and internal traceability:

- **Supply chain or external traceability**. This involves companies' interaction with partners, including providers of raw materials, transportation carriers, and distributors. The type of data being collected at each point along the chain and how that data is being shared are central aspects of external traceability.
- **Manufacturing plant and warehouse or internal traceability.** This refers to the systems to track and record the movements of raw materials through the various processes that result in finished goods and the procedures companies have in place to trace their genealogy, should the need arise.

It is very important that process manufacturers practice both external and internal traceability.

It is very important that process manufacturers practice both external and internal traceability to quickly isolate any suspect batches or products.

Forward and backward traceability: Forward traceability is a manufacturer's ability to identify all finished goods produced from any one batch or lot of raw material by lot or serial number. This includes defining which final customer has these individual lots. Backward traceability refers to the manufacturer's ability to trace which ingredients/raw materials were used to produce a specific product and establish the purposes for which the remainder of those materials were potentially used.

Quality and traceability: Although quality and traceability are two distinct disciplines, they have a mutual relationship. From one end, traceability directly improves overall quality. At the other

end, advanced quality management practices provide the granularity of information that a company can use to improve its traceability practices.

Operational Excellence: As a byproduct of most internal traceability projects, companies achieve better knowledge of their processes, and this opens further process optimisation opportunities. Traceability, good manufacturing practices, and operational excellence are all connected. A disciplined and well-organised production process makes traceability easy to implement. Vice versa, a clear model of the material flow and operational activities—traceability, in a word—is the basis of a well-managed manufacturing environment.

Section 2: The Benefits and the Broader Opportunities—From Reactive to Proactive

There are several ways of looking at traceability. Traceability initiatives vary among process manufacturers, all the way from a reactive approach to a more proactive one that delivers more value-added benefits in return. We have ranked these approaches with their associated benefits in order of ascending value-add below.

1. Compliance with regulations: At this basic level, process manufacturers must ensure they manage and meet a variety of compliance requirements such as REACH, RoHs, ISO, and other governing bodies. This is necessary to demonstrate that they are legally viable to have a market presence to begin with. Nonadherence to regulatory requirements would result in costly fines and other legal repercussions, as well as a potential ban from operating in a given market.

2. Speed of recalls: If a recall is required, the ability to pull the affected products that are already in circulation efficiently and in a timely manner is key for damage remediation, brand protection, and, most importantly, ensuring public health and safety. But the reality, as mentioned earlier, is that visibility and control across the extended supply chain still requires improvement. Overcoming this will help in more successful management and execution of recalls.

3. Higher efficiency and lower costs in processing recalls: Being able to identify the exact source of potential contamination or hazard quickly and accurately has the following benefits:

- More targeted recalls (i.e., smaller and/or lower number of recalled batches or lot sizes)
- Less cost in factory downtime associated with investigations
- Lower administrative costs associated with processing recalls and damage compensation to retailers as well as (end) customers, and stock recovery

Up to this point, traceability initiatives have been considered rather reactive and narrowly focused on business as usual, with minimum change involved. However, other benefits are directly linked to superior business performance.

A more sophisticated approach to traceability makes it easier for process manufacturers and their channel partners to understand the entire process journey that products and their related ingredients have undergone. This requires granular knowledge of any details from sourcing to delivery in an extended way, potentially multisite, multicompany, and multilegislative. Having access to this data across the product value chain provides insight into details such as who supplied the raw materials, who validated them, which steps went into processes, who handled and signed off the final product, who shipped and delivered it, and who on the customer side validated it. The process control enabled by traceability is a steppingstone to driving business value by creating other business opportunities.

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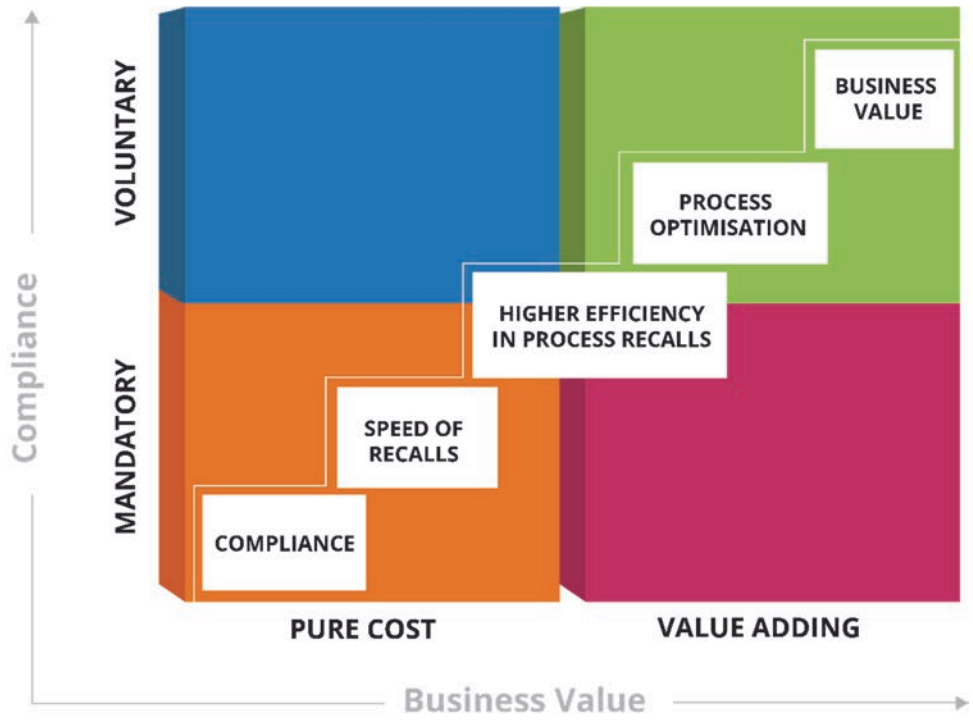
4. Process optimisation: With access to data spanning across end-to-end management, process manufacturers can now analyse the supply chain for insights and improvement. This includes quality control, planning and scheduling, being able to comply with other regulations (e.g., EU rules of origin), and being able to appropriately right-size all quality initiatives to the real needs of individual markets.

5. Enhanced business value leading to competitive differentiation: At the point where process manufacturers have achieved end-to-end value chain traceability, they can leverage this capability for competitive differentiation by demonstrating they are a viable and trustworthy supplier to their distributors and retailers and a reputable brand to ever more information-hungry and demanding customers. On both accounts, this enhances and, in some cases, even creates brand value.

Process manufacturers can take their traceability to even higher brand value levels by highlighting and being able to prove that their products come from environmentally sustainable and/or ethical sources (e.g., free of conflict minerals).

FIGURE 4
Traceability maturity model



Source: IDC Manufacturing Insights

Section 3: The Role of Technology

The opportunity of data everywhere: IDC sees data affecting the modern manufacturing supply chain across three dimensions:

- **RECEIVED:** Data is captured at any point of activity and made available in real time. Process manufacturers are increasingly relying on suppliers and downstream data, point of sale (POS), supplier and customer inventories, supply chain partner forecasts, and sensor data (IoT, RFID, barcodes, and AI-enabled cameras, and inspections).
- **DISTRIBUTED:** Data seamlessly flows through departments, plants, organisations, lab facilities, and partners in the same value network. The combined use of machine-to-machine (M2M), mobile devices, internet, and ERP allows information to seamlessly flow through departments, factories, suppliers, and partners, enabling quick response and alignment.
- **ANALYSED:** Data is analysed and correlated in real time, allowing timely decisions, capturing new opportunities, and initiating and managing corrective actions.

Being able to easily access accurate, real-time information is key to traceability: pockets of siloed data are stored in applications throughout the organisation. All of this can be harnessed for traceability purposes, but must be captured, made available, and shared across the organisation via a digital thread.

The focus on traceability goes hand in hand with digital maturity. IDC research shows that traceability as a change agent increases with digital maturity in all the companies IDC tracked. This implies that digitally mature companies have a better handle on traceability as a direct result of having digitised their data and processes. Another way of looking at it is that by the very act of starting an end-to-end traceability journey, the digital transformation program of a company receives a boost, essentially helping to lay down a foundation of digital initiatives. Figure 5 shows that companies that are digitally optimised—with more advanced digital initiatives than their peers— have a much higher focus on traceability as a way of improving their supply chain.

FIGURE 5
Importance of traceability by digital maturity

Q. How much is traceability driving change in your supply chain?

Source: Worldwide Supply Chain Survey, IDC, April 2020, Manufacturing Sample = 613

Several classes of IT applications are typically used for traceability, but not all of them have the same impact, according to IDC. Here we list these from most to least viable for the purposes of full and modern end-to-end traceability practices:

"Intelligent" ERP

Intelligent ERP (iERP) is a new generation of ERP that is cloud enabled and unifies data and processes from different sources into one single digital thread. The intelligence comes from more information, in-context learnings, and the application of the knowledge to deliver better business outcomes. In fact, iERP can process, analyse, and act on large volumes of data generated by the Internet of Things (IoT) in real time. This turns ERP not only into a strategic decision-making tool but also a suitable technology to enable full traceability. In fact, many iERPs include advanced business-relevant features such as integrated quality control management, full traceability, and project management capabilities.

With an iERP solution, process manufacturers can also simulate or even perform practice or voluntary recalls knowing that they can pull the data needed to deal with a recall quickly and efficiently to minimise any potential harm caused to (end) customer safety.

Blockchain

Blockchain or distributed ledger technology seems to be a promising solution to tackle the transparency and traceability challenge in process manufacturing. In fact, blockchain can trace and record transactions along the supply chain. This strengthens formula and recipe management safety and quality and reduces the time required to source comprehensive information on suppliers (and communicating this back to customers). Even though IDC research shows that traceability is one of the fastest growing use cases for blockchain, it is limited by the technology itself, which represents a challenge due to its relative immaturity and the inherent limitation that all players in the supply chain must comply for this to be effective**.**

"Traditional" ERP

ERP is ubiquitous and is the system of choice for countless enterprises. Many ERP systems have crossed the boundaries of traditional back-office processes and extend their direct coverage to many aspects of production processes, including traceability. Most of the manufacturers adopting ERP applications for internal traceability find it convenient as it doesn't require the purchase of new licenses and ERP is the system of record for lots of data that is necessary to implement traceability. But, although traditional ERP can handle traceability to a certain extent, it lacks the ability to manage real-time data or connection to control systems. In most of today's process production processes, traceability systems have to deal with multiple orders with different materials being processed on the same line, parallel mixing phases, and the addition of preblended materials, among others. Traditional ERP generally cannot handle this complexity well enough and is limited by its transactional capability.

Manufacturing-Specific Applications

Manufacturing-specific applications such as management execution systems (MES), warehouse management, and sales and operations planning (S&OP), are suitable for internal information gathering. MES, for instance, are the real-time backbone of the plant floor. They can capture data automatically, model complex processes, and store information about production in real time. So, plant floor traceability is one of the MES native functions designed to meet even the most stringent and detailed regulations. However, the drawback of these applications is that even though they can act as a diagnostic tool, they do not provide a holistic view of the journey a product has undergone.

Spreadsheets and General-Purpose Personal Productivity Tools

Personal productivity tools have been widely used in the industry to manage complex business processes, including traceability. They are readily available and easy enough to use for organisations that are trying to address any given issues quickly and with no additional investments needed. However, these tools have serious limitations for traceability. They are homegrown and can only handle very specific and dedicated requirements. Maintaining or extending these spreadsheets becomes almost impossible over time. Sharing the information is also very difficult, and quite often companies adopting this technology are forced to work in organisational silos. They cannot enforce procedures or manage complex workflows. They give

too much freedom to modify data structures and input forms. And they hardly scale in terms of volume of data and number of users.

While all these technologies enable traceability in the process manufacturing industry, none of them is a true "killer app" when it comes to end-to-end multi-enterprise traceability, with the exception of the "intelligent ERP." This is because the modern ERP provides end-to-end visibility across the value chain by organising data in a consistent and homogeneous way across different business processes, enabling manufacturers to dismantle silos and enable collaborative processes.

Many technologies enable traceability in process manufacturing, but none of them is a true "killer app" when it comes to end-to-end multi-enterprise traceability, with the exception of the "intelligent ERP."

Conclusion — Where do You Want to Be?

Today's customers and regulatory bodies are becoming increasingly demanding in terms of product quality and safety and the provision of detailed information. Product recalls and resulting media headlines have illustrated the devastating impact that quality and safety issues can have on sales and, even worse, brand value. These risks can be mitigated by a detailed traceability policy, but more importantly there is a lot of opportunity to be gained by moving beyond the regulatory pressures and embracing end-to-end traceability as a business differentiator.

Embracing end-to-end traceability as a business differentiator opens vast opportunities for business.

Ultimately, however, process manufacturers need to determine where they want to be on the traceability spectrum. Here are some actions to consider:

- Consider moving from a reactive (regulatory, cost avoidance-driven) approach to a proactive (value-add) approach, which requires appropriate digital technology investments.
- If you are driven by differentiating for competitive advantage, consider enterprise application software for end-to-end visibility of operational processes across the value chain, allowing you to download the entire product history as and when you need to, from the raw materials used through to finished goods.
- Use traceability as the business case for digital transformation if you haven't already. Digital maturity not only puts you in a good position to fulfil requirements related to quality, documentation, and traceability, but by using end-to-end visibility enabled by the digital thread, you can improve your product, optimise your supply chain, and improve your customer experience.

FIGURE 6

Technology for competitive advantage — Where do you want to be?

Source: IDC Manufacturing Insights

But most importantly, while the adoption of traceability technology for the mere purpose of regulatory compliance is a start, it does not deliver business value per se, although it satisfies cost avoidance.

Many process manufacturers that focus mostly on traceability from a reactive point of view end up having an expensive technology solution in place to comply with business and regulatory requirements, but they fail to extract the value that this generation of technology can deliver because they do not see traceability as a driver of competitive intelligence. On the other hand, process manufacturers that have a higher commitment to traceability and invest in it actively can reap the full scale of compound benefits that traceability can generate and hence can drive higher value for money from their technology investments.

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About the Analysts

Maggie Slowik, Research Manager IDC Manufacturing Insights EMEA

Maggie leads the European Manufacturing Digital Transformation Strategies program, supporting technology vendors and manufacturing organisations respectively with their digital strategy and innovation strategies, sustainability being a big area of focus.

Lorenzo Veronesi, Research Manager IDC Manufacturing Insights EMEA

Lorenzo leads IDC Manufacturing Insights' "Worldwide Smart Manufacturing" advisory services. His research focus spans the main technologies across manufacturing operations, supply chain, product lifecycle, and IT strategies.

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5th Floor, Ealing Cross,
85 Uxbridge Road
London
W5 5TH, United Kingdom
44.208.987.7100
Twitter: @IDC
idc-community.com
www.idc.com

Global Headquarters

5 Speen Street Framingham, MA
01701 USA
P.508.872.8200
F.508.935.4015
www.idc.com

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