



Driving Digital Dynamics

A research report on current obstacles to digital transformation in manufacturing, and how they may be overcome

MindMetre (a ThoughtSpark Company) — 2025



This 2025 **MindMetre** research report ***Driving Digital Dynamics*** aims to identify what factors are currently threatening to hold back the pace of digital transformation in the manufacturing sector.

One typical respondent said, “We know we need and want to do it [digitalization]... we’re just not always entirely sure how – both in terms of what we’ve done so far and then what we need to do for the rest of the decade.” This was a medium-sized manufacturer with sales offices and manufacturing sites all round the world.

This response encapsulates the forward challenges which have to be overcome if the pace of digital transformation in industry round the world is to be maintained – or even accelerated.

Our latest survey found that generalized ideas, concepts and language are out – and specific guidance, tools, examples and methodologies are in. More than anything else, respondents say that there is a lack of collaboration, sharing and verifiable, real-life, detailed examples.



Introduction

Driving Digital Dynamics garnered inputs from 1,088 manufacturers of all sizes, in the United States, Europe and Asia.¹ It was designed to identify factors which might be slowing or impeding the pace of digital transformation in manufacturing industry. The purpose of the research is to inform governments, trade associations and the collective manufacturing community of potential areas for attention if they wish the pace of digital transformation to be maintained.

This latest research follows on from MindMetre's previous study – *Digital Divisions*² – which benchmarked the sector's level of 'significant' investment to date in digital transformation. That report found that 25–30% of manufacturers had so far undergone 'significant'³ digital transformation, looking across all sizes of firm from the mega to the smaller.⁴ The study aimed to correct the sometimes exaggerated impression of digital transformation maturity, caused by the plethora of studies which focus only on large manufacturing companies with deep pockets.

Now *Driving Digital Dynamics* has revealed the key concerns of manufacturing companies as they strive to maintain pace in their digital transformation journeys.

Top concerns highlighted by the majority of respondents⁵ comprise:

- 1. Management understanding** to assess the benefits, risks, return-on-investment and best-practice journeys for digital transformation.
- 2. The data challenge** to capture, manage and leverage digital data for business advantage.
- 3. The shop floor** – engaging employees to implement and manage new systems and processes.
- 4. Guidance and collaboration** by the buy-side and the supply-side to share basic knowledge, practice and examples of successful digital transformation.

This short research summary reviews the state of play for digital transformation, then gives more detail on respondent inputs around each of these key concerns. Finally, we make a number of recommendations, based on respondent views, that may help overcome these obstacles.

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We've been on a path to not just 'do' digital but rather 'be' digital. We're moving into an environment where meaningful portions of the work are getting done by machines, guided by people. It's a mindset shift that is leading to some real breakthrough thinking.⁶

Juan Carlos Parada, Global Head of Customer Operations, Unilever

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Digital transformation – where are we today?

Manufacturers – large, medium and smaller – widely recognize the principal benefits of digital transformation. **A literature review allows us to summarize those benefits under four headings:**

- 1. Greater efficiency** (more uptime, automated processes, predictive maintenance, data-driven process optimization, etc.)
- 2. Reduced cost per piece** (reducing errors, waste, set-up time, and so on, through automation & visibility)
- 3. Enhanced competitiveness** (through greater profitability, greater agility, ability to pivot to new markets, reduce time-to-market, prove ESG and sustainable credentials, etc.)
- 4. Growth at scale** (capturing corporate/process know-how, develop virtually through digital twin, produce repeatable processes, take on international expansion, offer clients visibility, and so on.)

To enable these benefits, all sizes of manufacturer are investing in key technologies. This study first asked its community of respondents what their top three investment priorities would be in 2025–26.

The results of this survey are shown in the chart on the next page, and reveal that Robotics & Automation, as well as AI/Machine Learning lead the pack for the next two years. Cybersecurity shows strongly, indicating a growing awareness of the exposure of manufacturing systems where OT and IT are being integrated. Digital Twin investment is also prominent, along with Enterprise Systems looking to ingest and leverage data flows from manufacturing environments digitalized through Machine Vision and Sensor technology.

It is clear from survey responses and previous research, though, that adoption of digitalized

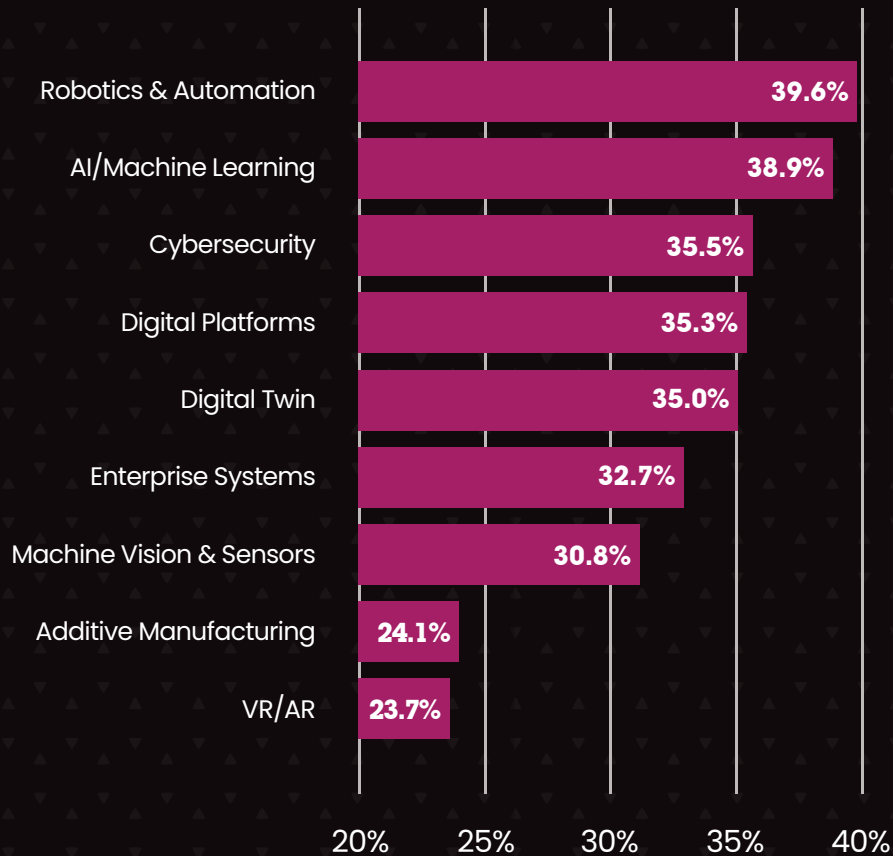
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If enterprise tools and platforms enable collaboration, a free flow of information, the removal of silos, and automation for repeatable processes, the workforce will be empowered and the culture will encourage leadership, continuous improvement, adaptability and accountability.⁷

Information Services Group (ISG)

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What are your top three technology investment priorities in 2025-26?



N = 1,088 manufacturers – all sizes – in North America, Europe, Asia.
Research period April 2024-Jan 2025

manufacturing solutions by SMEs is slower compared to larger enterprises.⁸ Larger manufacturers are usually better placed for digital transformation: they have deeper pockets; they can attract talent and workforce more easily with the power of their reputation and brand; and they can absorb greater scale of pilot activity, experimentation and payback period.⁹

Some argue that SMEs have an advantage over larger, international enterprises in achieving digital transformation:¹⁰ such as simpler organizational structures, greater ease of collaboration, less propensity towards islands of activity, less internal departmental politics. Nevertheless, widespread, 'significant' digital transformation initiatives are financially riskier for SMEs, and they often lack management, IT and process skills, which leads to a need for external support.

Across the board, studies from the last ten years have highlighted the high failure rate of digital transformation projects.¹¹ In the words of one study, "The reality for the majority of organizations undertaking a **digital transformation** is an estimated **failure rate** of between 63–90%.¹²"

All the more important then, that this latest MindMetre study continues to gather market opinion on the causes of potential failure or – more usually – under-performance versus expectations.

Research published by IFS identifies a debilitating state of 'option paralysis.' When asked to prioritize digital transformation technologies, more than 80% of manufacturing respondents listed every option as essential, underscoring the confusion that prevents decisive action.¹³

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Digital transformation is like any other significant change! You think, plan, discard and start again. The problem here is that if you don't start, you won't arrive. Whether IoT, end-to-end connectivity or analytics supported by AI, missing the right time creates more and more economic disadvantages that are difficult to make up for. This is exactly where financing concepts come into play that go hand in hand with the technology used, as well as those that are precisely geared to the needs of the customers.

Peter Welp,
Financing Solution Partner Germany,
Siemens Financial Services

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The main challenges to the pace of digital transformation

Respondents to **Driving Digital Dynamics** identified four main challenges which are currently impeding momentum for digital transformation in many manufacturing companies.

01. MANAGEMENT UNDERSTANDING & ENGAGEMENT

According to our respondents, senior management has – in many cases – not yet gained the expertise nor the evidential basis to effectively plan digital transformation. This is a fundamental issue as the ability to achieve transformation starts with realistic, knowledgeable planning. As one study notes, “There is an inherent relationship between the available competencies and the extent to which a firm can leverage the benefits of digital tools.¹⁴” And that competency starts at the top.

Some might argue that business leaders rely on their domain experts to advise them properly, which is true enough. But how does the senior manager work out which so-called experts to trust or to hire? Quis custodiet custodes?

As one respondent put it, “The majority of manufacturing leaders & CFOs know engineering & operations but don’t really understand how the digitalized environment works.” So more effort needs to go into management training specifically on the subject of digital transformation – technologies, methodologies, metrics of success and supplier contractual engagement.

With such training, essential first steps can be better planned. “Firms need to start by identifying the business problem properly and accurately

– especially in terms of the **art of the possible...** realistic goals,” said one respondent. They went on to describe the nightmare scenario of a manufacturer who spent millions on an automated factory only to find that inventory issues, a maintenance skills gap and difficulties with supply chain links ended up making their cost per piece more expensive than before the investment.

Some positivity was felt about generational change, in the sense that the older generation were retiring in favor of more digitally knowledgeable senior managers. As one research participant said, “The new generation of Mittelstand leaders get it!” These younger leaders were also felt to be more prepared to implement wholesale change. In the words one contributor, “Some legacy always has to go – and it’s a difficult mindset, both financially and operationally, to scrap & replace.”

Whether associated with age or not, a whole mindset change towards co-operation and collaboration was felt to be needed, particularly by medium-sized and smaller manufacturers. As one participant said, “Big firms can afford to pilot and can absorb a fair amount of experimental work that fails... In contrast, SMEs need to club together more, collaborate in

common cause, including pilots.” We have a separate heading for the wider subject of collaboration and open standards, but respondents emphasized that this mindset has to start at the leadership level.

Overall, the main senior management competencies felt to be lacking among a high proportion of manufacturers were identified as:

- Ability to build a realistic **digital strategy**, which understands the technology topology, inter-dependencies and skills required.
- Knowledge to create **achievable roadmap** of digital transformation:- managing the path between pilots and scalable roll-out; constructing a reliable business case for each stage of the digital journey; and deploying understanding of short- and long-term payback that persuades shareholders to invest.
- Ability to negotiate supplier agreements with reasonable terms tied to **business outcomes** rather than simple technology provision.

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It's a hard truth, but digital transformation projects are more likely to fail than succeed. What's encouraging is the growing recognition that failing to invest in the digitalization of crucial operations - and more importantly making advanced manufacturing technologies work to support people in their daily processes is fundamental. Manufacturers should embrace digitalization that augments workers' performance to deliver speed, flexibility, and visibility so they can pull in the same direction. With the technologies available today, companies can deliver transformative change from accumulating small wins against clear goals.

Johannes Mann, Senior Director Industry Processes, Hexagon

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02. THE DATA CHALLENGE

Respondents to *Driving Digital Dynamics* overwhelmingly confirmed an expertise gap for many manufacturers seeking to manage and leverage data streams flowing from the digitalized manufacturing production environment.

Standards such as ISA-95 (for enterprise-to-control system integration) are important enablers. Yet the multiplicity of integrations – controls, measurement, machine vision & sensors, inventory, supply chain, ERP, MES, CRM, etc) is complex and requires deep skill levels to plan, execute, monitor and measure. Whole businesses have emerged that offer software solutions to manage data flows, latency issues, decentralized structures, stranded information assets, and more.

Not only does the infrastructure of data exchange need to be set up; data science expertise is also required to choose, design and deploy

quality data intelligence that delivers measurable commercial benefits. Data has to be contextualized to become useful.

Respondents noted that data value was being best leveraged around digital twin and predictive maintenance applications. However, respondents also felt many areas – such as error reduction, temperature management and optimization, energy-efficiency, multi-site load balancing, OEE, short batching, and a variety of other data-driven improvements were generally not being so well handled.

The data challenge is intimately linked to strategic investment decisions. As one respondent emphasized, “Manufacturers need to understand the investment timelines better... It often takes 2–3 years to build a data pool that’s usable to drive commercial returns.” Equally, the supply-side bears responsibilities; one commentator noted, “Suppliers

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Without a proper data foundation in place to manage data accessibility across the business, manufacturers will continue to struggle with scaling their industrial data initiatives and use cases. This is why Data Operations cannot be overlooked as it provides a common data layer on top of operational technology devices and systems whereby data can be collected, analyzed, contextualized and integrated into various applications and use cases that can gain benefit from the same data in a way that they need it.

John Younes, Co-founder and COO, Litmus

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need to stop selling the dream and focus on selling the practical journey.”

Other research participants pointed to further challenges arising from data capability and integration gaps, such as: data trapped in control systems; not getting full value from Cloud solutions which “need to be more lift & shift”; data quality assurance so that AI delivers value; the need to optimize data flows even at the edge; the need for deployment templates; and a requirement for more progress with interoperability standards—“Interoperability not as a closed black-box but as transparent connectivity.”

The final piece of the data challenge, as highlighted by a majority of respondents, concerned cyber-security. Two key security issues were identified by respondents:

- The relative immaturity of OT-focused cyber-security compared with the much more highly developed applications for IT systems. OT tends to be the point of vulnerability. A US survey conducted in 2022 revealed that 78% of OT professionals had reported more than three cyber intrusions per year – and the volume has continued to grow since then. The persistence of legacy systems and inconsistent security measures continues to exacerbate vulnerabilities. OT professionals have responded by increasingly adopting standards such as NIS2 and IEC 62443 to establish a basis for their cyber-security initiatives.
- Budget constraints are also an issue. Again, better understanding by senior management of the importance of resourcing cyber-security properly is seen as crucial to getting a more equitable balance between IT and OT security issues. Many respondents cited the usefulness of independent, neutral benchmarking tools (such as those published by the International Centre for Industrial Transformation,¹⁵ or the World Benchmarking Alliance¹⁶) to provide an objective basis for internal planning.





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Industries today struggle with fragmented data, as silos and protocol incompatibilities limit its usability. Ensuring high-quality, contextualized data across machines, devices, and IT systems is crucial for decision-making and process optimization. Standardized approaches, such as Unified Namespace and the Asset Administration Shell, help centralize real-time data streams and enable seamless system integration. By breaking down data barriers, industries can enhance efficiency, improve interoperability, and drive smarter, automated operations—paving the way for true digital transformation.

Hagen Lehmann,
Director Industrial Business,
Amorph Systems

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03. ENGAGING THE WORKFORCE

In the word of one of our research respondents, “Investing in the tech is relatively easy compared to building the skills needed – we need long-term thinking to train the manufacturing engineer of today and of the future.”

Another put it even more succinctly: “Digital Transformation has stalled above the shop floor.”

Recognizing the lack (to date) of sufficient attention paid to the human-machine interface and the motivation and engagement of employees, has led to the concept of Industry 5.0. Industry 5.0 focuses on the engagement and upskilling of manufacturing workers and embraces those factors into strategic considerations and decisions. It aims to focus more on outcomes and value than the more technology-driven Industry 4.0 concepts.¹⁷

Indeed, most academic literature has focused on enabling technologies, failing to factor in the human element.¹⁸ Early thinking on Industry 4.0 focused on the idea that expert manufacturing knowledge held in human brains should be systematically captured so as to be retained and held in corporate memory even when skilled employees left or retired. This remains an important objective. Yet so does the reskilling or upskilling of workers (of whom there is a shortage) to deliver best value in the human-machine combination, such as cobot deployment and management. In particular, respondents highlight the key skill areas relevant to this upskilling:

- Technological competencies (as with Industry 4.0)
- Business decision skills (evidence-based) as decision making devolved down the seniority tree
- Communication competencies – collaboration, cross-department
- Learning competencies

Developing these competencies requires financial and management support, so the issue of employee engagement becomes a building block of successful strategic planning. Strategic skills roadmaps have to be built by management to plan employee qualification investments, alongside technical implementation of smart manufacturing. It cannot be an afterthought. Many respondents emphasized that employee qualifications are actually a key determinant for achieving smart manufacturing.¹⁹

Digital Transformation – Strategic Streams

ICT Infrastructure

- IoT
- Cloud
- Cybersecurity & blockchain
- Comms: network, WiFi, RFID
- Data exchange interfaces

IT Applications

- ERP
- MES
- Data analytics
- Digital twin
- Predictive maintenance
- Monitoring & optimisation
- CAD

OT Environment

- Robots
- Materials handling
- PLC
- PCS
- SCADA
- Sensors
- Machine vision

Human-Machine Collaboration

- Adoption training
- Virtual reality
- Augmented reality
- Robots
- Mobile devices
- Wearable devices

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Digital transformation in manufacturing holds immense potential. It, however, is often slowed – not by technology, but by human and organizational barriers. Legacy infrastructure, skill gaps, cybersecurity risks, and organizational silos can hinder progress, turning innovation into frustration. True transformation demands more than just technology – it requires cultural readiness, strategic vision, brave leadership and a commitment to overcoming obstacles. The challenge is not in adopting new tools, but in reshaping mindsets and workflows to embrace change. In an increasingly interconnected world, the manufacturing industry must work together along value and supply chains and across borders, while putting people in the center of all activities. Success therefore lies not just in innovation, but in collaboration and the resilience to navigate disruption.

Hannes Hunschofsky,
Managing Director,
EIT Manufacturing East GmbH

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Equally, said many research respondents, management needs to get 'into the mindset' of their people working on the shop floor. One commentator noted the need to "Automate training on demand for blue collar workers (who often don't have native language)". This meant, for instance, a system to access manuals from a constantly updated library, via mobile device, which presented set-up, adjustment, changeover or trouble-shooting solutions expressed pictorially as well as verbally. Enabling employee understanding in this way prevents digital transformation plans failing simply because shop floor workers do not know what to do.

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Digital transformation in manufacturing is not a mere upgrade - it's a seismic revolution. Data is its lifeblood, AI its engine, and the industrial world its uncharted frontier. Yet the greatest barriers to this shift are human, not technological. Visionary leadership, workforce expertise, and collaborative ecosystems are the linchpins of Industry 4.0's untapped potential. This research underscores three imperatives: leaders must cultivate digital fluency, employees require continuous upskilling and empowerment, and industries must dismantle silos to prioritise knowledge-sharing. Only by addressing these pillars can we surmount obstacles and unlock the revolution's full promise: operational agility, cost efficiency, market leadership, and growth at scale.

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Bala Amavasai, Chief Technology Officer, Celebal Technologies

Similarly, respondents also talked about the importance of incentivizing the shop floor to ensure effective adoption of new technologies. “We need to put ourselves in our employees’ shoes and ask the question that they will be asking... What’s in it for me?” said one research participant. Several commentators talked about the philosophy of sharing the benefits of optimization and efficiency with the workforce. In one example, greater machine uptime was achieved, but also more breaks introduced for the operators. In another, worker bonuses were linked to production gains. Gains were shared between business and workforce.

In short, greater attention and investment in the human-machine interface – enablement, training, communications, incentivization – was widely felt to be a critical success factor for digital transformation. By the same token, respondents noted that failure to address such issues was likely to lead to project failure.



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In manufacturing, we see that a lot of digitization projects and initiatives eventually “hover” above the shopfloor. They fail to reach the final step in communicating what the actual change boils down to for the blue-collar worker in his daily practice. With video-based work instructions we finally enable that missing link.

Matt Nys, Manual.to

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04. TRUE COLLABORATION

Much effort, say respondents, is devoted to publicity statements on collaboration, sharing, examples and best practice guidance. Yet the commercial reality is that not nearly enough is **actually happening**. While acknowledging the important activity by trade bodies in the US, Europe and Asia to offer guidance on digital transformation, respondents felt this is not sufficiently backed by manufacturers themselves sharing the detail of their successes.

In particular, participants in the research study pointed to the need for more...

1. Detailed examples of successful transformation projects

Clearly, these may often have to be anonymised, for competitive reasons. Attribution is unimportant, though. It is far more crucial, say respondents, that examples are **detailed** – describing the underlying rationale and business case/ROI, the challenges to be overcome, the technical and personnel techniques and KPIs, and the ongoing metrics. Commentators noted that this is an ideal opportunity for trade bodies to collaborate internationally to build a library of success stories “full of actionable insights” – perhaps similar to the German ‘Platform Industry 4.0’ initiative.

2. Recognised transition methodologies

“Our industry really lacks proven staged conversion guidance... we’re talking about a bite-sized approach but within a framework of strategic incremental gain,” stated one respondent, reflecting the majority call for better guidance and methodologies on best practice, risk assessment, scalability, and so on. “We need an officially endorsed approach that management can recognize and sign up to... a more collaborative

culture. Expertise and knowledge of successful digital transformation is in the hands of too few... and they want to hold on to it... We need to create fans of sharing,” explained a research participant. Again, international trade body collaboration could play a significant role here.

3. Further development of open standards

Interoperability – or lack thereof – is seen as a major sticking point for digital transformation. As one respondent explained, “However much solution suppliers say they want open systems and protocols, there remains a dichotomy... it’s fundamentally against their commercial interests.” Another added, “No-one has yet come up with a convincing way of encouraging the whole manufacturing eco-system to collaborate effectively – it will probably come down to the big systems integrators eventually forcing the pace.”

4. Insight into managing conversion disruption

While digital transformation solutions and stages look good on paper, they often involve turning off essential production units for periods that are commercially unsustainable. As one participant said, “The cost of downtime is often putting management off significant digital transformation.” “Easier, affordable access to digital twin technology is needed,” said another, “...making virtual development possible even for SMEs and so hugely reducing the time that critical systems have to be down.” Respondents are particularly looking to the supply-side for better method and the means of achieving digital transformation without dangerous commercial interruption.

Key Takeaways

In summary, manufacturing professionals taking part in the **Driving Digital Dynamics** research project pinpointed the key obstacles likely to impede the progress of digital transformation in manufacturing industry:

1. Gaps in management understanding & engagement
2. Lack of capability to capture, process and deploy actionable data and analytics
3. Failures to sufficiently engage the workforce in digital transformation
4. Lack of sufficient true collaboration, sharing actionable insights and best practice

Respondents suggested the following initiatives would help overcome these key challenges to digital transformation:

- A. A more comprehensive international repository of detailed, but anonymized, examples of digital transformation, including rationale, techniques and RoI metrics
- B. Officially endorsed, evidence-based methodologies for best-practice, phased transformation journeys
- C. Further development of open standards and interoperability, possibly implemented through a federation of international trade bodies
- D. Practical pathways for each stage of digital transformation, based on real-life experience, particularly ways of avoiding the cost of commercial interruption (e.g. digital twin development)



Footnotes

1. USA, N = 453; Europe, N = 359; Asia, N = 276. Research period, April 2024 – January 2025
2. https://www.thoughtsparkagency.com/assets/uploads/2023/09/ThoughtSpark-Digital-Divisions-Report_2024-02-Web.pdf
3. Defined as 50%+ of the manufacturer's production environment having undergone some form of digital transformation
4. All respondents to Driving Digital Divisions had over 50 employees
5. Defined as factors cited by over 70% of respondents
6. Validated by Juan Carlos Parada 2025 - <https://www.unilever.com/news/news-search/2024/utilising-ai-to-redefine-the-future-of-customer-connectivity/>
7. <https://www.businesswire.com/news/home/20230522005629/en/ISG-Study-Finds-Smart-Manufacturing-Success-Nearly-Doubled-in-the-Last-Year>
8. https://link.springer.com/chapter/10.1007/978-3-030-90700-6_82
9. <https://www.sciencedirect.com/science/article/pii/S0040162518315737>
10. Such as: <https://www.themanufacturer.com/articles/embracing-industry-5-0-is-a-game-changer-for-sme-manufacturers/>; https://link.springer.com/chapter/10.1007/978-3-030-25425-4_1
11. For instance, from: Boston Consulting Group; Deloitte; Bain & Co
12. https://www.researchgate.net/publication/350983517_Digital_Transformation_How_to_Beat_the_90_Failure_Rate
13. <https://www.themanufacturer.com/articles/manufacturers-at-risk-of-falling-behind-due-to-stalled-digital-transformation/>
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17. <https://www.sciencedirect.com/science/article/pii/S0278612521002119>
18. <https://www.sciencedirect.com/science/article/pii/S0925527320303418>
19. See also academic references widely cited, such as: <https://www.tandfonline.com/doi/epdf/10.1080/21681015.2023.2216701>; <https://www.tandfonline.com/doi/epdf/10.1080/00207543.2022.2101031>

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