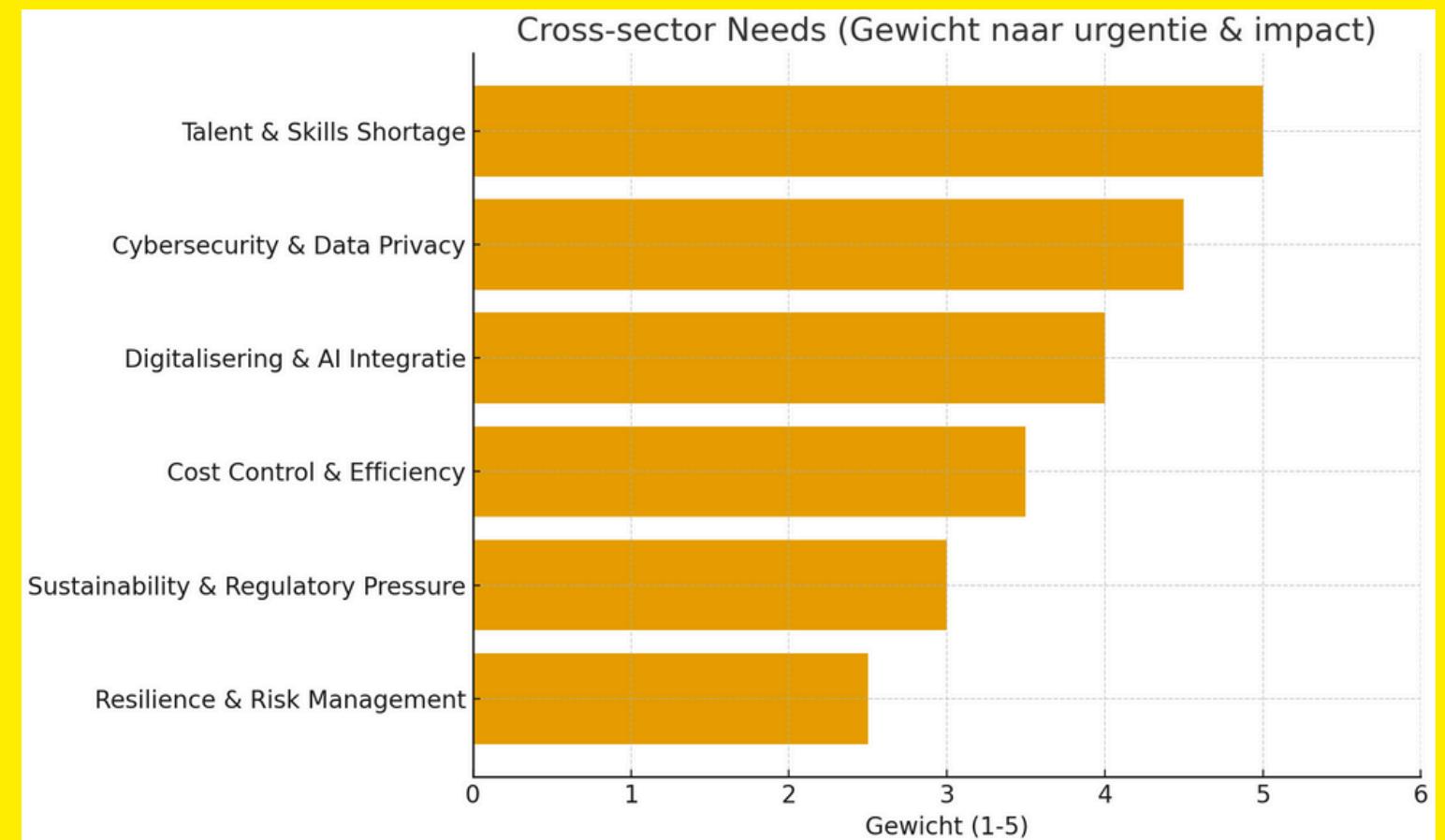


Cross-sector “Big Needs” (2025/2026)



bevindingen

- Talenttekort en cybersecurity zijn de zwaarste “pains” nu (2025/2026).
- AI/digitalisering en kostenbeheersing volgen daar vlak achter, als meer strategische maar nog steeds dringende prioriteiten.
- Sustainability en resilience zijn cruciaal, maar bedrijven ervaren ze vaak meer als middel-lange termijn druk (behalve in energie-intensieve sectoren of bij acute crises).

Based on:



sectors:

- Industry / productie
- Health care
- Government / publieke sector
- Commerce & Services

Hoe deze needs zich verbinden ?

Talent & Skills :

- AI/digitalisering (nieuwe vaardigheden nodig)

Cybersecurity:

- Digitalisering (meer tech = meer aanvals vectoren)

Sustainability & Cost control:

- (groen zijn kost geld, maar levert ook efficiëntie) Resilience

Risk & governance:

- (sectoroverschrijdend thema, van zorg tot overheid)



Lean impact + AI aanvulling (cross sector verbetergebieden)

Key points:

- **Lean** is hier dominant → talenttekort is primair een proces en inzet vraagstuk.
- AI vult sterk aan door kennisoverdracht te versnellen en vaardigheden meetbaar te maken.
- Vooral multimodal AI (AR/VR training) en RAG voor interne kennis zijn de next-level oplossingen die legacy (gewone e-learning) ver overstijgen.

[link>>>](#)

Talent & Skills Shortage

Lean Impact (dominant)

- Standaard werk & visuele instructies → sneller inwerken
- Cross-training (multi-skilled teams) → flexibiliteit
- Kaizen & betrokkenheid → retentie en motivatie
- Elimineren van wachttijd/inefficiënties → meer waarde per medewerker

AI Aanvulling

Legacy AI

- E-learning platforms met automatisering
- Skill-gap dashboards (basic analytics)
- Chatbots voor HR-vragen

Next-gen AI

- RAG → gepersonaliseerd opleiden met context (interne manuals, SOP's)
- Agentic workflows → AI-coaches die training + performance monitoren
- Multimodal AI → AR/VR-brillen met real-time begeleiding
- Policy-engineering → leerpaden afgestemd op compliance & veiligheid

6. Implementing AI and Preparing Future Workforce



THE TREND:

As manufacturers increasingly adopt AI and other new tech, they will need to consider how these technologies will affect their workforce, including hiring, training and upskilling. In addition to creating a business case for AI investment, employers will need to have a change management plan to assure the current workforce of their roles and importance in the adoption of AI. Manufacturers should be prepared to navigate new governance issues and standards and explore the additional opportunity to use AI for knowledge management and next-gen knowledge transfer.

Creating the Future of Manufacturing Work

AI capabilities to support and upskill a workforce are timely for manufacturers. Many face a pressing need to increase their workforce's productivity, capacity for innovation and career mobility. Enabling experienced workers to pass on their experience and develop the next generation is as critical as it is challenging. AI can help with these imperatives. AI models are scalable and flexible, and they are accessible even to workers without a technology background. AI can make work more productive, meaningful and engaging while providing predictive analytics to support the workforce. This increase in engagement, purpose and career mobility can help manufacturers retain experienced workers and attract new talent.

The future of work in manufacturing will have AI embedded into everything people do, experience and lead. To help their people and organizations thrive in the age of AI, manufacturers should focus on these three areas.

Go Beyond Upskilling

Manufacturing workers need new skills for AI, but skills aren't enough. Manufacturers can create a culture where people will want to work with AI. Otherwise, they'll slow-walk adoption. For this cultural shift, leadership can make clear that the goal is for AI to make people more valuable and productive, not replace them. "AI ambassadors" can serve as mentors and peer coaches, showing colleagues how AI can support their careers and help them learn how to use AI responsibly.

Much of AI's value for manufacturers will come through AI-driven, "agentic" workflows. In an agentic workflow, people and AI agents (entities programmed to perform specific tasks) work together. AI agents can perform simple tasks (such as routine maintenance) under human supervision. They can also help people solve complex challenges, such as supply chain optimization. The result is a workforce where people focus on more meaningful, higher-value work. It can improve their experience, helping to retain workers and attract new ones.

Centralize and Transfer Knowledge

Most manufacturers have critical experience and knowledge locked in places where it's hard to access: within their experienced workers, who are dispersed across the enterprise. AI can help centralize this knowledge, preserve it and transfer it to the next generation.

Today, anyone can interact with AI models in everyday language. If experienced workers have the skills and incentives to help train AI models—correcting mistakes and filling gaps in their knowledge—then these models will contain critical elements of their expertise. Through Q&A chatbots or other guidance tools, these models can transmit this expertise to others. By using AI as a catalyst to help each other grow and to help the next generation add more value, jobs will grow too.

Redefine What Leaders Do

AI will require manufacturing leaders' roles to change. They will have to foster more continuous learning around technology application as well as human-AI collaboration through role modeling and policy changes, such as introducing new metrics and incentives. Leaders will be managing and evaluating teams that include both people and AI agents. They will also have to confirm that they—and their teams—follow responsible AI principles to help unlock AI's value and manage its risks.

Leaders will need to reimagine and redefine the nature of manufacturing work. As AI does more routine and repetitive work, some skills will become more important: empathy, critical thinking, collaboration and creativity. Leaders will also need to make sure that AI isn't used too much. For example, in a customer-facing role, workers may use AI-generated data to better understand client needs, but their communication skills will be crucial in turning the data into exceptional service. The goal isn't to automate everything away, which would lead to errors, lack of problem solving and greatly reduced opportunities for innovation. The goal is to build a human-led, AI/tech-powered manufacturer where people remain in control, and AI helps create a manufacturing ecosystem that enables seamless upskilling, knowledge transfer, innovation, productivity and an engaging employee experience.

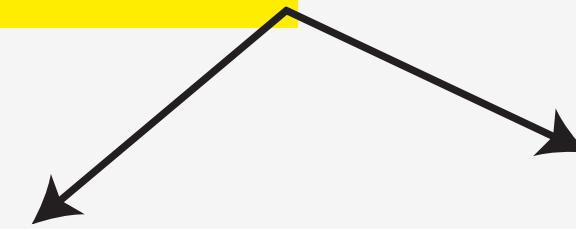
[LEARN MORE >](#)

A significant challenge identified by respondents was access to appropriate AI governance talent and skills in the workforce. Of respondents, 23.5% said finding qualified AI professionals was part of the challenge delivering AI. Another part of the challenge is the host of skills qualified AI governance professionals need.

[link>>>](#)

Lean impact + AI aanvulling

(cross sector verbetergebieden)



Key points:

- **Lean** zorgt voor processtabiliteit → je voorkomt menselijke fouten en verkort response-tijden.
- **Legacy AI** geeft detectie & dashboards, maar mist context (veel false positives).
- **Next-gen AI** (RAG + agentic workflows) maakt security echt adaptief, beleids-gedreven en multimodaal → wat nodig is voor 2025/2026.

[link>>>](#)

Cybersecurity & Data Privacy

Lean Impact (dominant)

- Value Stream Mapping → datastromen in kaart brengen (lekken?)
- Poka-Yoke → foutpreventie in toegangsbeheer en updates
- 5x Waarom → root cause analyse van incidenten
- Just-in-time patching → efficiënt en tijdig updates uitvoeren

AI Aanvulling

Legacy AI

- Anomaly detection (ML-gedreven loganalyse)
- SOAR (automatische incident-response)
- SIEM dashboards met AI-filters
- AI phishing simulaties

Next-gen AI

- RAG → AI die realtime policies & wetgeving raadpleegt voor compliance
- Agentic workflows → multi-agent SOC: detectie, triage, rapportage
- Multimodal AI → combineert logfiles + video surveillance + IoT-sensoren
- Policy-engineering → AI werkt binnen vooraf vastgelegde veiligheidsregels

The Role of Leadership in Driving Outcome-Focused Cybersecurity

Leadership plays a pivotal role in driving change and instilling a culture that takes cybersecurity seriously. It's imperative for leaders to lead by example, demonstrating the importance of cybersecurity through clear communication, investing in effective tools and training, and advocating for continuous improvement. These elements are crucial in fostering a culture that prioritizes OT cybersecurity.

Creating an OT cybersecurity plan is a strategic process that involves multiple stakeholders and detailed planning. The plan should clearly outline the goals, responsibilities, and procedures that will guide the organization's cybersecurity efforts. A few best practices include:

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In today's fast-paced industrial landscape, OT is the backbone of automation, productivity and data-driven decision-making. But as these technologies evolve, so do the threats targeting them. Cyberattacks on manufacturers and distributors have become more frequent and sophisticated, putting critical infrastructure at risk. For industries that rely on unbroken production lines and timely delivery, the consequences of a successful attack can be catastrophic—leading to financial losses, reputational damage and even threats to public safety. Protecting your OT systems is no longer optional—it's imperative.

Building a resilient OT-IT integrated future requires vision and a proactive approach to cybersecurity.

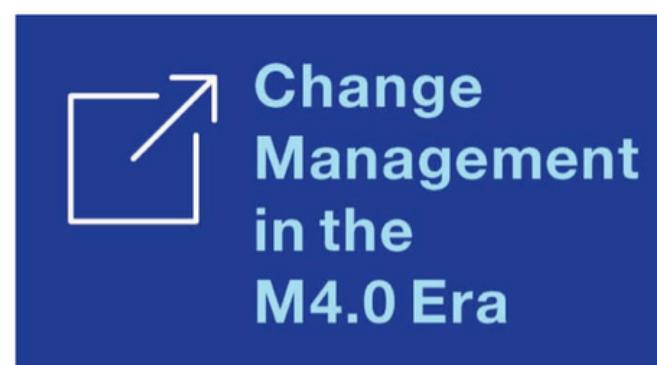
TAKEAWAYS:

- **Leaders need an outcome-focused cybersecurity vision** that sets clear, strategic goals for what they want to achieve in terms of security and ensures that decisions and actions align with these outcomes.
- **Take immediate action by integrating** the SANS Five Critical Controls for Industrial Control Systems (ICS), the first lie of cybersecurity defense, offering a structured approach to incident response, network architecture, visibility, secure access, and vulnerability management.
- **Stay one step ahead** by proactively addressing the common attack vectors that target OT environments to enhance organizational resilience against cyberattacks and safeguard critical operations.

In modern manufacturing, the integration of Operational Technology (OT) with traditional IT systems has given rise to a new set of challenges. OT, which encompasses the hardware and software that monitors and controls physical devices, is the backbone of manufacturing operations. Yet, it is often the case that these systems were not designed with cybersecurity in mind, thereby creating an environment ripe for exploitation.

A robust OT cybersecurity program encompasses the entire manufacturing process, with a focus on protecting the most vital assets. Although comprehensive frameworks like NIST and ISA/IEC 62443 exist to guide the development of a thorough plan, their complexity can sometimes hinder prompt action. Our recommendation is to start with the implementation of the SANS Five Critical Controls for ICS, which include:

1. OT-Specific Incident Response Plan
2. Defensible Architecture
3. ICS Network Visibility & Monitoring
4. Secure Remote Access
5. Risk-Based Vulnerability Management



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[link>>>](#)

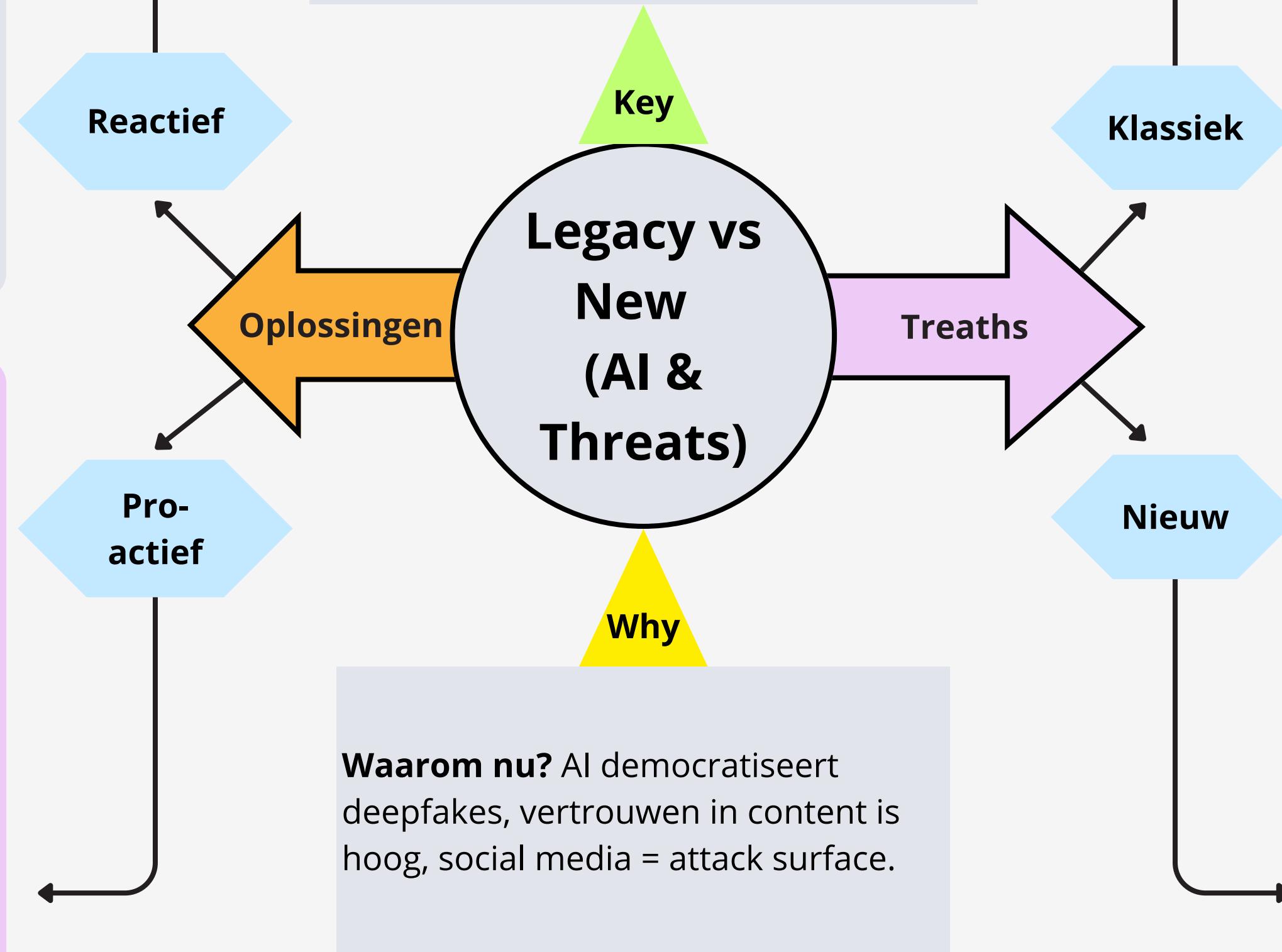
Legacy AI-oplossingen

- **Anomaly Detection** (veel false positives)
- **SOAR** (rule-based, beperkt)
- **SIEM + AI features** (onderbenut)
- **Dashboards** (beschrijvend, niet voorspellend)

New Era AI-oplossingen

- **RAG** → juridische compliance, audits sneller
- **Agentic workflows** → multi-agent SOC, mens alleen bij complex
- **Multimodal AI** → combineert tekst, beeld, geluid, sensoren
- **Policy-driven AI** → guardrails, juridisch correct
- **Governance AI** → explainable & auditable

Bedrijven moeten legacy defenses behouden, maar aanvullen met **New resilient AI & strategieën** → van reactief incidentbeheer naar proactieve, context bewuste bescherming tegen technische én sociale dreigingen.



Klassieke Threats

- Phishing
- malware
- ransomware
- Brute force
- credential stuffing
- DDoS-aanvallen

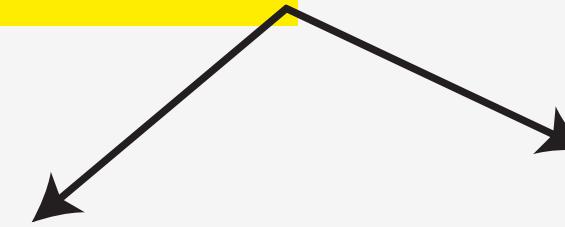
Gericht op voorspelbare patronen → firewalls/MFA volstaan.

New spectrum of Threats

- Deepfake voice/video cloning
- Synthetic identities
- Data poisoning / model manipulation
- Multimodal attacks (combinatie audio+video+tekst)
- Social media exploitation
- LinkedIn → spear phishing / whaling
- Instagram/TikTok → privédata → impersonation

Lean impact + AI aanvulling

(cross sector verbetergebieden)



Key points:

- **Lean** zorgt hier voor de basis: processen stroomlijnen en verspilling uit systemen halen.
- **Legacy AI** (RPA, dashboards) heeft veel impact, maar blijft fragmentarisch.
- **Next-gen AI** (RAG + agentic workflows) is cruciaal om integratie echt slim en schaalbaar te maken, zonder afhankelijk te zijn van losse silo's.

Digitalisering & AI Integratie

Lean Impact (dominant)

- Value Stream Mapping → bottlenecks in digitale processen zichtbaar maken
- Elimineren van dubbel werk tussen legacy en nieuwe systemen
- Standaardisatie van workflows → snellere adoptie
- Flow optimalisatie → soepele datastromen en procesintegraties

AI Aanvulling

Legacy AI

- RPA (Robotic Process Automation) voor repetitieve taken
- Basic chatbots voor klantvragen
- Predictive maintenance (eerste generatie modellen)
- Dashboard analytics

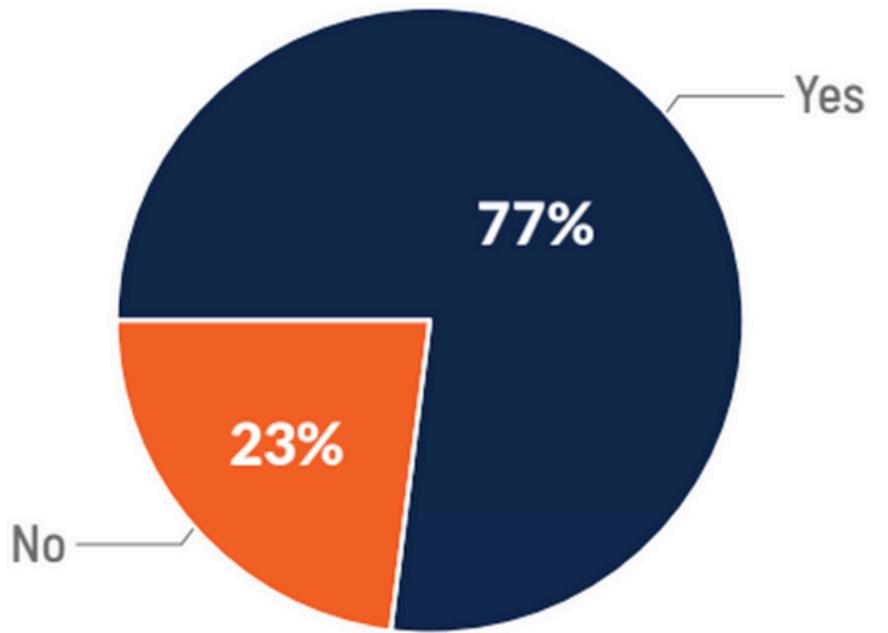
Next-gen AI

- RAG → context-gevoelige digitale assistenten die bedrijfsdata benutten
- Agentic workflows → multi-agent orchestration van processen
- Multimodal AI → combineert tekst, spraak, beeld, sensordata in één proces
- Policy-engineering → borgt > AI-automatisering voldoet aan regels & governance

- AI is changing the manufacturing landscape dramatically already.
- Manufacturing leaders who don't want to get left behind will need to understand the challenges and strategies of integrating AI tools to drive efficiency, enhance decision-making and manage data in complex environments.
- Managers and executives will need to level-up their digital leadership skills for successful digital transformation. They will also need to create a future-ready workforce empowered to leverage digital tools.

Starting an AI governance program involves hiring new or dedicating existing employees to an AI governance team. Companies are building these teams incrementally, starting with tasking the existing workforce and then hiring and empowering senior managers and executives, which the data suggests leads to fewer issues using AI and reporting on AI governance, among other positive outcomes. Many of the case studies illustrate how newer AI governance programs hire managers with prior experience in a digital governance discipline, like privacy.

Is your organization currently working on AI governance?



How Innovation Affects Manufacturers

- ✓ Collaboration and partnerships among innovation peers, industry, government and academia can accelerate innovation.
- ✓ Investing in innovation can be a play against economic uncertainty, as companies that innovate amid economic turmoil are often more profitable than those that do not.
- ✓ Increasing innovation ROI includes establishing metrics for Horizons 2 and 3, understanding the importance of nonfinancial metrics and working across functions to adopt and scale new technologies.
- ✓ Digitalization can help manufacturers boost the speed and agility of innovations by improving rapid prototyping, iteration, simulation and modeling.
- ✓ Innovation contributes to a resilient, transparent supply chain by using AI and data analytics to improve decision-making.
- ✓ The rapid pace of innovation and tech adoption means manufacturers must create a future-ready workforce, plan for knowledge transfer and upskill internal teams.

Embracing the Importance of Data in the AI Era

Manufacturers have always needed organized, accessible and high-quality data, from the factory floor to maintenance logs. With the rapid rise of AI—particularly GenAI—this task is imperative. For example, 65% of North American manufacturers say the most important lesson they learned from GenAI deployments is that success requires good data.³

Data readiness requires mature data collection, governance and management practices. This may be hard to achieve after years of disruptions and the daily realities of doing business. Beyond conducting a comprehensive data assessment to understand the organization's current state, manufacturers should focus on three best practices:

1. Build a Flexible and Scalable Data Infrastructure

Prioritize the development of a flexible, scalable data infrastructure. Transitioning to cloud environments is essential, as they provide the necessary storage and computational power to handle large datasets and complex AI models. Selecting the appropriate cloud configuration—public, private or hybrid—is crucial for meeting organizational needs. A multicloud strategy can offer additional flexibility and risk management,

enabling efficient cost management. Implementing a well-designed reference architecture ensures consistent, efficient analytics and AI deployments.

2. Establish a Strong Data Governance Strategy

Data governance is critical to data integrity, compliance and democratization. Establishing robust data governance frameworks enables effective monitoring, access and normalization of data across all systems and processes. This involves setting up comprehensive policies and procedures to make sure data is accurate, secure and accessible for authorized users. Using AI and automation in data governance platforms improves data management practices and fixes any remaining data quality problems. This will make operations more efficient and save money.

3. Ensure Data Quality and Validity

High-quality data is the foundation of effective data analysis and AI model performance. Focus on ensuring data validity, quality and proper formatting. Establishing a data catalog and lineage increases transparency and provides a comprehensive view of business-critical data. Implementing a master data management strategy helps define

Today's manufacturers face mounting pressure to innovate faster, but product teams are bogged down by manual, time-consuming documentation, spending up to 30% of their workweek writing rather than developing. This massive documentation burden, coupled with the challenges of coordinating communication across R&D, product teams and marketing, creates hidden barriers to innovation velocity, slowing product cycles and draining vital resources.

GenAI is transforming this landscape by automating and streamlining technical documentation throughout the product development lifecycle. Tasks that once consumed days now take minutes. Advanced GenAI solutions can generate precise technical documentation—from market research reports and project updates to product requirements and white papers. The result? Better cross-functional communication and collaboration across every phase of development—from discovery and viability to build and launch.

In selecting the right GenAI solution, buyers should focus on augmenting human expertise rather than replacing it. Human-led AI methodologies enhance teams' ability to analyze opportunities, translate complex concepts into compelling business cases and think deeply about their innovative work.

With reduced documentation and improved communications, product teams can reallocate their time value-generating work—deeper market research, sharper strategy and accelerated development. With the right GenAI solution, organizations can achieve 4x faster development cycles and launch superior, customer-centric products. This is the future of manufacturing innovation, where product teams innovate at the speed of thought.

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3.3 Convergence of Digital Twins and Artificial Intelligence

Symbolic Artificial Intelligence is a branch of AI research that emphasizes the use of explicit, human-readable symbols and rules to represent knowledge and reasoning about the world. At the heart of symbolic AI are knowledge graphs, ontologies, and logic-based reasoning. Knowledge graphs are structured representations of facts and relationships between entities that enable machines to understand and navigate complex information networks. Ontologies provide a formalized framework for defining the types, properties, and relationships of entities within a given domain and ensure consistency and interoperability between different systems and applications. Logic-based reasoning, a core component of symbolic AI, involves the application of formal logic to derive conclusions from a set of premises. This approach enables transparent, explainable and interpretable decision-making processes, where each conclusion can be traced back to the underlying rules and data. By combining these elements, symbolic AI enables robust and explainable AI systems capable of performing sophisticated tasks such as natural language understanding, semantic search, and automated reasoning.

In industrial context, ontologies are, among others, used to formulate requirements for products or the manufacture of products that can be checked in their context. This requires search criteria (ontology search points) with which clear identification is possible. For example, IEC 63278-1 [15] states that data models are defined on the basis of ontologies. The semantics of the actual data is typically documented by referencing these ontologies.

Ontologies originate from a variety of application areas and are intended for use in specific contexts. Examples of such ontologies include material science ontologies that facilitate the selection of materials for specific applications based on standard properties, ontologies in the construction industry or product data dictionaries that standardize the representation of products in electronic catalogs. For ontology-based data to be optimally effective in the planning and documentation of production systems, it is essential that the underlying ontologies meet certain minimum quality requirements. For instance, the concepts defined in the ontology must be uniquely identified on a global scale, or special properties must be defined on the basis of clearly specified data types and compatible physical units (see IEC 62832 series [20] and IEC 61360 [21]). The vocabulary defined by those dictionaries represent one bridge between Digital Twins and Artificial Intelligence: Property-based description of the Asset Administration Shell relies on semantic links to dictionary items; dictionaries form ontologies to reason about domain vocabulary which can be used by Artificial Intelligence. Consequently, symbolic AI can reason about (annotated) data provided by Digital Twins. Vice versa, insights derived from symbolic AI can be offered and utilized as a component of an asset administration shell, which may be conceptualized as a Digital Twin.

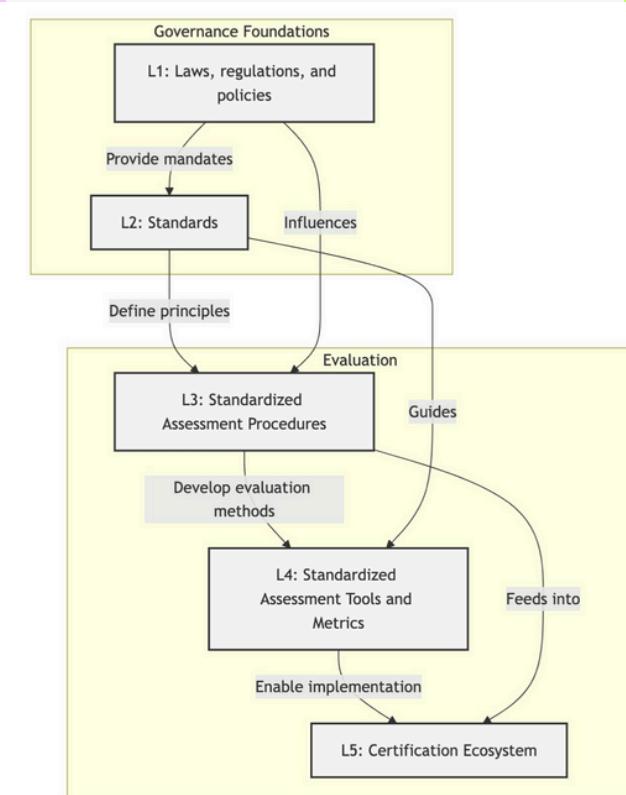
Semantically annotated data as provided by Asset Administration Shells play also an important role in context of Large Language Models and Generative AI as it is becoming increasingly obvious that these subsymbolic AI methods can be strengthened by combining them with symbolic AI (as provided by Digital Twins / Asset Administration Shells).

data management by processes algorithmizing, moving towards automating new governance models and systems, specialists' skill improvement, and supportive beliefs of environmental society. Data management is an undeniable part of managing roles in modern factories. Also, new governance through self-adaptation and self-optimization is applied. Another enabler is improving the skills of people emerging in new roles in the factories. So, there were some explanations of enablers for readers to be aware of the details.

Lean impact + AI aanvulling (cross sector verbetergebieden)

Key points:

- **Lean** is hier zeer krachtig omdat verspilling = milieu-impact.
- **Legacy AI** ondersteunt rapportage en energiebeheer, maar vaak reactief.
- **Next-gen AI** (RAG + multimodal) maakt duurzaamheid proactief: realtime compliance + simulaties → betere strategische keuzes.



Sustainability & Regulatory Pressure

Lean Impact (dominant)

- Elimineren van verspilling → direct lagere CO₂-voetafdruk
- Procesoptimalisatie → minder energie- en grondstoffengebruik
- Standaardisatie van metingen → eenvoudiger ESG-rapportage
- Value-stream denken → waarde maximaliseren met minimale impact

AI Aanvulling

Legacy AI

- Energiebeheer dashboards
- Basis rapportagetools voor ESG
- AI voor route-optimalisatie in logistiek
- Recycling- en afvalmonitoring

Next-gen AI

- RAG → realtime naleving controleren (EU Taxonomy, CSRD, ESG)
- Agentic workflows → multi-agent coördinatie van duurzaamheid, finance & operations
- Multimodal AI → simulaties van CO₂-impact via tekst, beeld en sensordata
- Policy-engineering → garandeert dat processen altijd binnen wettelijke kaders blijven

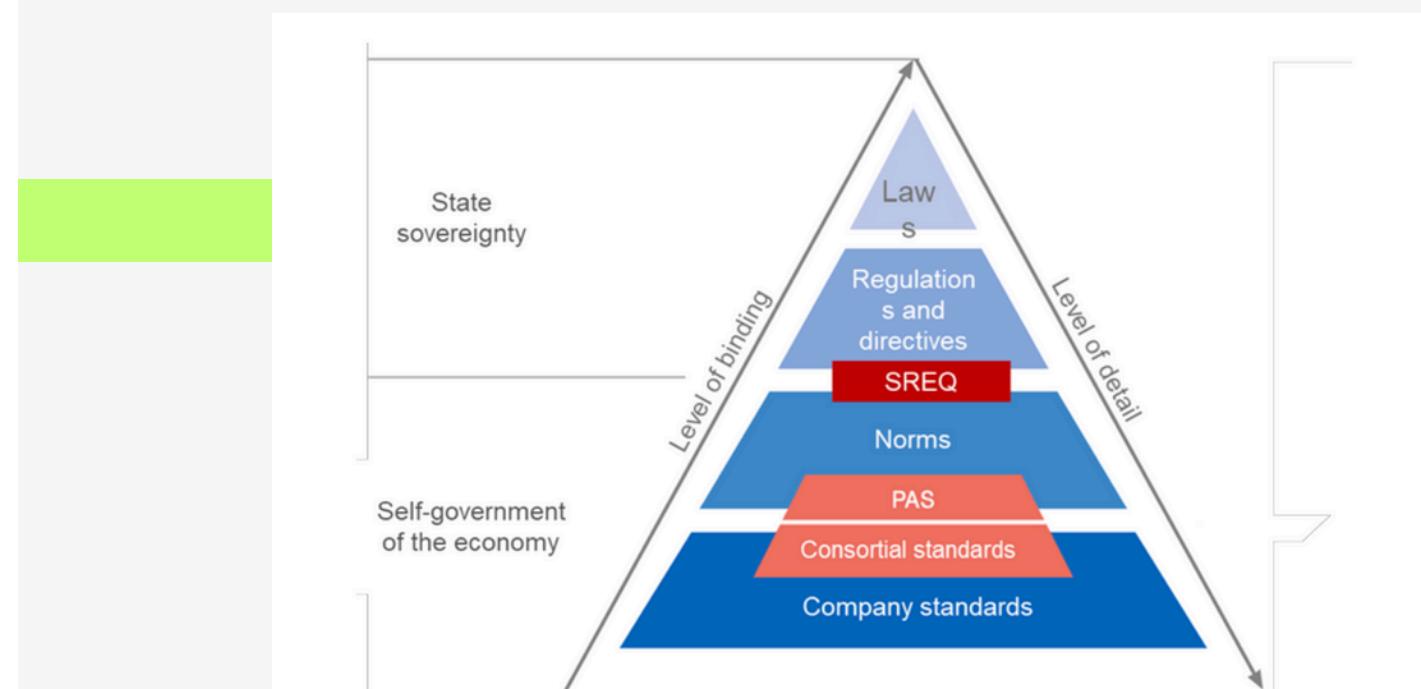


Fig. 1. Standards and norms in the legal system of Europe

ESG stands for environmental, social and governance and encompasses various topics and involves multiple teams and stakeholders. And a company's ESG performance can drive business success, influence investor decisions, and impact supplier and regulatory compliance. Its metrics are nonfinancial in nature and difficult to measure; the data are often fragmented, incomplete, inaccurate or simply unavailable. Disclosures are often reliant on estimates.

8. Exploring Energy Options to Power New Technologies

THE TREND:

As manufacturers continue to adopt AI and other new technologies, the huge volume of new tech and data centers will strain an already aging and insufficient power grid. GenAI has the potential to unlock data insights that manufacturers will need to stay competitive, but with one ChatGPT query taking nearly 10 times more energy than a traditional Google search,⁴ energy planning is nonnegotiable. Manufacturers must plan for the energy demands of Manufacturing 4.0 in 2025 and beyond as well as future growth and expansion.

Source:

4. <https://www.cnbc.com/technology/chatgpt-uses-10-times-more-power-than-google-searches-says-goldman-sachs-19435551.htm>

Of surveyed organizations, 77% are currently working on AI governance, with a jump to near 90% for those organizations already using AI. Importantly, 30% of organizations not yet using AI reported working on AI governance, perhaps revealing a prevailing "governance first" prioritization of ensuring good governance is in place before AI use. This is supported by some of the case studies, which indicate organizations are implementing formal AI governance programs after using AI for smaller use cases but before embracing AI as a strategic imperative.

Approximately 47% of respondents reported AI governance as a top five strategic priority for the organization.

Top functions tasked with the primary responsibility for AI governance

22%

Privacy

22%

Legal and compliance

17%

IT

10%

Data governance

6%

Ethics and compliance

5%

Organizations are building the foundation for compliance and strategy implementation.

Organizations using AI, which can broadly capture most analytical technologies depending on the definition, are increasingly looking to understand their compliance obligations. Many organizations use AI governance to build out a compliance program while also steering AI use toward strategic aims — from reducing headcount to increasing market competitiveness. For almost half of the respondents, AI governance was a top-five strategic priority.

Organizations see hiring AI governance professionals as an important part of professionalizing an AI governance program.

Few organizations are satisfied with their level of AI governance staffing, with only 10 out of 671, or 1.5%, reporting they will not need additional staff in the next 12 months.

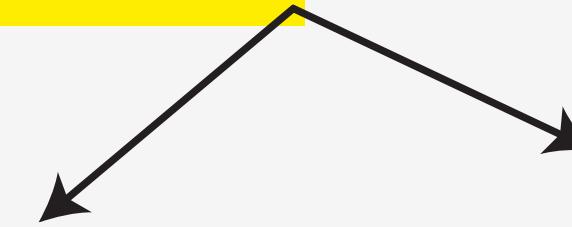
Choosing the right leaders and functions to lead AI governance sets the tone for an AI governance program.

Who leads the efforts in the organization has a noticeable impact on AI governance efforts and is often correlated with different markers of AI governance maturity. When the primary responsibility for AI governance is with their organization's privacy function, respondents were significantly more likely to be confident in their ability to comply with the AI Act, at 67%.

Organizations are thinking seriously about how to best approach AI governance.

This report shows there is no one single path; each organization will need to consider its objectives and unique situation when deciding how to develop its AI governance program. While organizations can leverage their existing privacy and compliance functions to support AI governance, AI introduces unique

Lean impact + AI aanvulling (cross sector verbetergebieden)



Key points:

- **Lean** richt zich op veerkracht via stabiele processen, visual management en continu verbeteren.
- **Legacy AI** geeft waarschuwingen, maar vaak te laat of te fragmentarisch.
- **Next-gen AI** (agentic + multimodal) tilt resilience naar een nieuw niveau: continue monitoring, realtime beslissingen en policy-geborgde acties.

Resilience & Risk Management

Lean Impact (dominant)

- Root cause analysis (5x Waarom) → onderliggende oorzaken van verstoringen aanpakken
- Visual management → duidelijke protocollen en crisisrespons-stromen
- Proces stress-tests → simulaties van piekbelasting of storingen
- Continu verbeteren (Kaizen) → leren van incidenten en processen robuuster maken

AI Aanvulling

Legacy AI

- Basic risk dashboards
- Predictive maintenance (eerste generatie)
- Early-warning modellen voor supply chain
- Scenario-planning in spreadsheets met AI-ondersteuning

Next-gen AI

- RAG → realtime beleids- en wetgevingscheck tijdens crisissituaties
- Agentic workflows → multi-agent crisismanagement (monitoring, planning, communicatie)
- Multimodal AI → integratie van satellietdata, sensoren, nieuws & weerinformatie
- Policy-engineering → borgt dat respons altijd binnen governance- & compliance-kaders blijft

Ensure you have enough variation in your suppliers to withstand disruption with this manufacturing buyer-

Proactive Supply Chain Management Is Key for Mitigating Disruptions

A version of this article was published originally on RSMUS.com.

Companies have been adjusting their just-in-time approach to inventories as globalization has shifted in recent years, and business leaders need to explore new tools proactively that can help them maintain operations when critical parts of their supply chain are threatened. For many fragile supply networks, even a small disruption can have outsized effects.

Especially for manufacturers, gaining greater visibility into their supply chains is not only a strategic advantage but also a necessity.

Cascading Effects

Without clear supply chain visibility, businesses risk being caught off guard by delays, shortages and cost increases—whether caused by labor strikes, extreme weather events or a rare bridge collapse like what happened in Baltimore in March 2024. This lack of insight can lead to cascading failures—an unexpected delay in one part of the supply chain can halt production elsewhere, leading to missed deadlines, unhappy customers and financial losses.

Greater visibility allows companies to anticipate these disruptions rather than react to them. By understanding where potential bottlenecks exist and identifying alternative routes or suppliers, businesses can maintain

The Strategic Advantage

With uncertainty being the new normal, the ability to see clearly through the fog of supply chain complexity and fragility is invaluable. For industrial businesses, the message is clear: Gain visibility now, and you will be better prepared to keep your operations running smoothly.

continuity and mitigate risk even when primary transportation methods are compromised. This proactive approach transforms a potential crisis into a manageable challenge.

Tools for Transparency

Achieving supply chain visibility starts with data. Companies need to invest in technologies that provide real-time insights into the movement of goods, the status of inventory and the health of supplier networks.

AI-powered solutions can assess suppliers to help organizations ensure business continuity and avoid potential disruptions. Advanced data analytics platforms can track shipments, forecast delays and identify risks across layers of the supply chain before they materialize, including the organization's direct suppliers as well as second- and third-tier suppliers and beyond. These tools allow businesses to create dynamic supply chain models that can adapt to changes in real time.

For example, if a rail strike were to disrupt a key transportation corridor, a company with full supply chain visibility could reroute shipments quickly via alternative methods, such as trucking or air freight. They could also identify suppliers closer to their production facilities or adjust production schedules to align with the availability of materials. This flexibility is only possible when companies have a clear, real-time view of their supply chains.

How Supply Chain Resiliency Affects Manufacturers

- ✓ Strategies to guard against supply chain disruption in 2025 include expanding the supplier pool and finding suppliers closer to manufacturing facilities.
- ✓ Seventy-three percent of supply chain and operations executives are planning to deploy GenAI in a move toward resilient, autonomous supply chains. However, merely 7% have completed implementation, according to a survey conducted by the Manufacturing Leadership Council.
- ✓ While GenAI offers promising benefits to the supply chain, manufacturers must also be aware of the technology's risks and challenges.
- ✓ Digitally enabled supply chains will have improved resiliency, visibility, planning, agility, predictability and a rapid or autonomous response to disruption.
- ✓ Manufacturing as an industry will need to invest in networks, such as digital passports and authoritative identifiers, to track sustainability claims within the supply chain.
- ✓ A first step to a more sustainable, and thus resilient, supply chain starts by being a good trading partner—for example, how many miles do your trucks run empty? Do you drive interoperability across your networks? How often do you change purchase orders?

Sensors implement smart supplies, and digitalization is the key to transforming the supply chain.

Production Chain Transformation, Smart Supply,

Lean impact + AI aanvulling (cross sector verbetergebieden)

Key points:

- **Lean** heeft hier traditioneel de sterkste track record → verspilling wegnemen = directe kostenbesparing.
- **Legacy AI** levert voorspellende inzichten en automatisering van administratie, maar blijft vaak silo-gericht.
- **Next-gen AI** (agentic workflows + multimodal) maakt integrale kostenoptimalisatie mogelijk, vooral in supply chain & energie.

Cost Control & Efficiency

Lean Impact (dominant)

- Elimineren van de 7 wastes (overproductie, wachttijd, transport, voorraad, defecten, overprocessing)

- Just-in-time voorraadbeheer → minder kapitaal vast in stock

- Kaizen events → continu kleine verbeteringen met directe ROI

- Flow efficiency boven resource efficiency → meer output per proces

AI Aanvulling

Legacy AI

- Predictive analytics voor demand forecasting

- Basic KPI dashboards (kosten vs. omzet)

- RPA voor financiële administratie

- Energy management systemen (eerste generatie)

Next-gen AI

- RAG → realtime kostenrapportage en compliance-checks

- Agentic workflows → AI-agents die voorraad, productie en inkoop afstemmen

- Multimodal AI → energie-optimalisatie via sensordata + weers- & marktdata

- Policy-engineering → budgetallocatie volgens regels & strategische kaders

“Data mastery” is defined as the ability to gather, organize, analyze and use information from all facets of manufacturing. Data mastery produces step changes in efficiency, cost-effectiveness and productivity.

There is a gap between data strategy and overall business strategy, though data is essential to remaining competitive, according to the Manufacturing Leadership Council.

Investing in innovation can be a play against economic uncertainty, as companies that innovate amid economic turmoil are often more profitable than those that do not.

Increasing innovation ROI includes establishing metrics for Horizons 2 and 3, understanding the importance of nonfinancial metrics and working across functions to adopt and scale new technologies.

Digitalization can help manufacturers boost the speed and agility of innovations by improving rapid prototyping, iteration, simulation and modeling.

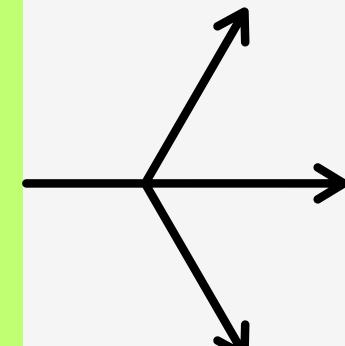
- Trade uncertainty: 78.2% (up from 77.0%)
- Rising raw material costs: 68.1% (up from 66.1%)
- Increasing health care costs: 65.1% (up from 60.0%)

Industry sector

hoe elk overkoepelend vraagstuk zich vertaalt naar concrete industry uitdagingen.

- Talent & Skills Shortage**
 - Tekort technisch personeel (operators, monteurs)
 - Data engineers & AI-specialisten
 - Cross-training & upskilling nodig
 - Hogere druk op HR & opleidingen
- Cybersecurity & Data Privacy**
 - OT/IoT-beveiliging (industriële netwerken)
 - Bescherming intellectueel eigendom
 - Cyberaanvallen op supply chains
 - Compliance (NIS2, export control)
- Digitalisering & AI Integratie**
 - Predictive maintenance
 - Smart factories / Industrie 4.0
 - Digital twins & simulaties
 - Integratie ERP / MES / legacy systemen
- Cost Control & Efficiency**
 - Lean productieprocessen
 - Supply chain optimalisatie
 - Energie-efficiëntie (stijgende prijzen)
 - ROI-gedreven automatisering
- Sustainability & Regulatory Pressure**
 - CO₂-reductie (klimaatdoelen 2030)
 - Circulariteit & afvalreductie
 - ESG-rapportage
 - Strengere EU-regelgeving (CSRD, EU Taxonomy)
- Resilience & Risk Management**
 - Geopolitieke risico's (China, grondstoffen)
 - Supply chain resilience (alternatieve leveranciers)
 - Klimaatrisico's (energie, grondstoffen)
 - Business continuity bij crises

Vertalen naar >>

- 
- Rollen / functies
 - Hoger Management
 - Midden Management
 - Kenniswerker / medewerker
 - Consultant
 - Risk officer
 - Security officer
 - Etc

Real-world RAG Use Cases

advancements, smart factories can seamlessly cater to the unique needs of individual customers, efficiently manufacturing small batches or customized items. Also, a Smart system in Manufacturing with Mass Personalization (S-MMP) for Production lines and scenarios of production systems can be helpful in this field [15]. Thus, it shows that personalization and customization are enhanced. It has not only improved customer

10. Supply Chain Planning

13. Project Assistance

2. Customer Automation

3. Sales Assistance

5. Financial Forecasting

6. Legal Review

a successful way to develop the smart factories in I 5.0 because the whole production system is under the meticulous insight of a new generation of technologies. New technologies like AI and IoT and others observe the production system implementation process. If factories tend to have a new way of producing, they must try to apply new technologies in their methods. According to the research, SFP has a nice position in the industry, especially in the future. It is understood that the local predictive automatic response of remote monitoring should be perfectly made in smart factories [66] during the production process. In today's situation, society and people are not too patient to control and monitor things. For this reason, automatic controlling is created. Also, remote monitoring can be productive in the production process.

There are eight enablers and eight barriers in the SFP framework in I 5.0. These factors are extracted

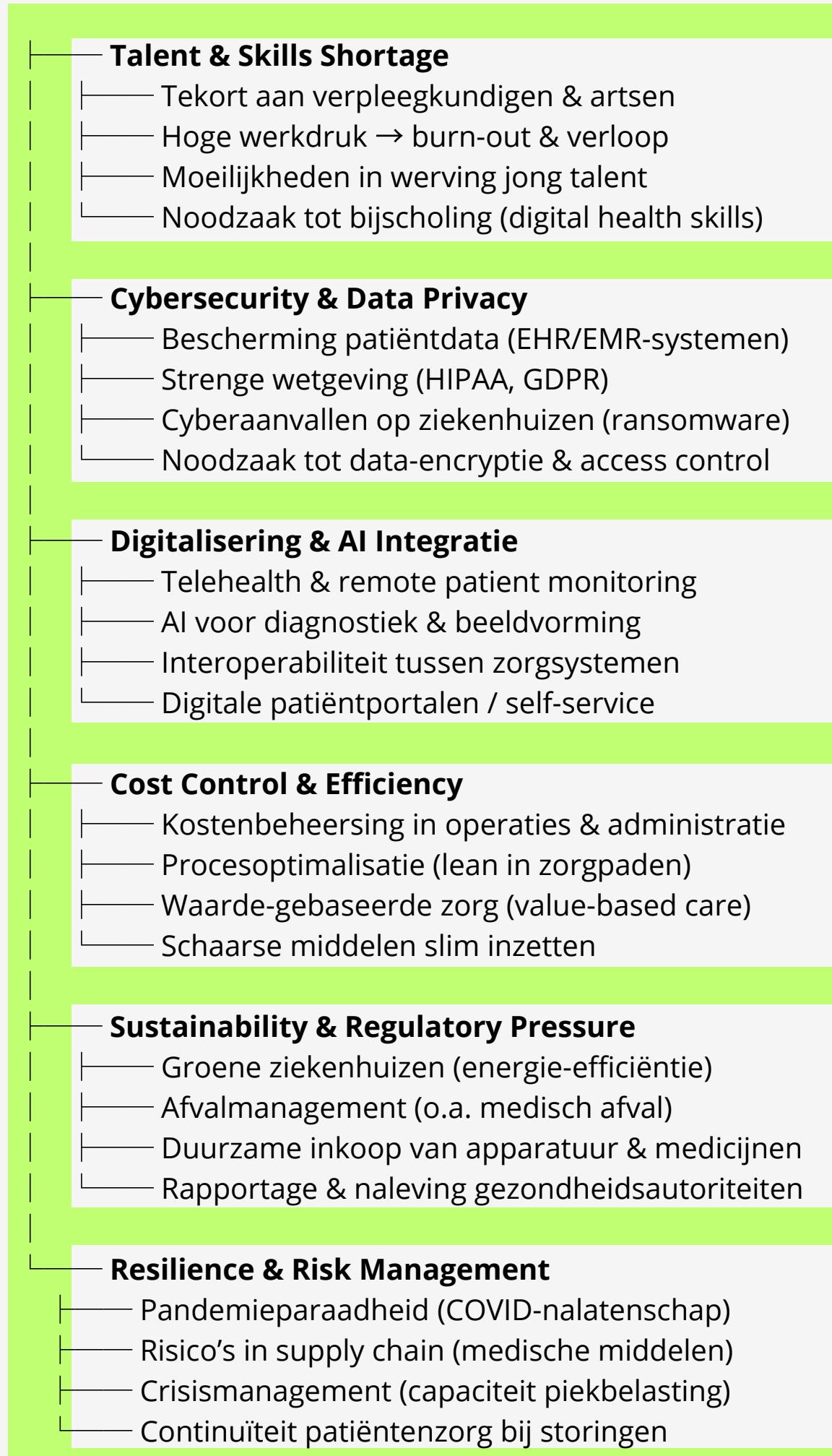
data management by processes algorithmizing, moving towards automating new governance models and systems, specialists' skill improvement, and supportive beliefs of environmental society. Data management is an undeniable part of managing roles in modern factories. Also, new governance through self-adaptation and self-optimization is applied. Another enabler is improving the skills of people emerging in new roles in the factories. So, there were some explanations of enablers for readers to be aware of the details.

Health care sector

hoe elk overkoepelend vraagstuk zich vertaalt naar concrete health care uitdagingen.

health care > unieke accenten

- patiëntveiligheid
- regelgeving
- continuïteit van zorg.



Vertalen naar >>

Rollen / functies
Hoger Management
Midden Management
Kenniswerker / medewerker
Consultant
Risk officer
Security officer
Etc

RAG in Healthcare: A Real-Life Success Story

In a groundbreaking application, a major hospital network implemented RAG to enhance their clinical decision support system. The challenge was to provide doctors with the most current and relevant information during diagnoses, considering the rapid pace of medical research publication.

The RAG system was integrated with the hospital's electronic health records and connected to multiple medical databases and journals. When a doctor inputs a patient's symptoms and test results, the system:

- Retrieves the latest relevant medical literature and clinical guidelines.
- Augments this information with the patient's medical history and current health data.
- Generates a comprehensive report suggesting potential diagnoses, treatment options, and relevant recent studies.

The impact was significant:

- 30% reduction in misdiagnoses for complex cases.
- 25% decrease in time spent on literature review by doctors.
- 40% increase in early detection of rare diseases.

Medical Diagnostics and Research

RAG (Retrieval-Augmented Generation) marks a notable advancement in medical diagnostics and research. RAG systems utilize vast databases of medical knowledge, including electronic health records, clinical guidelines, and medical literature, to support healthcare professionals in making accurate diagnoses and well-informed treatment decisions. Tools like IBM Watson Health exemplify this application. Utilizing natural language processing and machine learning algorithms, [IBM Watson](#) analyzes patient data against extensive medical literature, aiding doctors in diagnosing complex cases more effectively. In oncology, this platform helps oncologists determine personalized treatment options based on a patient's unique genetic profile and the latest research findings.

One notable application is IBM Watson Health, which employs RAG techniques to analyze large datasets, including electronic health records (EHRs) and medical literature, to aid in cancer diagnosis and treatment recommendations. Watson's ability to retrieve relevant clinical studies and generate personalized treatment plans based on individual patient profiles illustrates how RAG can optimize decision-making in healthcare settings. According to a study published in the *Journal of Clinical Oncology*, [IBM Watson for Oncology](#) was able to match treatment recommendations with expert oncologists 96% of the time, showcasing the potential of RAG to augment human expertise in medical diagnostics. The integration of such technology not only enhances patient outcomes but also reduces the cognitive load on healthcare professionals, allowing them to focus on patient care rather than data management.

Government sector

hoe elk overkoepelend vraagstuk zich vertaalt naar concrete government uitdagingen.

Government > unieke accenten

- transparantie
- publieke verantwoording
- veiligheid.



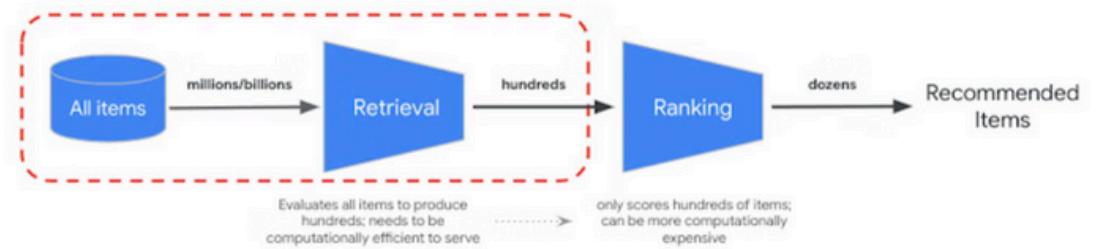
Vertalen naar >>

Rollen / functies
Hoger Management
Midden Management
Kenniswerker / medewerker
Consultant
Risk officer
Security officer
Etc

Document Summarization and Search

Retrieval Augmented Generation (RAG) has emerged as an efficient technology for document summarization and search. It leverages advanced information retrieval techniques to enhance the capabilities of large language models (LLMs). RAG systems can provide efficient results by integrating retrieval methods such as Approximate Nearest Neighbor (ANN) algorithms with complex ranking models.

For example, Google's Vertex AI Search uses a two-stage retrieval process: it first uses approximate nearest neighbour (ANN) algorithms to gather potential results quickly, then applies deep learning models for re-ranking to ensure the most relevant documents are prioritized. This approach enhances the accuracy of search results and allows for extracting critical information from documents, ensuring that users receive concise and contextually relevant answers without the noise of irrelevant content.



Source: Google

In the finance sector, [Bloomberg](#) has implemented RAG to streamline summarization of extensive financial documents, like earnings reports, by pulling the latest data and extracting insights. This system improves decision-making for analysts by providing real-time summaries tailored to current financial contexts. The ability to pull up-to-date information is critical in fast-moving environments, enhancing the relevance of summaries provided to users and supporting their strategic decisions.

Fraud Detection and Risk Assessment

Companies implementing RAG have reported a significant improvement in fraud detection rates as compared to traditional machine learning models. This is primarily due to RAG's ability to access and incorporate real-time, relevant data during the decision-making process. Traditional methods rely heavily on pre-defined rules and historical data, which can be limited in scope and may miss emerging fraud patterns. RAG, however, enables dynamic, contextual data retrieval, enhancing the system's ability to detect anomalies by integrating up-to-date, external information like newly reported fraud schemes or regulatory changes. Financial companies like JPMorgan Chase make use of AI-driven fraud detection systems using Retrieval-Augmented Generation RAG models. These systems continuously retrieve and analyze real-time data from various sources to monitor transactions and detect potential fraud. Similar to RAG, they combine data retrieval with advanced analytics to assess transactions in context – enhancing the accuracy and responsiveness of fraud detection.

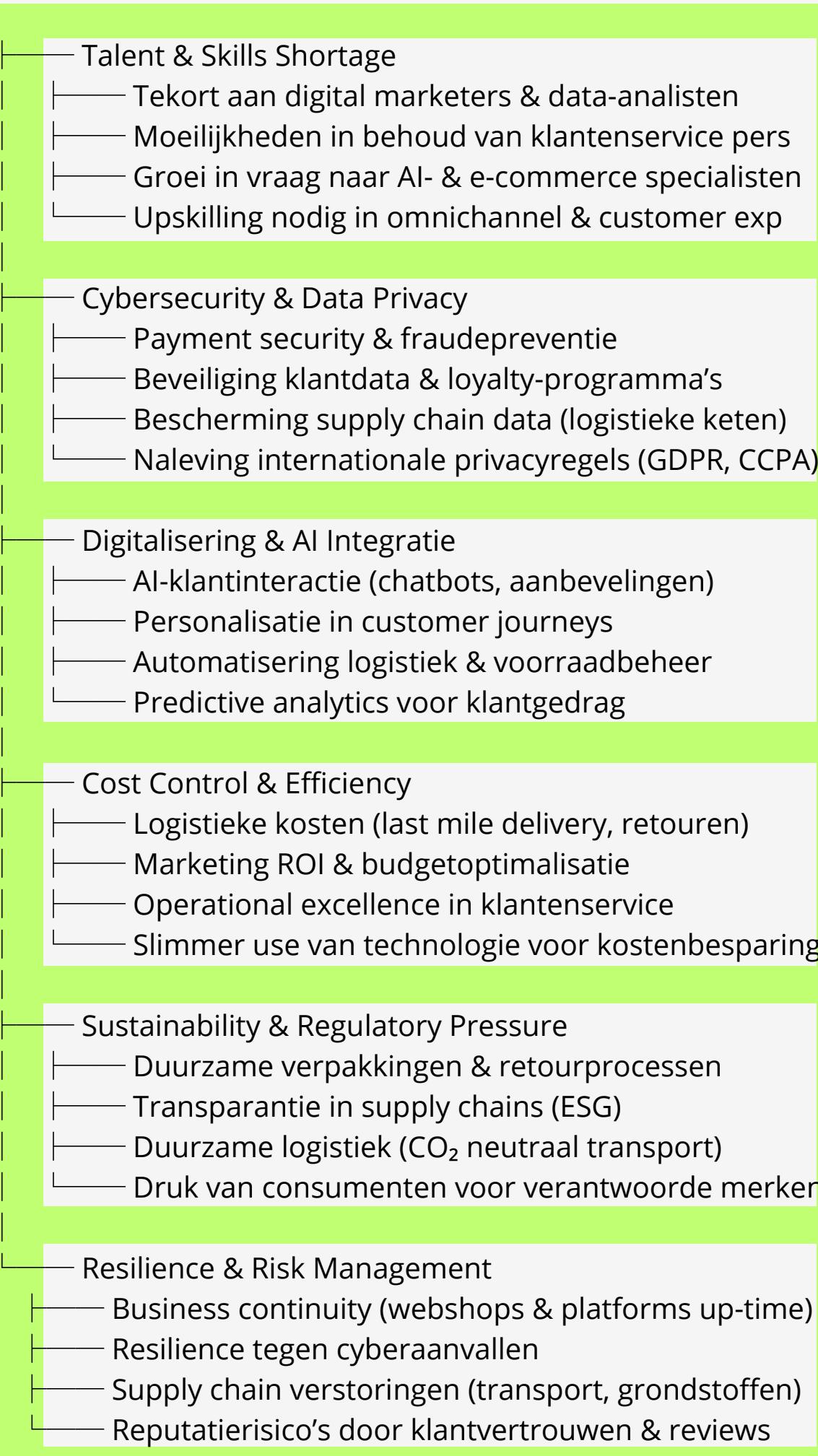
J.P. Morgan has been using the underlying AI-powered large language models for payment validation screening for more than two years. It also speeds up processing in other ways by reducing false positives and enabling better queue management. The result has been lower levels of fraud and a better customer experience, with account validation rejection rates cut by 15-20 per cent. J.P. Morgan is also using AI to automatically show insights to clients, such as cashflow analysis, when they need it.

Commerce & Services sector

hoe elk overkoepelend vraagstuk zich vertaalt naar concrete Commerce & Services uitdagingen.

Gouvernement > unieke accenten

- klantgerichtheid
- snelheid
- veiligheid
- van data & betalingen.



Vertalen naar >>

Rollen / functies
Hoger Management
Midden Management
Kenniswerker / medewerker
Consultant
Risk officer
Security officer
Etc

Customer Support Chatbots

Retrieval-augmented generation (RAG) enhances customer support chatbots by combining retrieval-based systems with generative AI to provide accurate and contextually relevant responses. When a customer asks a question, the chatbot retrieves relevant information from sources like knowledge bases, FAQs, or customer records and uses a generative model to craft a personalized response based on the retrieved data. This enables chatbots to handle complex queries that require up-to-date, detailed information.

For example, [Shopify's Sidekick chatbot](#) – designed to automatically ingest Shopify store data, leverages Retrieval-Augmented Generation (RAG) to deliver superior AI customer service by offering precise answers related to products, account issues, and troubleshooting.

Enhance your customer experience with the best AI chatbot for Shopify

Customer expectations for seamless and personalized interactions with online businesses have never been higher. In response to this demand, we at [Sendbird](#) are proud to announce the launch of a groundbreaking [Shopify chatbot](#).

This new AI chatbot is designed to automatically [ingest Shopify store data](#) to deliver superior [AI customer service](#) and create an enhanced [ecommerce chatbot](#) experience. Let's discover how our AI chatbot capabilities can revolutionize your store shopping experience.

E-commerce Product Recommendations

Retrieval-augmented generation (RAG) is revolutionizing e-commerce product recommendations by combining generative AI and retrieval systems to provide highly personalized shopping experiences. RAG models first retrieve the relevant product information from external knowledge bases or a company's product catalogue and then generate recommendations based on the user's preferences, search behaviour, and historical data. Unlike traditional recommendation systems that rely solely on predefined algorithms or collaborative filtering, RAG dynamically tailors suggestions by understanding specific customer needs in real-time. This results in more relevant and accurate recommendations, boosting user engagement and increasing sales.

For example, [Amazon](#) has integrated AI-driven recommendation engines that utilize Retrieval-Augmented Generation (RAG) techniques to enhance e-commerce product recommendations. The COSMO framework leverages large language models (LLMs) alongside a knowledge graph capturing commonsense relationships from customer behavior, enabling the system to generate contextually relevant suggestions.

