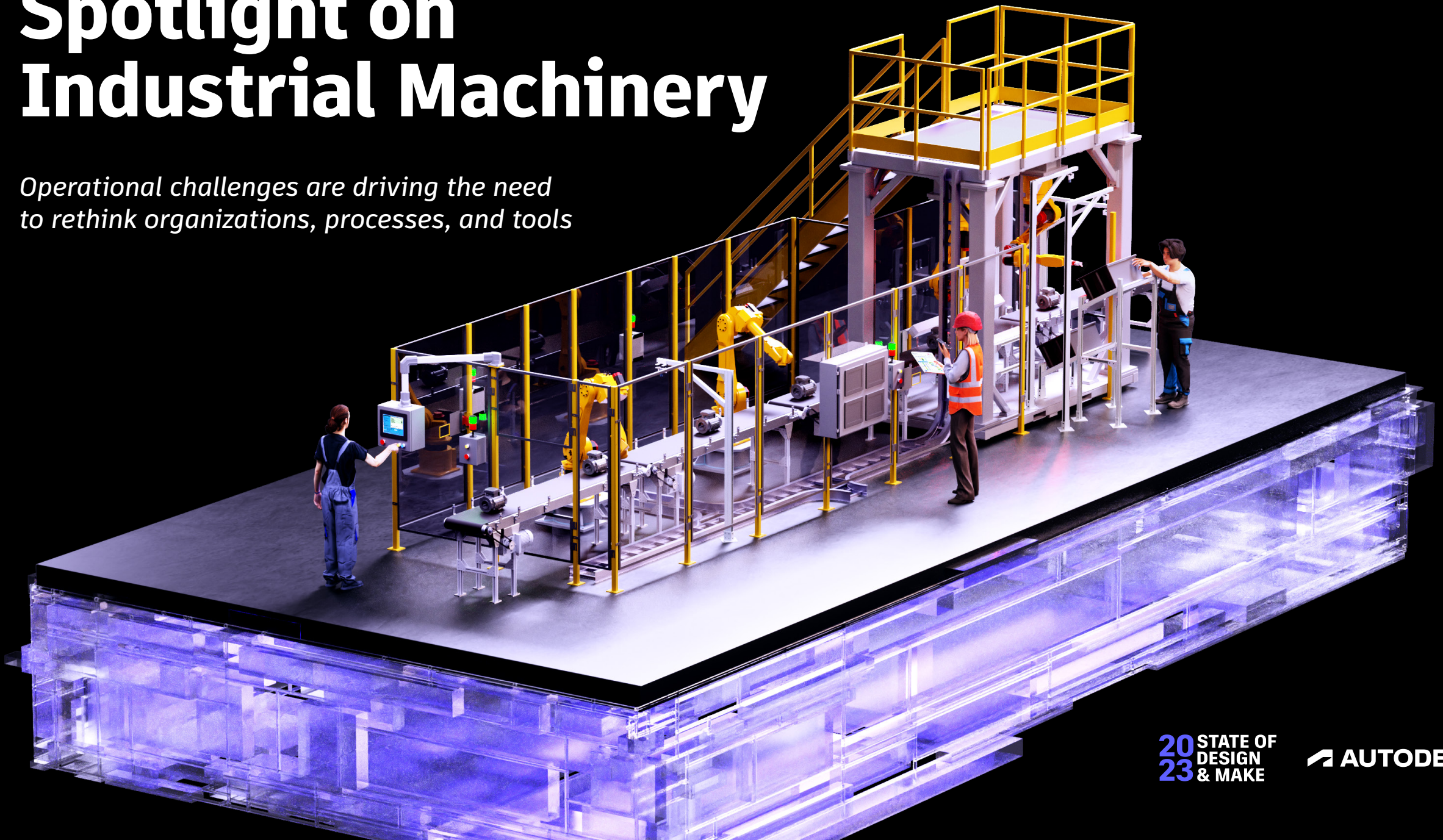


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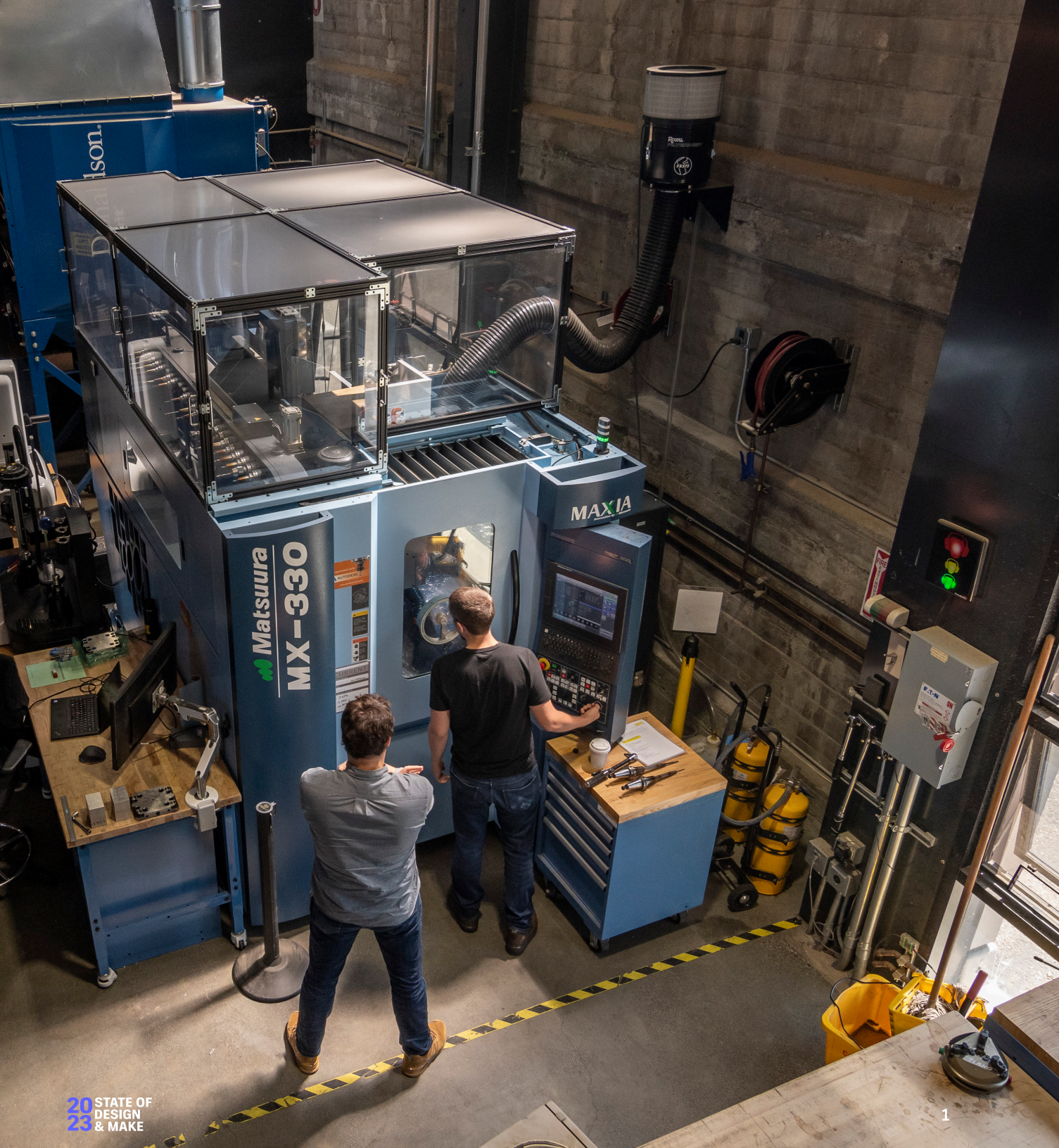
Spotlight on Industrial Machinery

*Operational challenges are driving the need
to rethink organizations, processes, and tools*



20 STATE OF
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& MAKE

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External factors test resilience

From digitalization to war in Ukraine, a combination of recent macro trends and unexpected crises have had a major impact on increasingly connected global industries. The industrial machinery sector has been hit particularly hard. The industry's business structures are often centralized and rely on teams that can collaborate on a global scale. This has led to a highly specialized technological landscape full of midsize companies, many of which are less resilient than large multinationals to the impact of such external factors.

External factors often have significant impacts on internal operations. This includes the entire value chain—from early concept development to aftermarket services. The precise impact and subsequent challenges vary depending on each company's business model. One key differentiator is the strategic setup for serving customers, which typically involves

either a highly standardized, product-driven approach or a customer-specific, project-oriented offering. While a product-focused business prioritizes economies of scale, project-driven companies rely on highly flexible, customizable solutions and often have very limited vertical integration.

Digging deeper into current challenges

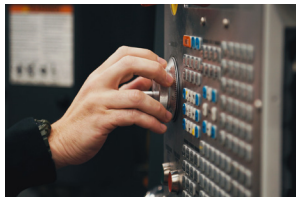
To learn more about the operational challenges facing the industrial machinery sector, Autodesk collaborated with the management consultancy Roland Berger to survey

more than 40 senior executives at industrial machinery companies throughout the value chain. The report covers organizations in all eight industry subcategories below.

Of the 42 companies surveyed, 27 have a product-focused business

model, with the other 15 adopting a more project-driven approach. Allocations for large, multi-technology corporations—which may operate multiple business models—were made based on specific insights and the roles of the interviewees.

8 clusters of the industrial machinery industry



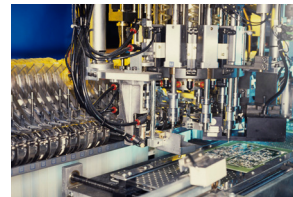
Industrial electronic and automation equipment



Machine tools



Industrial process equipment



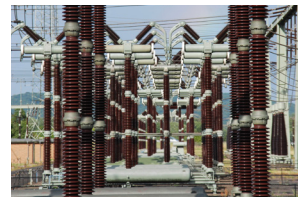
High tech



Mining, agriculture, and construction equipment



Packaging and material handling equipment



Power generation and transmission equipment

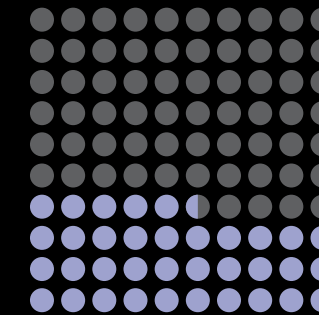


Fluid systems and fluid power equipment

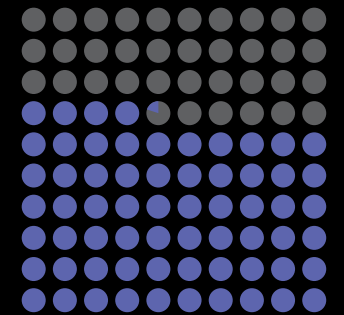
Interviewees allocate their business toward project or product business based on their field of expertise

Share of product versus project business interviews:

35.5%
Project business



64.2%
Product business



N=42

From digitalization to demographics: Four main challenges

Industrial machinery companies are currently under significant pressure from numerous directions. Dealing with these challenges requires considerable management attention, yet the resources and expertise required are often scarce.

Based on our interviews, we identified four key challenges that affect most value-stream functions, although the importance of each challenge varies from industry to industry:

1. Digital transformation
2. Demographic change
3. Reallocation of geographic footprint
4. Environmental sustainability

Challenge 1: Digital transformation

The term “Industry 4.0” may have been around for more than a decade, but the industrial machinery sector is still laying the foundations for its digital business models. There are two main reasons for this gradual progress: Fundamental strategic changes take time to implement, while several unexpected

issues have emerged in recent years that have diverted valuable time and resources—crises such as wars and pandemics, for instance.

Nevertheless, most of the companies we interviewed have already implemented measures to digitalize processes and data-sharing within dedicated value-stream steps. The next challenge is to integrate operational functions into a company-wide digitalization framework. For this, most of the companies we spoke to are looking for a centralized “orchestrating platform” that assesses and aggregates data from the existing software toolbox.



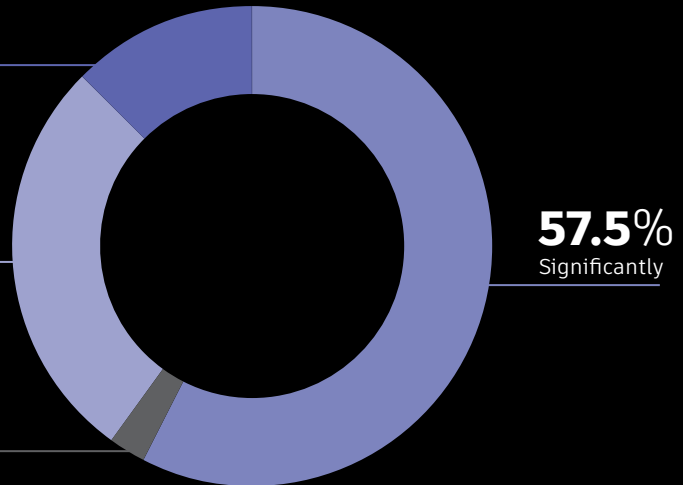
AI is seen to change future operations significantly by the majority of the interviewed companies

To what degree will AI change future operations (engineering, production, procurement)?

12.5%
Fundamentally

27.5%
Slightly

2.5%
Not at all



N=40

The main function of this orchestrating solution is to provide a single source of truth for all available data, enabling industrial machinery companies to further use cross-functional data-interfaces. Moreover, a solid foundation will be laid to start benefitting from the available data. This data could be exemplarily used to train and develop artificial intelligence (AI) algorithms for a variety of operational purposes, yet the interviews have shown that the industry so far hasn't built up the internal know-how and capacities to develop these AI pilots on their own.

In more detail, interviews have shown that certain value stream functions

“Wilco has concluded the baseline work with regards to digitalization in the past years and is now fully leveraging the potential of data transparency across the organization. Our engineers are currently becoming more and more creative to use the available data to further reduce time to market, improve production efficiency, and address many more topics.”

—Dr. Mustafa Mahmud Al-Haj, Senior Vice President Group Operations, Wilco SE

benefit relatively quickly and easily from integrating AI, such as sales contract analysis, engineering for the automated scaling of potential technical concepts, procurement to automate negotiations, or service for automated first-level support.

AI can also improve the planning of highly complex and interdependent production tasks. Nevertheless, the expected time horizon for the go-live of such AI applications is seen to be more than five years from today.



Challenge 2: Demographic change

Demographic change, particularly employee aging, will have a significant impact on industrial companies. As more workers retire, knowledge retention will become increasingly important. Over the next three to five years, some interviewed companies are facing an employee turnover rate of more than 10%, simply due to retirement.

What's more, the competition for well-qualified employees to replace retirees is becoming fiercer due to a decrease in the available workforce. To address this challenge, companies must

focus on improving their recruiting processes as well as implementing the right knowledge-transfer processes. Those who get it right stand to gain an advantage over competitors. Since improved competitiveness typically includes increased salaries or additional benefits for new employees, the experts we spoke to are concentrating greater resources on improving knowledge transfer.

How can they do this? In addition to established processes like internal training academies, it is particularly important to have the right solutions to document and share knowledge. Yet, according to our interviewees, the

solutions currently available are often too complex, too time-consuming, or not sufficiently supported by their company's culture of documenting and sharing information. They want platforms that can seamlessly integrate with their existing software landscape and automatically and incrementally build up an internal knowledge base without major manual effort.

Lastly, demographic change will also be an important driver for footprint adjustments. Increasingly, companies are looking to move their skilled and labor-intensive sites to locations that can offer the right employee pool—in terms of age or qualifications.

“Today’s younger generation is not interested in doing technical optimization and development of highly complex technical products/solutions—we see that many of the younger people rather become influencers or social engineers—however, the industry is doing a poor job in employee branding. The companies who are good will be more competitive in finding highly qualified employees, as this industry is cool.”

–Kim Hansen, Vice President Strategy, Sandvik AB

Challenge 3: Reallocation of geographic footprint

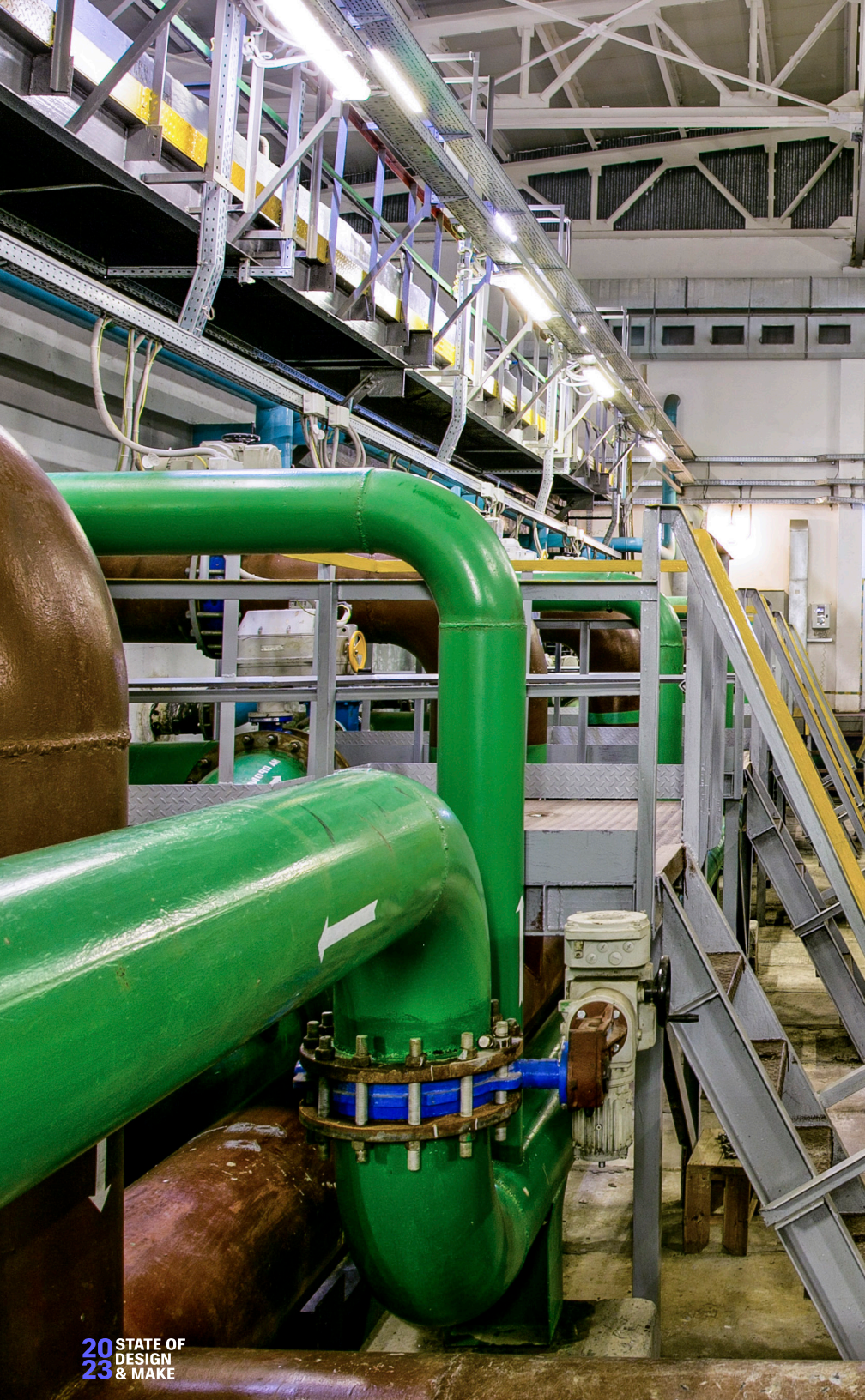
A diverse footprint in engineering and R&D, as well as production and service centers, is seen as a last resort to gain access to highly skilled employees and mitigate the risk of capacity shortages. Ultimately, building up facilities in countries with the right labor force can secure a company's future; often, this is more important than the actual cost saving.

Yet availability of skilled employees is not the only external impact affecting the geographic footprint of industrial machinery companies. Several recent

events have shown the vulnerability of centralized networks. Consequently, many companies are now evaluating their global footprint and how operations are handled between different locations.

These changes are leading to more distributed networks that require precise steering and increased remote collaboration among employees. However, many proprietary or specialized solutions within the market do not fully support the requirements of collaborative working. Subsequently, the need for new digital solutions to manage the complexity of these networks is emerging as well.





Challenge 4: Environmental sustainability

The final major challenge highlighted by our interviews is the need to adapt to changing sustainability requirements on several fronts, with both legal regulations and customer demands evolving rapidly. Industrial machinery businesses need to rethink their product design as well as how they produce and purchase products and components. Interviews have shown that for many companies the emphasis is only on operational emissions during the lifetime of their products, not including internal scope 1 emissions.

In the long run, focusing solely on emissions during a product's operational phase doesn't go far enough. As sustainability requirements continue to change, companies need to take a more holistic view that includes the production and assembly of machinery as well as its end-of-life decommissioning. This requires additional software solutions, especially for automated calculations of CO₂-equivalent emissions during production.

Product design is also important to deliver sustainable machines, but, according to our interviews, market participants currently feel insufficiently prepared in this value

stream step. Thus, platforms that support engineers in the design phase by giving greater guidance on sustainability will become increasingly valuable.

Sustainability doesn't only apply to a company's internal operations—it also affects supply chains. To ensure sustainable supply chains, sufficient transparency toward tier 2-plus suppliers is needed. Interviewees said cross-company solutions and data exchange are key to acquiring the necessary transparency and securing sustainable and efficient production. Realizing this will require sufficient data interfaces between companies throughout the supply chain.

“Our clients required us to address sustainability in the past years, and we have managed the topic especially regarding wastewater and emissions during the design of our process plants. Yet to fully maximize the impact and drive the targets to where they should be, a push from legislation is needed, as well.”

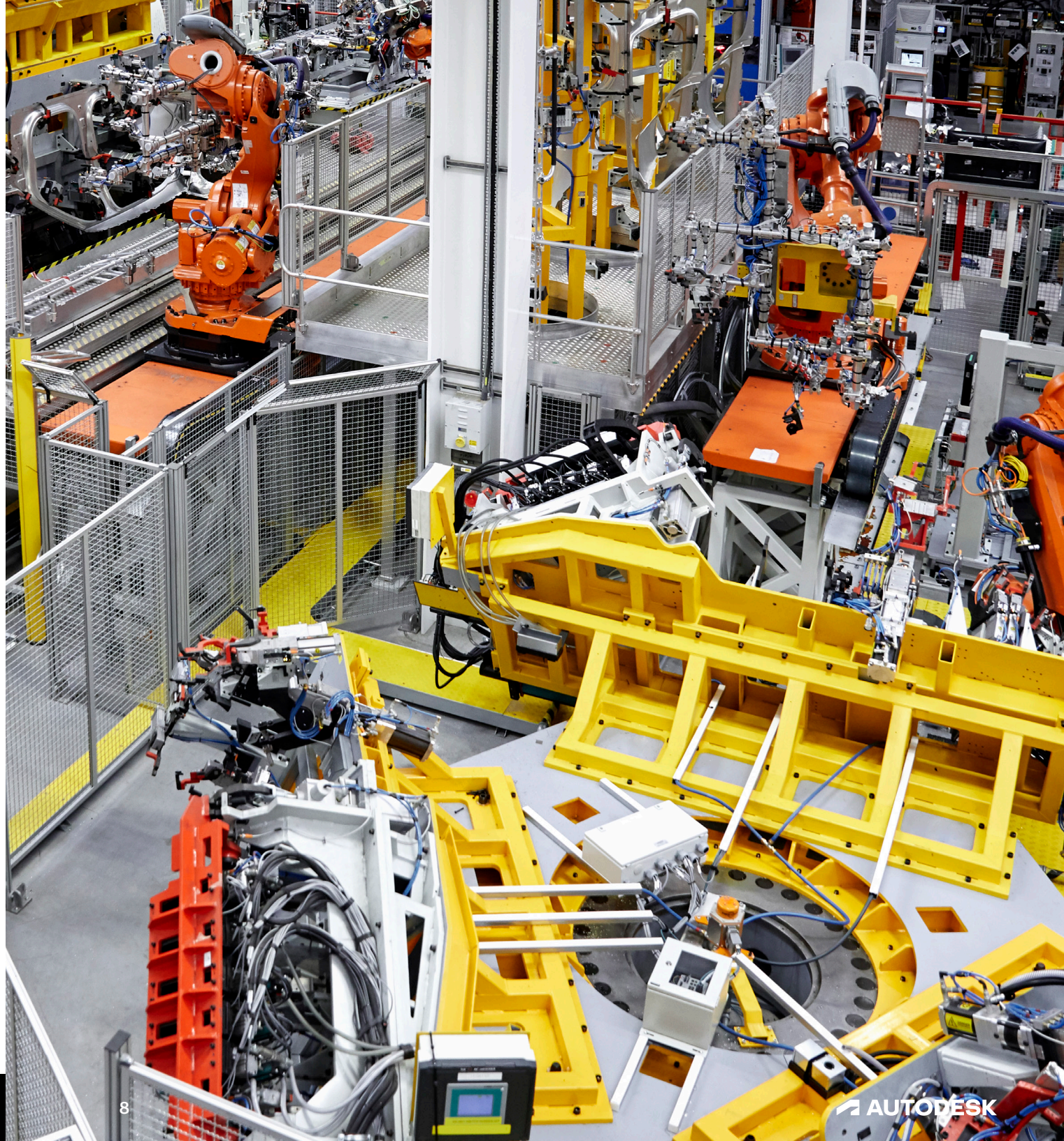
—Liege Robson, former COO, thyssenkrupp Industrial Solutions AG

Project- vs. product-driven businesses

The four main challenges impact most of the companies we interviewed, regardless of their business model. However, the degree of impact and potential solutions vary for project- and product-focused organizations.

A key difference can be found in the acquisition of cross-company supply chain transparency. While product-driven businesses tend to have a stable supply base with long-term relationships, project-driven companies rely on highly specialized and complex supply chains that are tailored to each project. This results in a higher expectancy of product businesses to achieve the needed supply chain transparency—which goes hand in hand with the expected

ability of product businesses to drive sustainability requirements down their supply chains in the future. On the other side, project-driven companies are a lot more reserved regarding their potential transparency achievements in the next years. Cross-industry standardization and regulation of data exchange will be a key prerequisite to enabling and improving the transparency of complex, volatile supply chains in the project environment.



Another example of differentiation between project- and product-focused companies lies in how they adapt production or engineering footprints. Project-driven businesses are generally less vertically integrated and therefore less asset-heavy, meaning they can adapt their footprint more regularly. This can be seen in their use of local or nearshored customer-facing engineering capabilities, for instance. For project-focused businesses with a high degree of customer interaction, local representation is often seen as a key enabler for successful

project management: In addition to their project-delivery capabilities, local employees are more likely to have better knowledge of local technical regulations. Thus, high-cost engineering functions are typically moved to nearshore locations rather than global low-cost engineering centers.

By contrast, many of the product-focused businesses we interviewed favor a more global approach. For them, a remote engineering office in a cost-efficient country with sufficient

availability of skilled employees is more beneficial due to more standardized processes that allow for easy steering of such networks.

The final key variation between business models comes in how they address the challenge of sustainable products and solutions. Product-driven companies are currently introducing emissions calculations for their products, which typically focus solely on the operational phase of the machinery rather than its full lifecycle from creation to disassembly. By

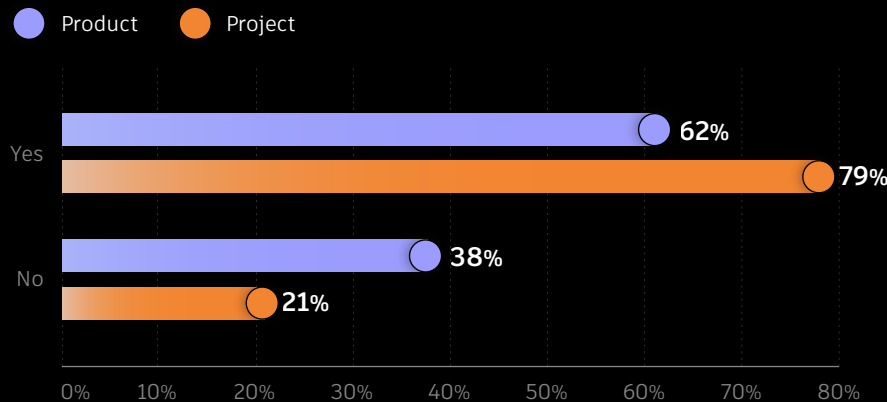
contrast, project-oriented businesses tend to have little insight into the emissions of their solutions, as the one-time effort is high and clients often do not focus on optimized emissions but rather on good technical solutions.

This will result in different industrial machinery requirements for the future. Project-focused companies will demand highly flexible, automated databases that calculate emissions in parallel to the design phase. This is due to the high volatility

inducing several changes during the development of the technical solution. For product-oriented businesses, the scalability and standardization of emissions calculations across different product groups becomes more relevant. In addition, product-driven companies will need to expand their focus toward a holistic cradle-to-cradle perspective faster since scope 1 emissions become increasingly relevant when operational energy consumption is increasingly decarbonized.

Project businesses are more actively adapting their footprint compared to product businesses

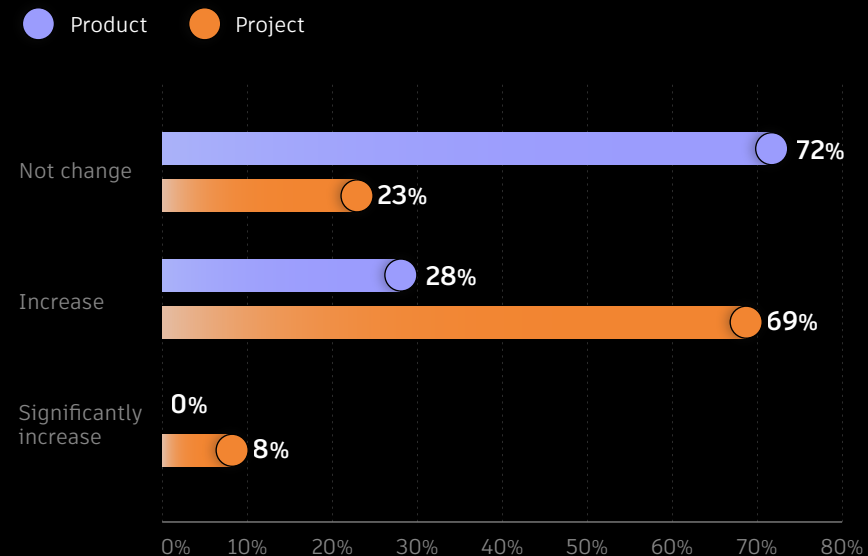
Due to the geopolitical situation, we are actively adapting our engineering/production footprint:



N=14 Project, 26 Product

Nearshoring is significantly more important for project businesses due to regular customer interaction

Nearshoring R&D (e.g., Eastern or Southern Europe) will ...



N=13 Project, 25 Product

Strategies and solutions to overcome the identified challenges

To address the identified four operational challenges and find suitable solutions for the specific situation of the company, dedicated strategies and software solutions need to be implemented. One strategy addressing all four challenges is the increased collaboration with external companies such as supply chain partners, IT, or sustainability service providers to benefit from their in-depth know-how. When it comes to software platforms, our interviewees cited orchestrating platforms, sustainability emissions calculations, and knowledge-management solutions as being the most important. We outline the benefits of each of these below, as well as offer insights into what industrial machinery companies expect from their functionalities.

Strategic ecosystems

Without strategic ecosystems, companies must build up significant internal resources to satisfy all different market requirements. Some challenges and legal requirements can only be solved on an intercompany level. Collaborative ecosystems can enable companies to access new markets and customer segments, as

well as gain deeper insights into customer preferences and new technological challenges and opportunities.

These strategic ecosystems exceed many traditional collaboration models and involve sharing both sensitive data and in-depth strategies. Due to the close collaboration required, strategic ecosystems usually consist

of just five to 10 strategic partners. Each partner fits one of five archetypes, as outlined in the chart below, and each archetype brings specific benefits to the network. Key suppliers, for instance, enable joint planning and improved resilience, whereas software and service providers boost expertise and resources to tackle the variety of challenges.



To manage this level of collaboration with their ecosystem partners, industrial machinery companies currently rely heavily on manual data exchange and regular meetings. In the future, cross-company software for automatic data exchange will be key to maximizing an ecosystem's full potential.

Developing a strategic ecosystem takes detailed planning and preparation. After initiation, participants must define internal targets and rules for the ecosystem and screen potential partners. Dedicated communication workshops involving all companies are vital for building trust. We recommend starting any ecosystem collaboration with a relatively simple project, before tackling more complex objectives. To ensure consistent benefits for all participants, the ecosystem should be reviewed on a regular basis and adjusted if necessary.

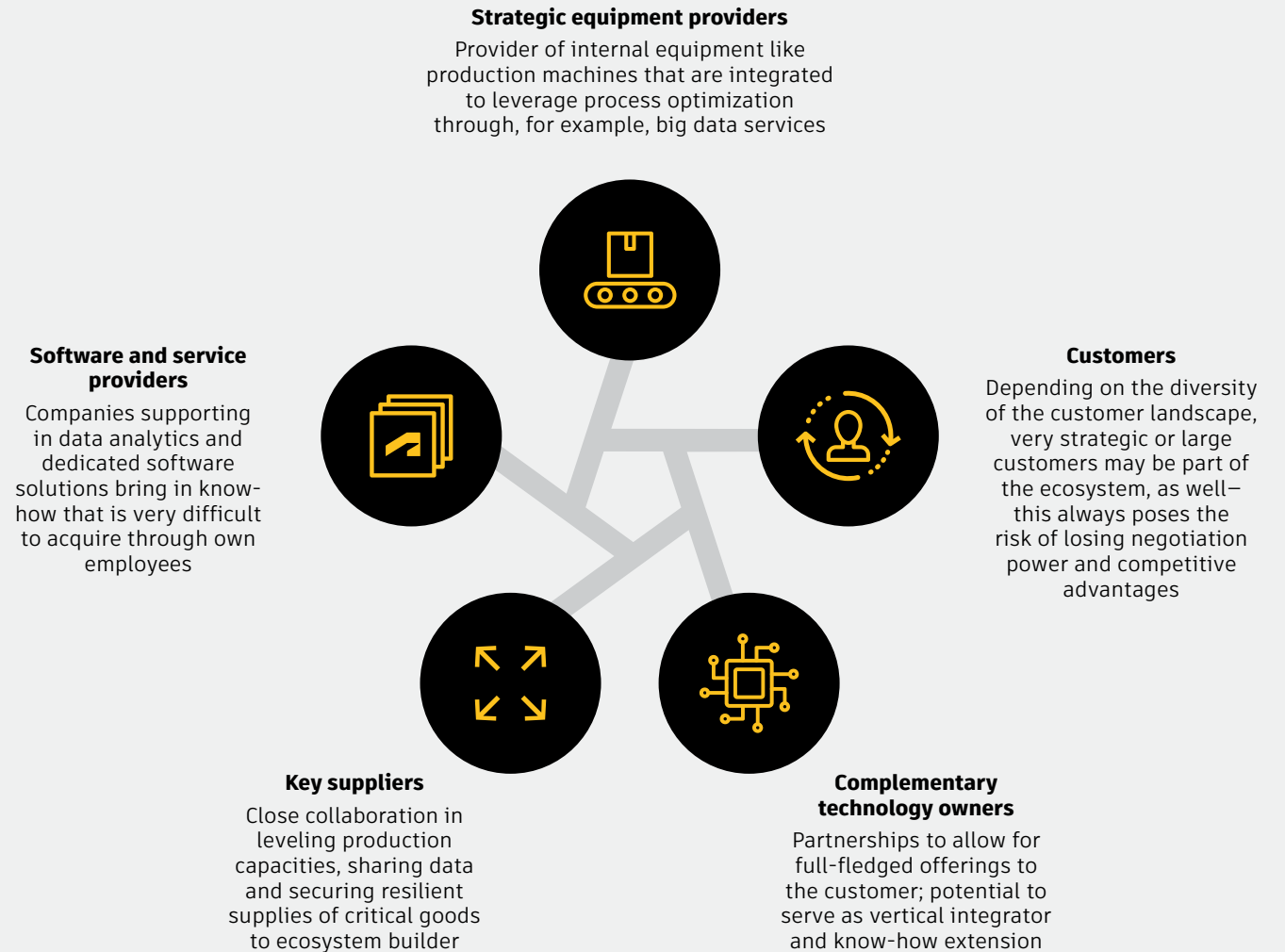
Orchestrating platforms

Orchestrating platforms can help a company acquire greater transparency

of its digital landscape. These solutions provide an end-to-end view of cross-functional processes, in addition to training AI and integrating other efficiency drivers. According to our interviews, companies are looking for solutions that work holistically rather than just optimizing individual functions within the value chain. Yet, market participants are seeing a lot of solutions influenced by the provider's legacy background. An example is having engineering solutions with many functionalities to manage data during product development but limited functionalities when it comes to financial or planning data handling.

If such a holistic platform was available, fundamental changes affecting the organization of industrial machinery companies would be possible. Organizational interfaces no longer serve merely as points for one-way data handover, but as hubs for collaboration with upstream and downstream processes, including customer functions. Moving away from a siloed, functional organization could be a long-term goal to strive for.

Strategic ecosystem partners consist of five potential archetypes:



“By staying in close and regular contact with promising start-ups, we are developing our own strategic ecosystem, especially with regard to needed software and tool support, addressing and solving operational challenges in the future.”

—COO of industrial process equipment manufacturer



Sustainable emissions solutions

The rising importance of sustainable products, combined with a growing focus on the entire lifecycle of industrial machinery, is making emissions calculation solutions increasingly relevant.

Many companies still rely on external service providers to leverage their databases and manually calculate emissions for selected products. But this approach is resource-intensive and leads to long latency periods between obtaining and implementing feedback during the design process.

Our findings show that industrial machinery companies would prefer in-house product certification for emissions, including a rapid control loop to quantify emissions and optimize machinery. This requires an automated platform to simultaneously calculate emissions for parts, assemblies, and entire machines in parallel to the actual design of these elements.

Knowledge-management solutions

Nearly all company representatives we interviewed said their current knowledge-management processes are insufficient to capture relevant expertise and experience in the face of major demographic change. This is only part of the challenge: Sharing and distributing this knowledge within an organization can also be difficult.

One way to improve these processes could be increasing the use of internal knowledge-sharing facilities like training academies. Future improvements to the current generation of platforms will also help companies tackle this challenge. Key characteristics for these solutions would include:

- Quick and easy documentation of available/acquired knowledge
- Ease of use, without the need for dedicated training
- Sufficient support in clustering available expertise
- Easy distribution of available knowledge to all employees

Summary

These are trying times for the industrial machinery sector, with many external factors posing long-term challenges. This can also offer tremendous opportunities: Solve these challenges, and market participants can gain valuable advantages over their competitors.

But this won't be easy. Most companies within the industrial machinery industry currently lack the expertise and resources to address these challenges as sufficiently as their customers need and expect them to. In addition to customer demands, regulatory adjustments will further drive developments, especially in the field of sustainability.

By becoming aware of, understanding, and prioritizing operational challenges, industrial machinery companies can focus resources and develop offerings strategically. For topics that cannot be addressed with internal resources, external service providers and solution suppliers can help these companies improve efficiency and development speed in a much closer strategic partnership. The development of true strategic ecosystems will provide companies with the decisive solutions to address known and future challenges.



ABOUT THIS STUDY

The *State of Design & Make* report is a global, annual study for leaders who design and make places, objects, and experiences. It identifies the most pressing drivers of change shaping today's business decisions to help leaders prioritize and invest in the future.

Autodesk partnered with Roland Berger, a leading global management consultancy, to survey and interview 42 managers and experts from the industrial machinery industry. The interviewees originate from all eight industrial machinery subclusters: industrial electronic and automation equipment, machine tools, industrial process equipment, high tech, mining, agriculture, and construction equipment, packaging and material handling equipment, power generation and transition equipment, fluid systems and fluid power equipment.

The interviewees gave qualitative insights into their most pressing operational challenges as well as answering standardized questions. This enabled the authors to derive the most pressing trends and potential solutions and conclude additional cross-company insights by a quantitative analysis.

Spotlight on Industrial Machinery focuses on the key results of the qualitative interviews and summarizes the identified four key challenges. Besides these qualitative insights the results of selected quantitative questions are shown as well.

AUTHORS

Jan Niestrath, Autodesk GmbH

Bernhard Langefeld, Roland Berger GmbH

Frederik Heuvel, Roland Berger GmbH

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