TÜRKİYE MANUFACTURING TRANSFORMATION INSIGHTS REPORT 2022-2023

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MEXT

Contents

Foreword

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MEXT, as Türkiye's leading Technology Center for Industrial Transformation, is providing all of the services our manufacturers need for digital transformation under one roof. We conduct the world's most comprehensive digital maturity assessment initiative, showcase the most advanced end-to-end integrated digital factory with more than 170 Industry 4.0 use-cases in a real production environment, reskill employees with customized capability building programs, and establish one of the most vibrant ecosystems in the world to get the manufacturers and solution providers together.

MEXT joined the incentive program, which is led by KOSGEB (Small and Medium Enterprises Development Organization). SMEs can benefit from MEXT services as a part of the model factory network in Türkiye. Against all of the limitations faced during the COVID-19 pandemic, our globally certified assessors have visited, assessed, and prepared roadmaps for more than 160 manufacturers. We completed the first phases of two major automotive OEM supplier transformation initiatives and shared our insights as a contributor to The Global Smart Industry Readiness Index Initiative: Manufacturing Transformation Insights Report 2022.

On the other hand, Green Deal is completely changing how our manufacturers do business. Besides metal, one of the most affected industries, other industries such as cement, textile and chemicals are also under pressure. We are focused on the twin transitions of green and digital, believing that the Green Deal will be enabled by digital transformation. Therefore, we are diligently stepping into sustainability assessments to help our manufacturers in the near future.

We would like to extend our heartfelt thanks to Mr. Özgür Burak Akkol, the Chairman of MESS Turkish Employers' Association of Metal Industries, for his visionary leadership and unwavering support in guiding these transformative initiatives.

Digital transformation is inevitable.
We are in the middle of the digital selection era, and manufacturers who do not act today will face harsh circumstances. They will either be out of business in the near future, will be taken over by a competitor as a fraction of their current value, or will produce low-quality products and serve a mediocre market.
Industry 3.0 enabled manufacturers to automate their production, whereas Industry 4.0, on the other hand, is here to automate our business and increase agility, flexibility, productivity, and quality.

Industry 4.0, or digital transformation, in a nutshell, is a new level of organization and control where the generated data turns into information through the entire value chain of the lifecycle of the products. This information is presented to related personnel in real-time by connecting all instances, which leads to dynamic, self-organizing, value-added connections within and across companies.

The Official SIRI Assessment is a powerful resource to help companies separate the substance from the noise and synthesize the essence of Industry 4.0 into an easy-to-understand universal framework to start things off on the right foot. SIRI is designed to perfectly balance technical rigor with practical applicability and create roadmaps custom-tailored to manufacturers' specific needs with global benchmarks to their peers.

In collaboration with MEXT, we collected invaluable insights from several industries and created this report to guide manufacturers on their transformation journey.

Executive Summary

The future is uncertain, but it is certainly digital. While digital transformation is reshaping how manufacturers operate, this report provides data-driven insights from more than 160 digital maturity assessments to help manufacturers navigate their transformation journey.

Digital transformation is not a project. From operation to organizational structure, manufacturers must embrace this new way of doing business. To succeed in the 4th Industrial Revolution, companies must engage and progress with the right partners. Within this context, MESS Technology Center (MEXT) has sought to help and guide businesses on their digital transformation journeys since 2020 as the world's most comprehensive digital transformation and capability-building center.

Even though the initiative was started for the association's member companies in the metal industry, MEXT is now conducting the world's most comprehensive "Digital Transformation in Industry" study across various sectors, including textile, cement, and chemicals, and continues to expand to other industries.

A successful digital transformation journey begins by assessing the current situation and developing an appropriate roadmap based on the company's goals and industry dynamics. At MEXT, we assess the digital maturity level of organizations using the Smart Industry Readiness Index (SIRI) in the field with our advanced manufacturing experts to provide a roadmap comprising success-proven projects for their digital transformation. As an output of the assessments, this report interprets data from more than 160 manufacturers across Türkiye and provides the following:

- Insights on the current state of Turkish manufacturers in digitalization across multiple sectors and company sizes.
- A comparison of Türkiye's average performance in the textile, machinery and equipment, automotive, and general manufacturing industries with the global benchmark.
- Industry-specific insights and a one-page summary for each industry, including visualized data from assessment results, common pain points, and future recommendations.
- A success story from the textile industry that exemplifies how companies can make use of the SIRI program to start and scale digital transformation in their factories.

Although our research findings suggest that the digital maturity score varies by sector and company, this report highlights shared concerns among Turkish manufacturers as a starting point. One crucial insight is that Best-in-Class organizations outperform in the Organization building block, whereas companies with lower maturity, particularly SMEs (Small and Medium-sized Enterprises) lag behind.

Although the overall maturity is at its nascent stage, Türkiye is on a promising trajectory towards digitalization, with numerous industries already demonstrating significant advancements and commitment to this transformative journey.

This research seeks to encourage Turkish manufacturers by emphasizing the role of a capable workforce in digital transformation. We hope that the insights and examples we shared will inspire enterprises and guide decisionmakers to join the SIRI program and collaborate with MEXT to begin and advance their digital transformation initiatives.

Understanding The Smart Industry Readiness Index (SIRI)

The SIRI program aims to assist manufacturers of all sizes and industries in starting, scaling, and sustaining their digital transformation journeys. It was created in partnership with world-class technology providers, consulting firms, and industry and academic experts.

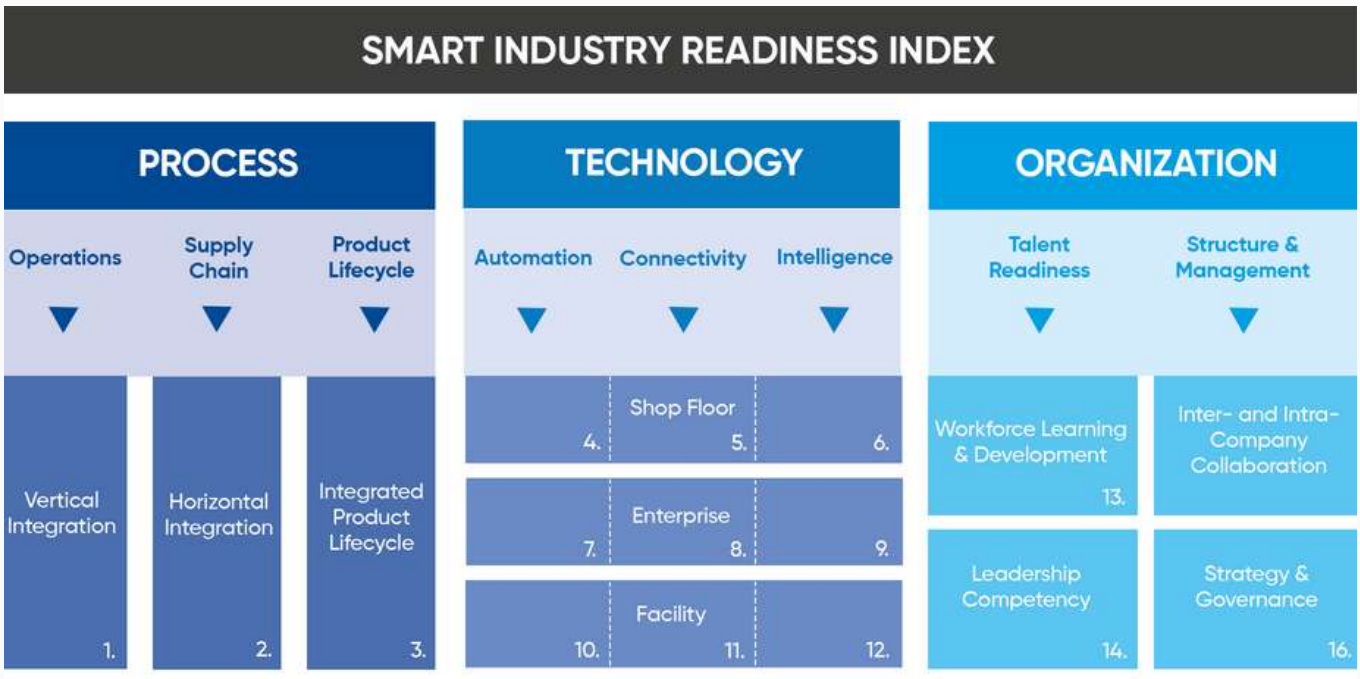
The SIRI framework is composed of three layers:

01 The top layer defines three Industry 4.0 building blocks: Process, Technology, and Organization which are equally important for a company to fully realize the benefits of digital transformation.

02 The second layer divides these three building blocks into eight pillars, reflecting essential factors that businesses must focus on.

03 The third layer includes 16 dimensions that should be considered while assessing the current levels of maturity.

Figure 1 | SIRI Framework - Building Blocks, Pillars and Dimensions



Source: International Centre for Industrial Transformation (INCIT)

Process Building Block

Manufacturers have placed a priority on process improvements. Industry 4.0 shifts the focus of process improvement from enhancing individual processes to integrating processes across a company's operations, supply chain, and product lifecycle. Hence, the Operation, Supply Chain, and Product Lifecycle are the three pillars that make up the Process building block.

Technology Building Block

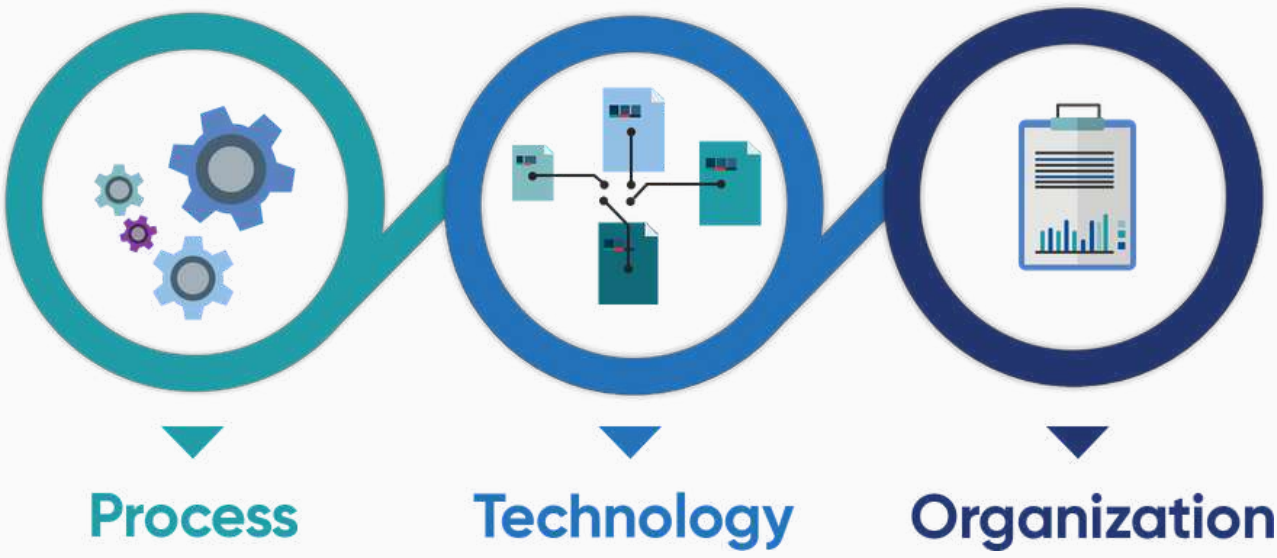
Without technological development, the industrial revolutions would not have happened. The technology building block is segmented into three pillars; Automation, Connectivity, and Intelligence, which are necessary for companies to achieve their Industry 4.0 ambitions. To enable continuous and dynamic data exchange and analysis, physical assets and equipment are connected with corporate systems, and digital technologies combine to form this hyper-connected industrial landscape.

Connecting devices, machines, and computer-based systems is the focus of automation and connectivity in order to gather and integrate data. Intelligence, on the other hand, involves processing and analyzing that information.

Organization Building Block

Besides technology and process improvements, organizational readiness plays an equally important role in transformation. Industry 4.0 calls for a greater focus on the entire workforce and the institutional systems that govern how the company functions to reach the potential and innovation within the organization. Therefore, the Organization building block considers Talent Readiness and Structure & Management as its pillars.

Figure 2 | Three building blocks of SIRI



Source: International Centre for Industrial Transformation (INCIT)

The International Centre for Industrial Transformation (INCIT), an independent, non-governmental, not-for-profit organization now manages and governs the SIRI program. SIRI assessment provides an independent review of a facility's manufacturing operations by independent qualified individuals known as Certified SIRI Assessors (CSA) who are experienced industry practitioners. SIRI provides a global benchmark on the overall manufacturing landscape and is specific to each industry. The SIRI framework aims at helping companies learn new concepts, evaluate their facilities, architect company-specific transformation roadmaps, and deliver results that bring value to their businesses.

The maturity scores of the SIRI methodology are derived from (but are not limited to) the Industrie 4.0 Maturity Index developed by the German Academy of Science and Engineering (Acatech).[1] As shown in Figure 3, the Acatech model defines the beginning of Industry 4.0 as achieving Visibility (maturity stage 2), recognizing what is happening within the enterprise. The two prior levels, Computerization and Connectivity (maturity stages 0 and 1), fall under Industry 3.0. After the Visibility level is achieved, the systems can understand the root causes behind an event within the factory, or in other words, reach Transparency maturity.

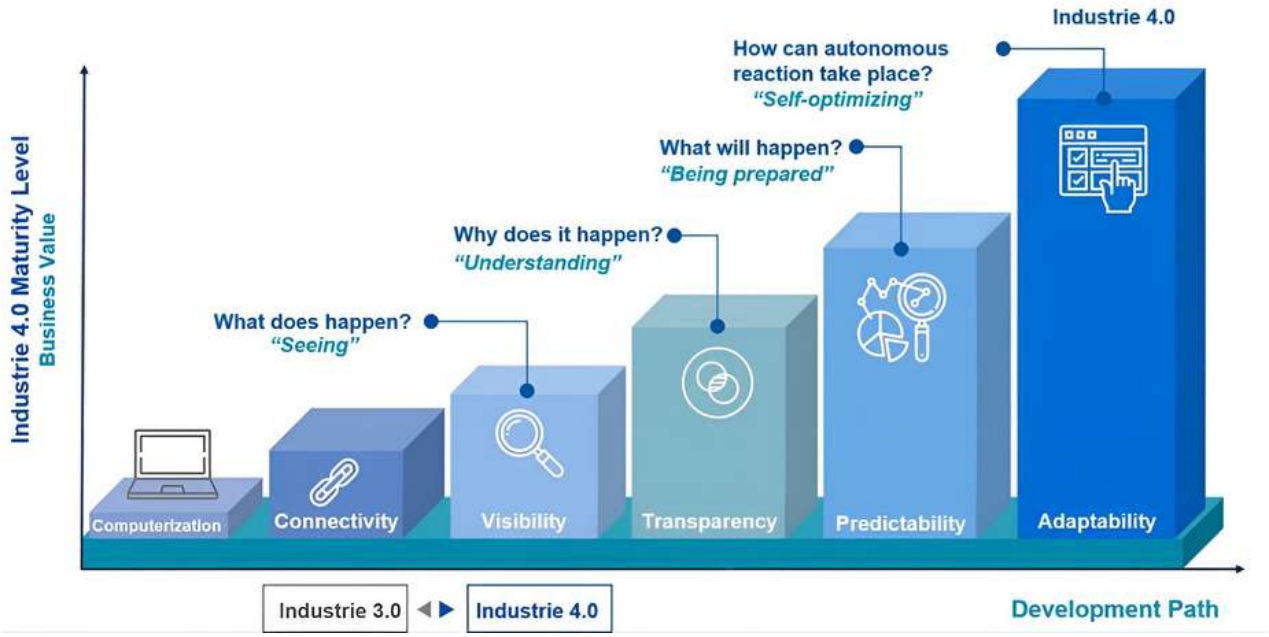
The two last stages of the maturity index highly rely on the system's ability to process and execute information. At the Predictability maturity, the methods used within the company can foresee what is likely to happen based on historical outcomes. Finally, the Adaptability maturity level signifies the highest maturity that can be achieved, a stage where processes are autonomously controlled by integrating data across all data sources that can affect the related area.

The Official SIRI Assessment (OSA)

The Offical SIRI Assessment (OSA)[2] is an independent assessment carried out usually in two days, on-site with company executives to determine the current state of a manufacturing facility and the company's priority areas of action. It includes the following:

1- **An assessment of the current state** evaluates the maturity of the factory/plant across the 16 dimensions of the SIRI framework. The company's maturity is assessed by CSA through observations and discussions with company executives, resulting in classification into one of six maturity bands for each of the 16 dimensions. Band 0 denotes the lowest level of maturity, while Band 5 signifies the highest level of advancement.

Figure 3 | Maturity stages of the Acatech Industrie 4.0 Maturity Index



Source: Industrie 4.0 Maturity Center

2- A prioritization matrix exercise that uses the following pieces of information which are provided by the company:

01 Cost profile, which is the breakdown of the company's cost categories as a percentage of its manufacturing output. The cost profile of a company consists of ten cost categories available in Appendix 1.

02 5 key performance indicators (KPIs) prioritized by the company, are measures used to evaluate a company's success or effectiveness in achieving its key business objectives and strategic directives. The Prioritization Matrix considers 14 categories of KPIs that are organized into four main groups - Productivity, Quality, Flexibility and Speed. The explanation of 14 KPIs is available in Appendix 2.

03 The proximity to the industry best-in-class scores, which is the difference between the company's current maturity scores to the highest assessed maturity in the related industry, for the corresponding 16 SIRI Dimensions.

T : Assessment Matrix Score

I : Cost Profile

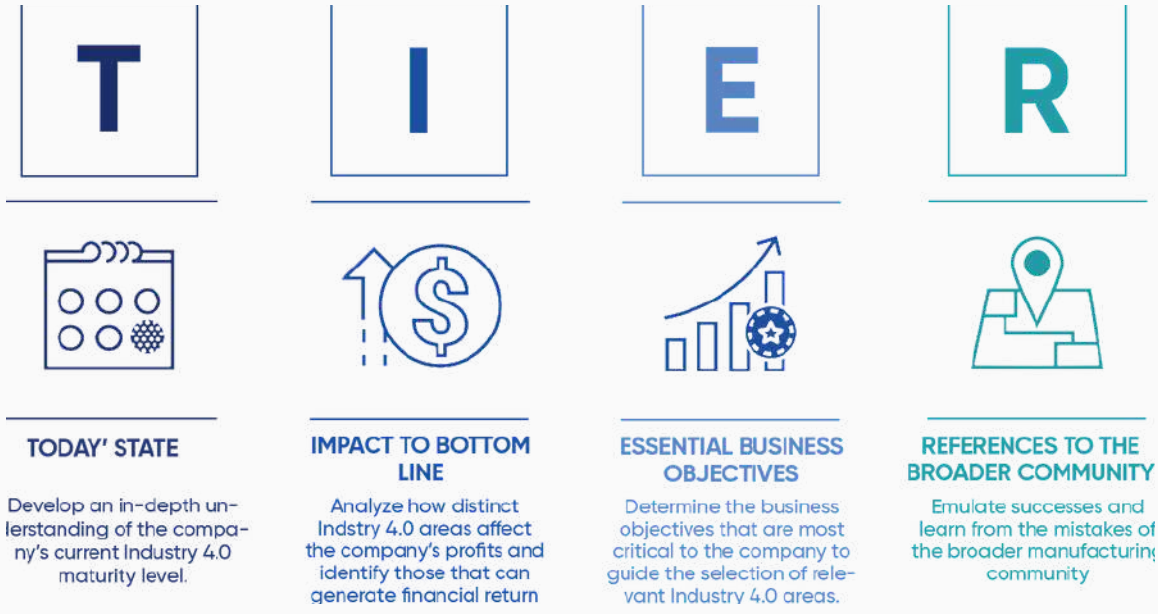
E : Key Performance Indicators

R : Industry Best-in-Class Benchmark

The prioritization formula is based on a mathematical model that uses the cost profile, selected KPIs, and current maturity vs industry best-in-class benchmark results as the main parameters. These parameters are weighted according to the company's planning horizon. A company's planning horizon is the length of time into the future that is accounted for in a particular plan. The organization is expected to select one of the three planning horizons; Strategic, Tactical, or Operational, in order to determine the emphasis to be placed on each of the three essential variables.

It is critical not to fall behind in digital transformation, but companies have limited resources. Therefore, the Prioritization Matrix exercise of the OSA uses three weighted factors to identify the four high-priority SIRI Dimensions so that the manufacturers can be assured that assigning resources to improve the related dimensions' maturity will yield the highest return.

Figure 4 | The TIER Framework



Source: International Centre for Industrial Transformation (INCIT)

Digital Maturity of Turkish Manufacturers Across 16 Dimensions

Our analyses across the three SIRI building blocks provide insight into how Turkish manufacturers have approached transformation and where we stand relative to the global benchmark.

Figure 5 | Average maturity of Turkish manufacturing companies across SIRI building blocks

Source: MEXT (Analysis by Digitheta)

The average digital maturity in all three blocks is between 1 - 1.5 maturity level. Most studied companies have not yet attained an average maturity stage score of 2 (Visibility). Since Industrie 4.0 is defined as beginning at the "Visibility" stage, only a small proportion of companies can be said to have fully utilized the benefits that can be reaped by Industry 3.0 (maturity stages 0 and 1) and commenced the large-scale implementation of Industrie 4.0.

Process and organizational maturity lead the way, with a favorable trend in manufacturers' digital transformation potential, considering that organizational resilience is essential in business transformation. On the other hand, the Technology building block in Türkiye has a lower maturity average. The detailed analyzes of the pillars under the Technology building block provide critical insights into common pain points.

Figure 6 | Average maturity of Turkish manufacturing companies across Process dimensions

Source: MEXT (Analysis by Digitheta)

Vertical Integration is the integration of processes and systems across all hierarchical levels of the automation pyramid within a factory. Planning, quality, maintenance, material movements, process parameters collection, and information flow among these functions are assessed. An average score of 1.42 shows that standard operating procedures (SOPs) are established, and manufacturers have started to conduct these through digital solutions.

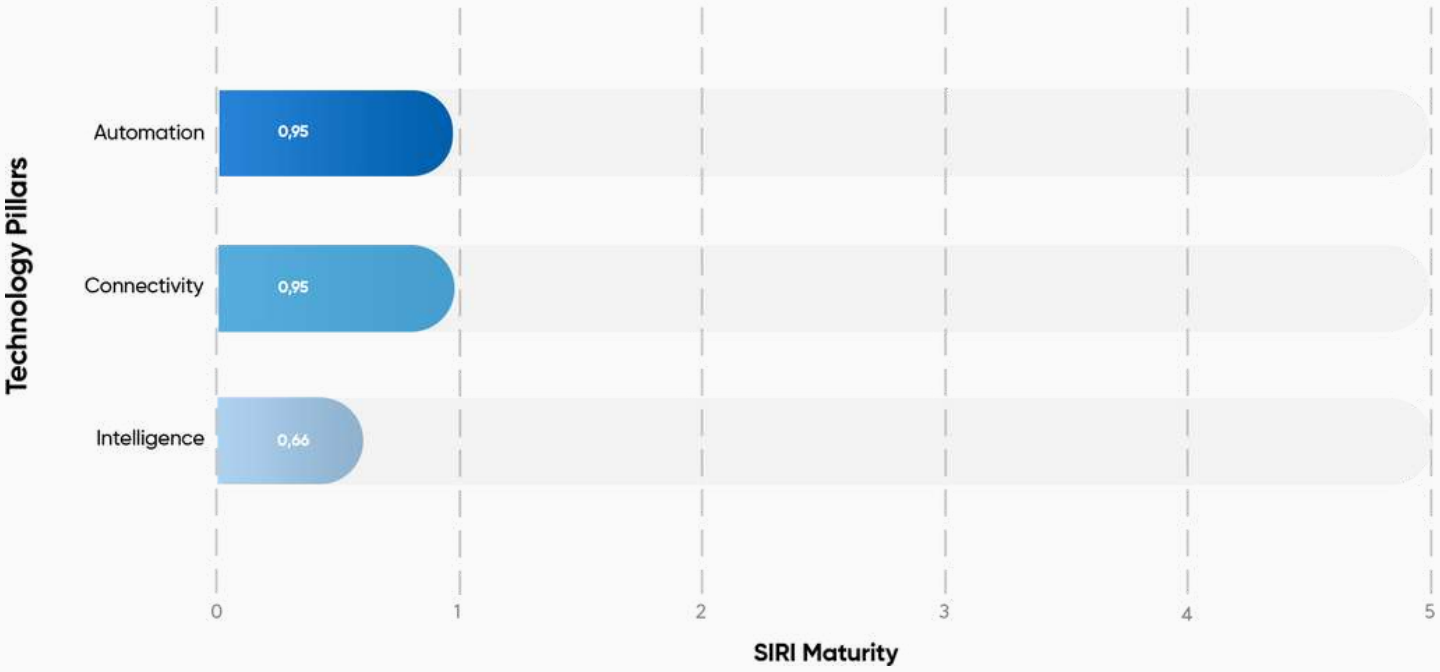
Even though the usage of digital systems for quality, maintenance, and material movements are widely used, most manufacturers need help to apply digital solutions to planning and process parameters collection. Therefore, implementing an Industrial Internet of Things (IIoT) platform to collect and contextualize process parameters directly consuming from the equipment's controller and integrating these under a unified operations management should be aimed to improve operational excellence on the shop floor.

Horizontal Integration integrates enterprise processes across the organization and with stakeholders along the value chain. Sales, enterprise resource planning, logistics, and purchasing functions are assessed. Results indicate that while digital tools are commonly used with an average score of 1.69, the processes are still primarily completed by humans. Pain points in this area include problems with master data management in ERP systems and underutilization of e-procurement functionalities. To build a more resilient supply chain, the next step is implementing an end-to-end integrated enterprise platform via Electronic Data Interchange (EDI).

Integrated Product Lifecycle involves the integration of people, processes, and systems throughout the entire product lifecycle. Customer requirements and engineering changes are primarily managed through analog tools, while design is usually supported by CAD (Computer Aided Design) software. However, usage of Product Lifecycle Management (PLM) software remains limited.

The average maturities of Technology pillars indicate that although most of the manufacturers in Türkiye have started collecting data about their processes, most of them cannot yet utilize the collected data to create business value.

Figure 7 | Average maturity of Turkish manufacturing companies across Technology pillars



Source: MEXT (Analysis by Digitheta)

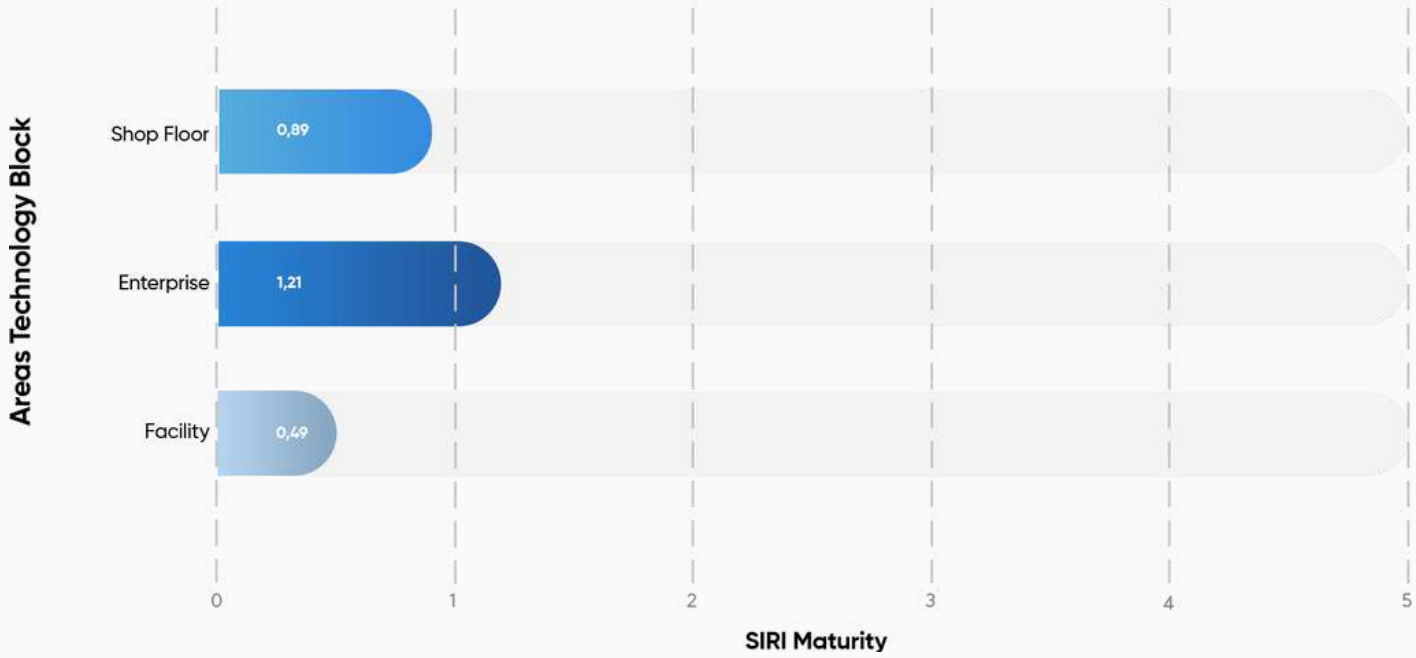
The Technology building block encompasses the Automation, Connectivity, and Intelligence pillars, which are evaluated in turn. The Automation pillar assesses the extent to which repetitive tasks are automated through digital systems or machinery, while the Connectivity pillar focuses on the quality of data and its exchange between the systems used within the company. The Intelligence pillar, on the other hand, is concerned with the processing and analysis of that data.

As depicted in Figure 7, the Automation and Connectivity pillars have reached maturity stage 1, meaning that some repetitive tasks are automated among manufacturers, and the systems within their facilities are connected to the network. However, despite this relatively modest level of maturity, the most critical pillar of the Technology building block - Intelligence - remains a significant challenge. With an average maturity below one, it is evident that manufacturers are still at the beginning of their journey to derive insights from the data they generate.

Companies rely heavily on analog programs such as Excel for analysis, which do not provide real-time notifications in case of deviations. Manufacturers must adopt systems with real-time analysis capabilities to optimize their operations and stay ahead of the competition. This will help them to quickly and efficiently analyze ey areas such as operational excellence, financial operations, and supply chain, among others.

The insights uncovered that the manufacturers mostly invest in the enterprise area, rather than operational technology areas; shop floor, and facility.

Figure 8 | Average maturity of Turkish manufacturing companies across Technology areas



Source: MEXT (Analysis by Digitheta)

The pillars of the Technology building block are examined under three areas of the company; shop floor, enterprise, and facility. While the enterprise area examines the systems and operations at the corporate level, the shop floor and facility areas consider how the production and facility-related operations are executed within the plant.

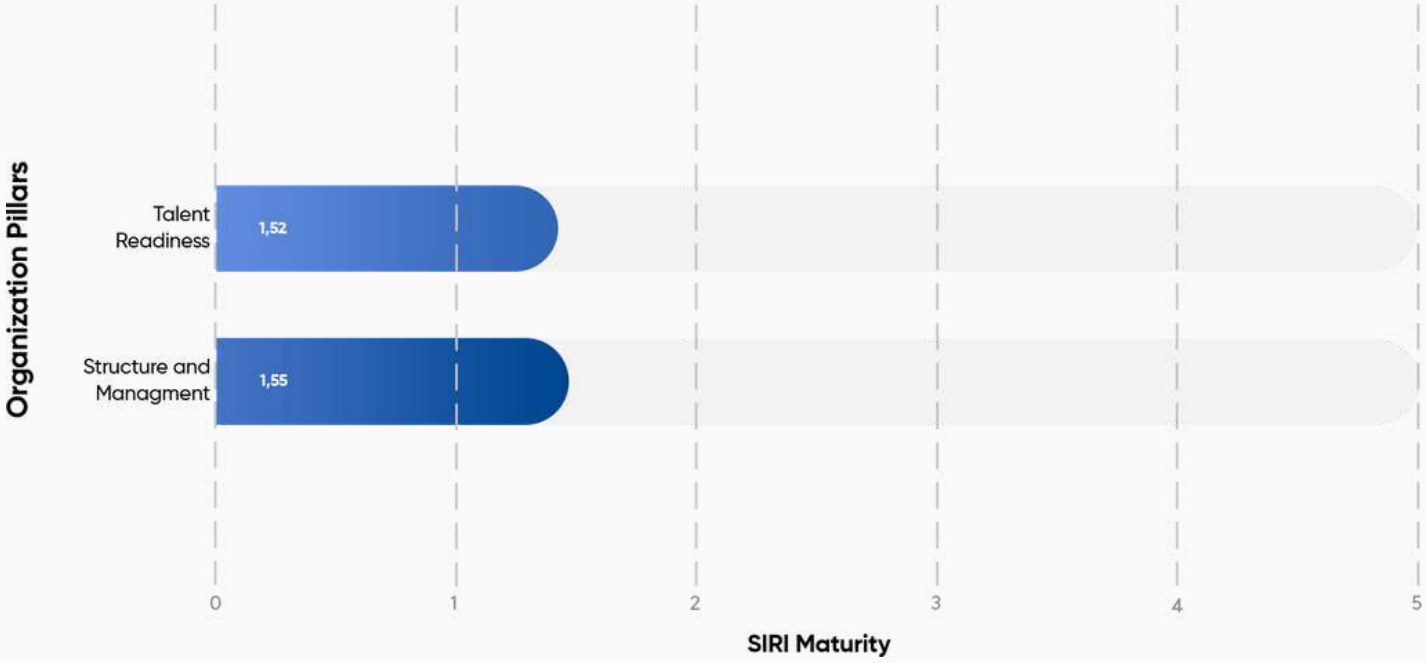
As Figure 8 indicates, the enterprise is the most powerful Technology area in terms of digital maturity. On average, manufacturers have exceeded the maturity score of 1 in the enterprise area and started implementing IT systems to support their corporate processes.

On the other hand, the technology investments on the shop floor and facility areas still need to be improved, as these areas fall behind the maturity score of 1.

Investments in enterprise systems are undoubtedly crucial for businesses. However, they only address some of the challenges facing manufacturers. Efficient management of customers, suppliers, financials, and personnel, as well as boosting productivity and reducing the carbon footprint through intelligent facilities, are pressing concerns for manufacturers.

Companies need to invest in training on digital transformation to keep up with technological advancements, while the organization should become more agile as structural change.

Figure 9 | Average maturity of Turkish manufacturing companies across Organization pillars



Source: MEXT (Analysis by Digitheta)

The Talent Readiness pillar evaluates the organization's human capital and its readiness for digital transformation. Under this pillar, the Leadership Competency dimension assesses the management's ability to adopt and utilize innovative concepts and technologies to enhance the company's competitiveness. Meanwhile, the Workforce Learning and Development dimension seeks to improve the workforce's skills, competencies, and abilities to attain organizational excellence. An average score of 1.52 on the Talent Readiness pillar, as shown in Figure 9, indicates that companies are making an effort to stay current with advancements, but these initiatives require wider implementation throughout the organization.

While the Talent Readiness pillar assesses a company's human capital in digital transformation, the Structure and Management pillar evaluates how it is utilized.

Collaboration across all levels of an organization to reach shared objectives and establish seamless working processes can be a daunting task. The biggest obstacles to successful collaboration are not necessarily technical in nature but, instead, often stem from cultural and institutional factors. The average score of 1.55 on Structure and Management suggests that companies are facing challenges in establishing formal channels that enable employees to share information and work together across cross-functional targets.

In order to gain a deeper understanding of the strengths and weaknesses of Turkish manufacturers in comparison to their global competitors, a comparison of Türkiye's maturity averages across 16 SIRI dimensions was conducted with the global benchmark.

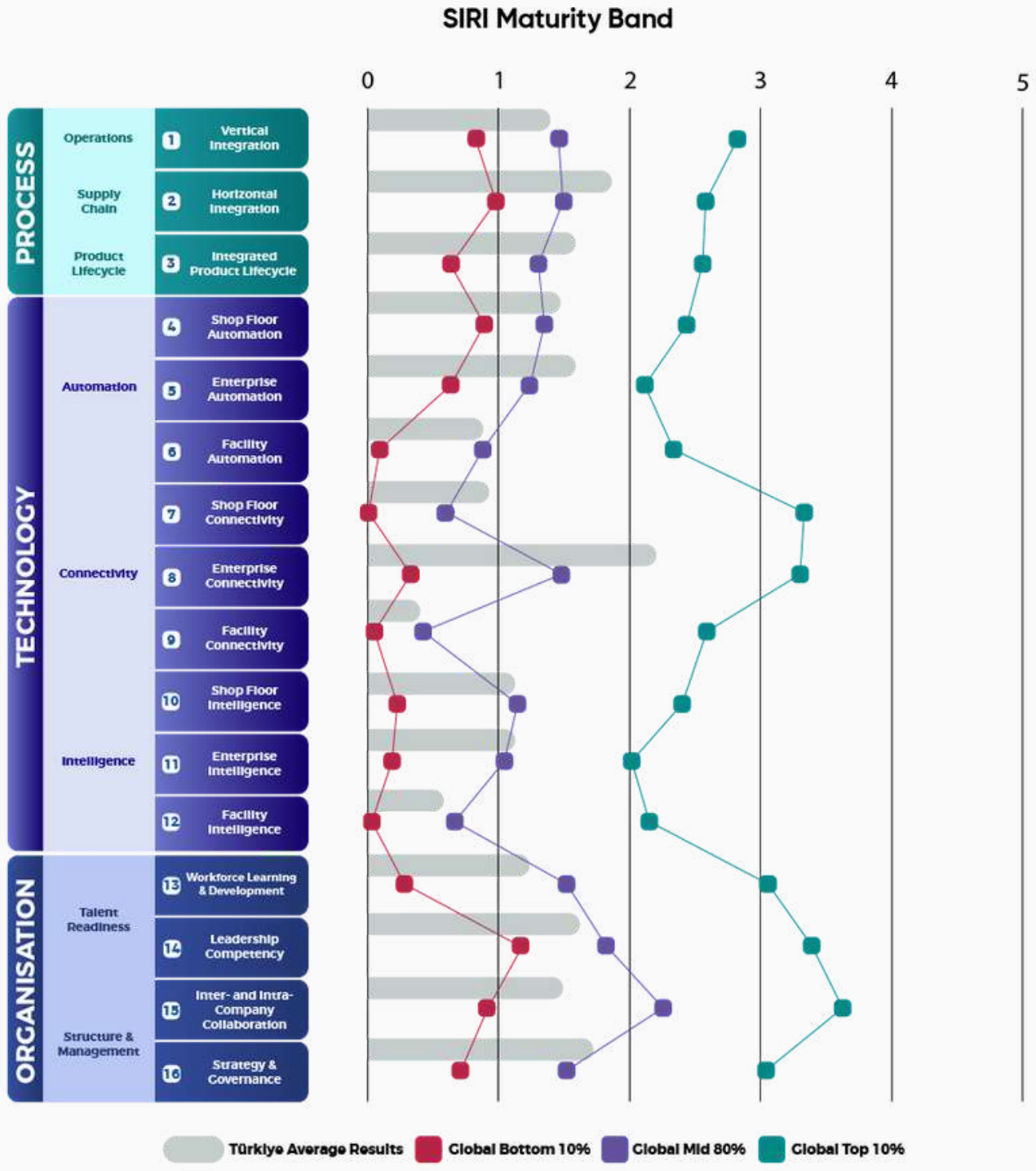
SIRI framework's 3B Maturity Benchmark is used to assess and compare different production locations across the globe depending on their digital maturity. The quantitative reference points are obtained by ranking and categorizing all firms that have taken the OSA according to SIRI Maturity into three groups:

1. Best-in-Class, representing the top 10% of companies on a global scale.

2. Broad Middle, representing the middle 80% of companies on a global scale.

3. Bottom Performers, representing the bottom 10% of companies on a global scale.

Figure 10 | Comparison of Turkish manufacturers' average maturity with the global 3B Benchmark



Source: MEXT (Analysis by Digitheta)

As depicted in Figure 10, Türkiye's average maturity aligns with the global average for most dimensions, exhibiting higher maturity in the Enterprise Connectivity dimension. However, in terms of organizational dimensions, particularly Inter- and Intra-Company Collaboration, there is a noticeable lag of nearly 0.5 maturity levels, indicating a significant difference.

The analysis revealed that digital transformation maturity in Turkish manufacturers presents a diverse profile, similar to the global distribution. However, does this hold true for all manufacturers in Türkiye individually? Türkiye showcases a mosaic profile in terms of digital transformation maturity, mirroring the global distribution. To gain a deeper comprehension of the factors that distinguish their levels of maturity, it is essential to analyze the industry, company size, and investments made by specific companies to drive their transformation journey.

While the global Best-in-Class companies exhibit a maturity score difference of approximately one level compared to the Broad Middle companies, this difference amplifies in the organizational and connectivity dimensions.

As previously stated, the 3B standard classifies all companies that have completed the OSA according to SIRI Maturity into three categories: Best-in-Class, Broad Middle, and Bottom Performers.

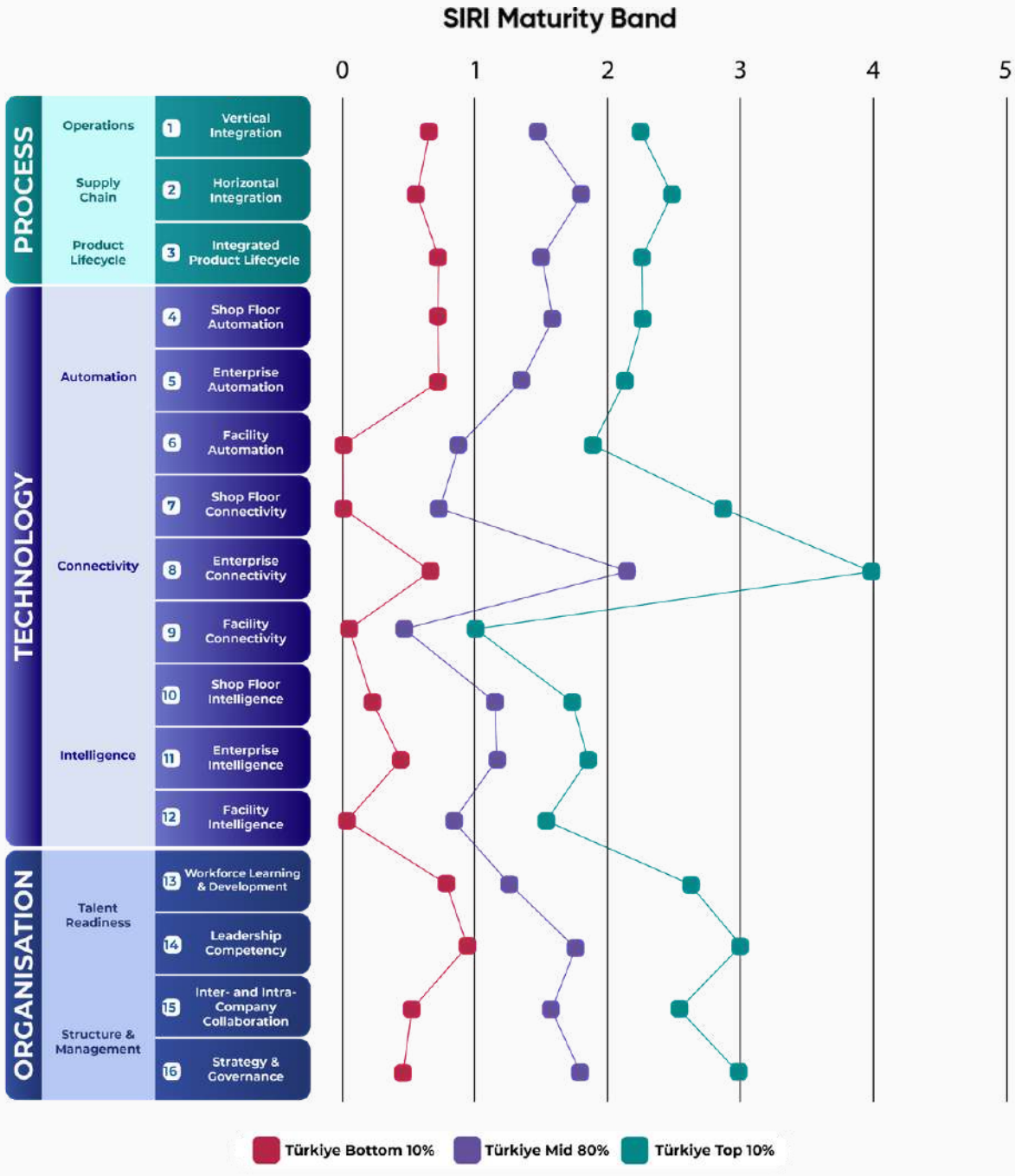
We also conducted the SIRI framework's 3B Maturity Benchmark to compare different production locations across Türkiye depending on their digital maturity. The quantitative reference points are obtained by ranking and categorizing companies that completed the OSA in Türkiye based on their SIRI Maturity.

MEXT Digital Factory, Digital Performance Dashboard

Highlights of Digital Maturity Differentiating Factors

The 3B benchmark for Türkiye highlighted the performance of the companies in digital transformation and marked the differences between Türkiye's digital **transformation leaders and laggards.**

Figure 11 | The 3B Maturity Benchmark for Türkiye (2022)



Source: MEXT (Analysis by Digitheta)

Bottom Performers vs Best-in-Class: What drives digital maturity?

The SIRI insights uncovered that although the majority of the manufacturers in Türkiye have started to collect data about their processes, most of them cannot yet utilize the collected data due to interoperability problems and limited intelligent systems.

1- Process

The 2022 benchmarking exercise for Türkiye showed that the average Assessment Matrix Score of the companies in the Broad Middle and Bottom Performers falls between Band 0(Not Defined) and Band 2 (Digital) across the three Process dimensions (Vertical Integration, Horizontal Integration, and Integrated Product Lifecycle). In comparison, the average Assessment Matrix Score of the companies in the Best-in-Class for each of the three dimensions falls between Band 2 (Digital) and Band 3 (Integrated), demonstrating that these companies have mostly completed the digitization of their processes and are taking the next steps towards integrating them.

2- Technology

Figure 11 demonstrates that Band 2 maturity, the threshold for Industry 4.0, cannot be attained in most of the 16 SIRI dimensions. Furthermore, the data reveals that the average maturity of Shop Floor, Enterprise, and Facility Intelligence in Türkiye cannot surpass the Band 1-Computerised level. This implies that most manufacturers still need systems that can analyze and provide real-time visibility where the deviations are directed to related personnel to take action.

Bottom-Performers and Broad Middle use digital systems as databases

These systems are currently working as a means of data storage and creating alarms based on predefined rules. The usage of digital systems should expand to a level where deviations can be identified, and data can be transformed into meaningful results and insights. This can happen by implementing digital tools and systems to facilitate the analysis and enable the convergence of data from different sources, such as digital performance dashboards or facility management systems. Yet, investing in digital systems would not ensure an enhanced intelligence level.

The gap between Bottom Performers and average performers is significant, especially in the Technology block. Türkiye has strong manufacturers that show similar maturity to top global performers; however, investments in Operational Technology Network for Facility and Shop Floor security should be addressed to maintain a competitive advantage.

The maturity gap in Connectivity prevents reaching complete transparency

Among all 16 SIRI dimensions, Enterprise Connectivity maturity significantly outranks the others on average. While IT investments in Türkiye show an upward trend, the Operational Technology (OT) connectivity average is far behind compared to Enterprise Connectivity.

A common misconception about digital transformation is that it is usually linked to IT investments. Yet, manufacturers can only reach the desired control and autonomy through digital transformation with the convergence of OT and IT systems and utilizing the shop floor data.

Manufacturers need operational excellence on the shop floor, which requires seamless coordination and transfer of critical information in real-time among several departments, like planning, quality, maintenance, production, purchasing, and logistics.

A seamlessly connected factory, where all assets, including machines, products, materials, labor, and auxiliary equipment, are integrated through a shared network, will not only facilitate effective communication between machines and humans but also enable companies to leverage data more efficiently to gain new insights and support real-time decision making.

Collecting data from the Operational Technology layer also provides opportunities for efficient facility management.

Despite the gap in performance between the Best-in-Class, the Broad-Middle, and the Bottom Performers, a common challenge for all companies is in the area of facility dimensions. Given the current global circumstances, such as the Green Deal regulations and the ongoing energy crisis, it is crucial that manufacturers place a greater emphasis on monitoring and improving their energy and utility consumption in the coming years. Manufacturers should tackle twin transformation, both Digital and Green, for two practical reasons:

01 Real-time visibility enables proactive planning in case of energy resource disruptions and soaring petrol and energy prices.

02 Digital transformation enables a circular economy which facilitates the compliance for Green Deal's sustainability measures.

With these trends in mind, it is critical to underline the need for interoperability and security for Shop Floor and Facility connectivity. Achieving visibility on these processes addresses utility consumption levels, which would provide the opportunity for cost and emission reductions.

Why does Operational Technology (OT) security matter?

Stuxnet, a malicious computer worm, targets supervisory control and data acquisition (SCADA) systems and is believed to be responsible for causing damage to Iran's nuclear program. Even though the operation is air-gapped from the internet, the virus is supposed to be spread via an operator or contractor using a USB flash drive. The virus sent false feedback to the central controller, and it therefore could not be identified by anyone monitoring the equipment without an indication of a problem until the equipment began to self-destruct.

Cyber security should be a part of doing business; besides technological investments, the workforce should be trained regularly.

Potential actions to secure the Operational Technology network are:

- Train personnel and conduct periodic internal tests to increase awareness.
- Separate the industrial (operational technology) networks from public business networks with firewalls and a demilitarized zone (DMZ).
- Monitor and log all activities on the network.
- Regularly conduct penetration tests. Test configurations of access points, switches, etc.
- Apply multi-factor authentication methods for remote access.
- Apply a password retention policy and regularly check if any of the users' information was breached elsewhere since most users tend to use the same passwords on different platforms.

MEXT Digital Factory, Assembly Line

3- Organization

As seen from the benchmarks, Best-in-Class companies notably outrank other groups in all organizational dimensions: Workforce Learning & Development, Leadership Competency, Inter- and Intra- Company Collaboration, and Strategy & Governance.

This is not unique to Turkish manufacturers; similar trends can be seen in The Global SIRI Initiative: Manufacturing Transformation Insights Report 2022.

Empowering the organization and reinforcing the workforce is the key

Another reason why the Technology building block lags in Türkiye compared to the global Best-in-Class companies might be the lack of a digitally skilled workforce.

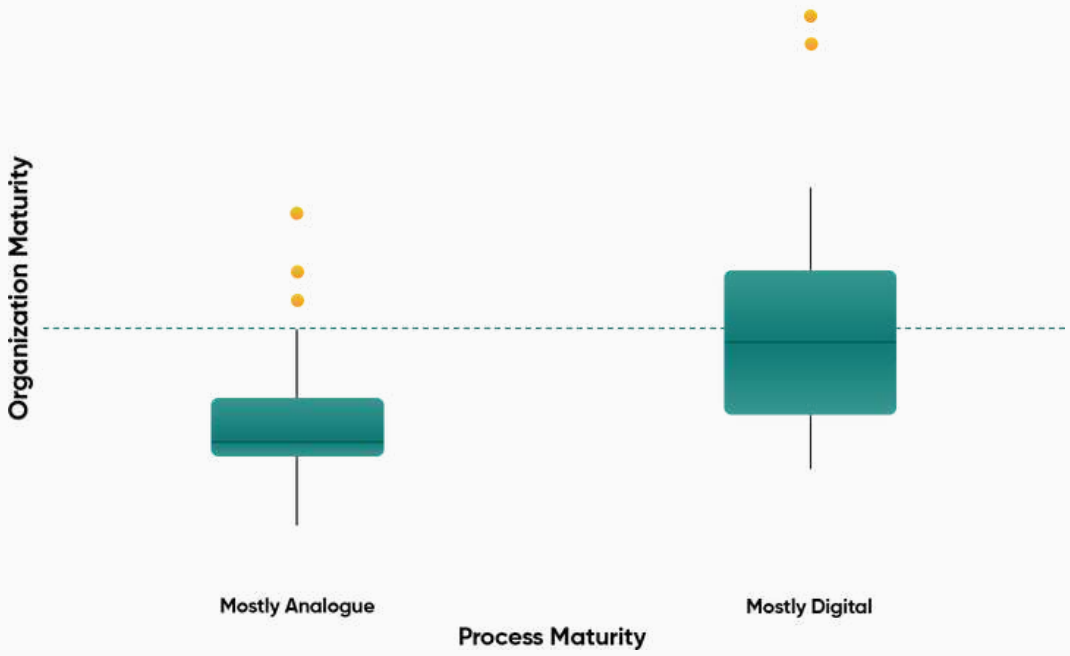
Notably, the average maturity of the Workforce Learning and Development dimension is below the Band 2- Continuous level.
It implies that most companies must incorporate technological trends and digital transformation subjects in their current L&D program.

To effectively deploy and operate digital systems, the workforce should be upskilled and reskilled to respond to the companies' emerging needs.

Furthermore, where this approach aligns with the company's strategy, organizations should welcome the enhancement and expansion of employees' skill sets and provide clear career development pathways for all jobs. Aside from the technical abilities required, leadership should comprehend the concepts of I4.0 and be aware of the benefits these technologies offer before making investments.

A clear roadmap, a workforce properly informed about technological advancements, and (allowing) digital project management tools improve other dimensions' maturity as well.

Figure 12 | Distribution of Organization maturity stages according to Process maturity



Source: MEXT (Analysis by Digitheta)

According to our findings, the Organization building block influences Process maturity. We discovered that companies with a clear roadmap, that are properly informed about technological advancements, and allow digital project management tools have reached a digital Process maturity level (band 2 or above). As shown in Figure 12, without some outliers, all companies with low organizational maturity conduct their processes predominantly via analog tools. This suggests that there is a link between the organization's maturity and the Process building block. This might have two underlying reasons.

First, for a company to manage its processes using digital technologies such as ERP (Enterprise Resource Planning) or MES (Manufacturing Execution System), the employee skill set should be competent.

Second, the management team should have a strategy for investing in digital solutions and empowering the organization to use them. Our field evaluation results show that when the workforce possesses the necessary skill set and is enabled by management to adopt new technology, it is easier for the organization to deploy digital process management systems.

Transforming the skill sets of all employees on each level from operators to C-Suite will take a long time. Speed is the differentiating factor; organizations can benefit from the upskilling programs by leveraging change agents and improving the dissemination speed. Adopting a "train the trainer" approach, organizations can quickly adapt and increase the number of resources to help along this transformation.

Who are the change agents?

The "change agent" approach suggests that a team of influential people would be trained on digital transformation, implement projects, and disseminate the knowledge to the organization.

"Change agents" are talented leaders passionate about digital transformation that will most effectively foster digital transformation within the company and the stakeholders. The "change agent" training program is aligned with the organization's digital transformation strategy and goals. It covers technical subjects such as data science, data analytics, and robot programming to facilitate and accelerate the company's digital transformation through upskilling and reskilling.

Digital transformation projects require cross-functional collaboration, and classical waterfall project management methodologies have several areas for improvement. Since most projects will be a new challenge to team members, an agile structure should be embraced. Piloting quickly, creating a minimum viable product (MVP), and iterating according to lessons learned to require flatter and digitally mature organizations. Cross-functional teams must be established where the teams are empowered to alter specific responsibilities. Autonomy is developed in the workplace when the teams are mandated to commit resources to discrete and longer-term tasks and projects where the risks and rewards are shared.

The most successful digital transformation organizations, such as the WEF's Global Lighthouse Network of advanced manufacturing companies, invest equally in their people and technologies, according to a McKinsey study.[3] These findings show that a strong organization is a foundation for effective digital transformation. Digital Transformation boils down to change management; agile organizations better adapt and benefit from technological advancements.

Companies' common limitations in organizational maturity

Workforce Learning and Development:

- Well-established skill competency matrices for all organizational levels - including the blue-collar are missing.
- The content of the training programs is inadequate in subjects on new technologies and digital transformation.

Leadership Competency:

- The management team acquires knowledge of the latest technologies through personal initiatives or ad-hoc channels; formal avenues to educate leaders on Industry 4.0 still need to be included.
- Leaders who initiated pilot studies are not knowledgeable enough to scale the solutions on the enterprise level since the architectural know-how is limited.

Inter and Intra Company Collaboration:

- The use of digital tools to facilitate collaboration and communication across teams and stakeholders is limited.
- The teams do not have the mandate to commit resources or alter certain obligations to achieve common goals

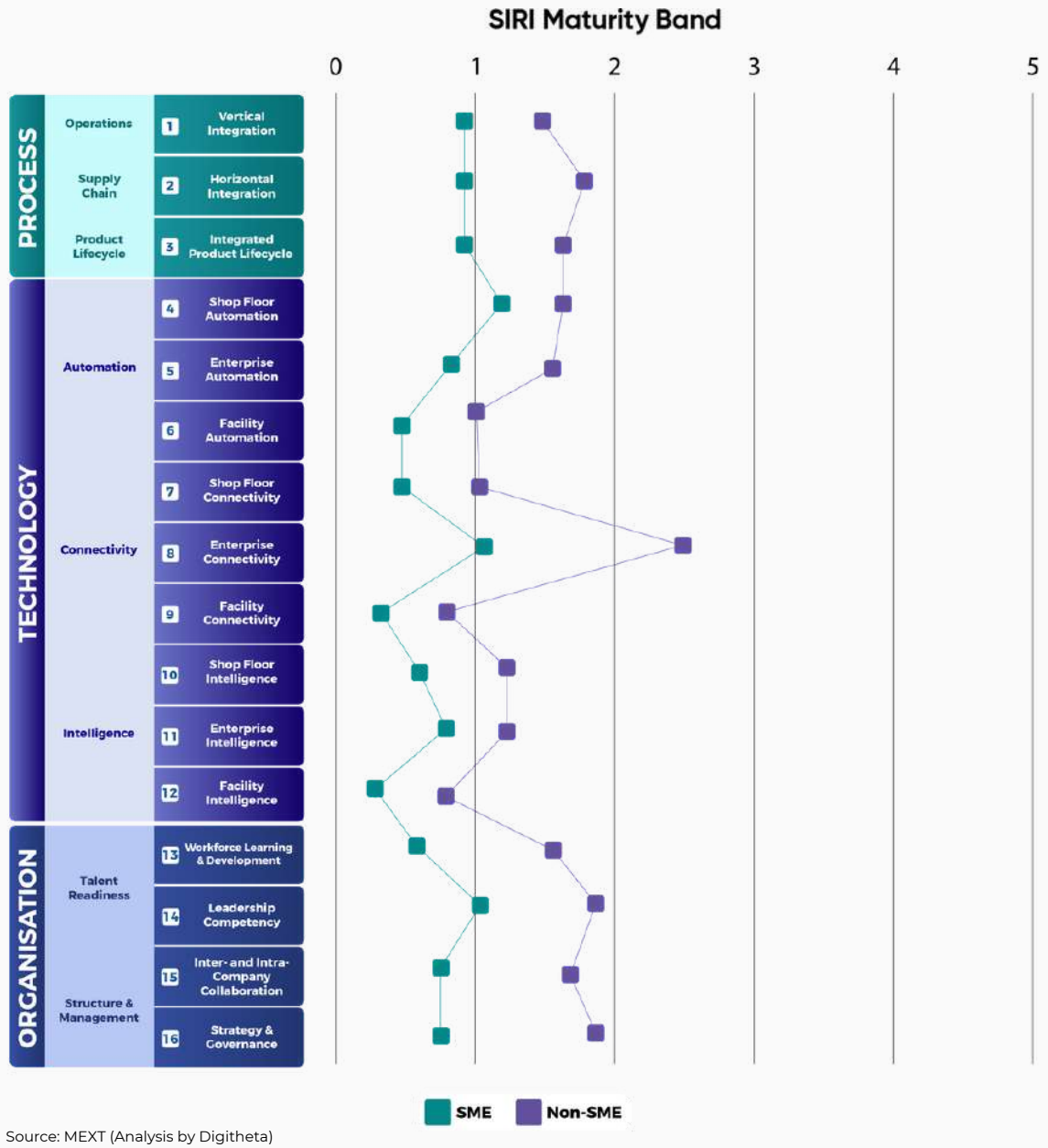
Strategy and Governance:

- Although the majority of businesses aspire to modernize their factories, action plans are not formalized.
- Transformation plans or roadmaps are discussed usually with the top management and usually are not communicated to the rest of the organization.

Understanding Different Company Sizes Across Manufacturers

To better understand the pace of digital transformation across different company sizes in Türkiye, we analyzed and compared the maturity of non-SMEs and SMEs,[4] which made up 80% and 20%, respectively, of the assessed companies. We compared Türkiye's results with global insights.

Figure 13 | SIRI Maturity profiles of non-SMEs and SMEs in Türkiye (2022)



Source: MEXT (Analysis by Digitheta)

MEXT Digital Factory , İstanbul

Non-SMEs are digitalizing while SMEs are still standardizing their processes.

The benchmark in Figure 13 clearly shows that SMEs are below the Band-1 maturity level in almost all dimensions. This is worth emphasizing, particularly in the context of the Process Building Block, because it links to a need for more standardization in the processes. Non-SMEs, on the other hand, are digitizing their already standardized processes. A similar trend can be observed even more distinctly in the 3B benchmark: The bottom performers- dominantly consisting of SMEs- performed below Band 1 in all Process dimensions.

This finding shows that the majority of Turkish manufacturers need lean concepts before moving forward with digital transformation. According to the OSA results, many organizations, particularly SMEs, have yet to capitalize on all of the benefits of lean transformation.

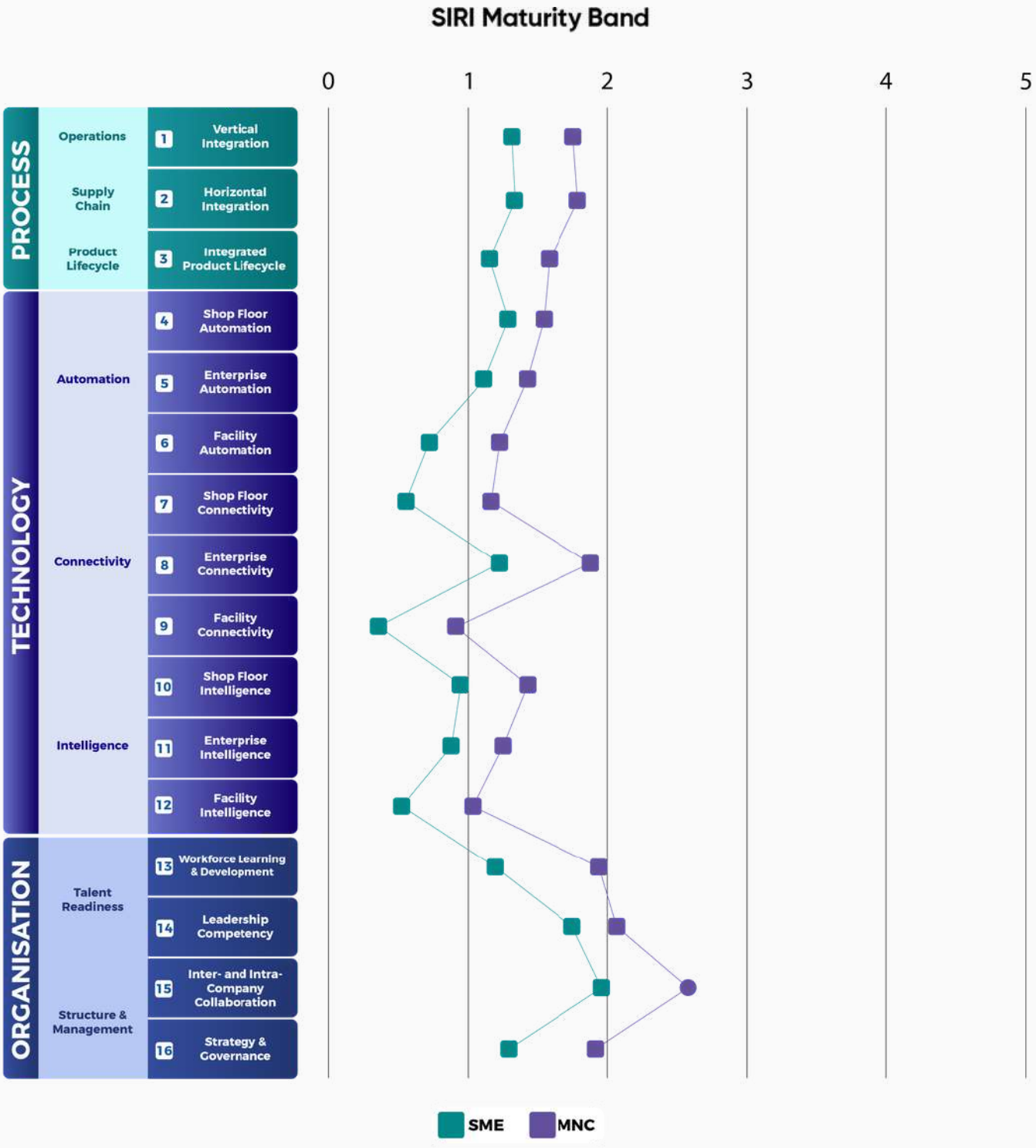
One of the key aspects this report aims to emphasize is that the digital transformation journey should begin on top of standardized processes where lean manufacturing is a highly effective tool.

Initiatives such as the Model Factories founded under the Ministry of Industry and Technology umbrella are a good demonstration of this concept. The primary objectives of Model Factories are to provide productivity increase and digital transformation based on lean philosophy. In addition, they aim to increase the competitiveness of enterprises by applying productivity-enhancing techniques, with training and consultancy services regardless of the sector, as much as possible.

Currently, eight centers provide consultancy, training, and projects with learn & transform approach to manufacturers focusing on the use of lean manufacturing techniques, which is preferred because of the fastest results and ease of application among the other methods to increase the efficiency of the enterprises. Funded by UNDP and The Ministry of Industry and Technology, the aim is to increase the number of model factories to cover the remaining manufacturing cities of Türkiye to improve productivity as a national movement.

The difference between SMEs and non-SMEs in Türkiye is more evident when compared to global figures. Under the Organization Building Block, Turkish SMEs' performance lags behind non-SMEs by nearly 50%, as depicted in Figure 13. However, as illustrated in Figure 14, this gap between SMEs and MNCs (Multi-National Corporations) is less significant across the global landscape. Given their limited workforce and resources, an essential question emerges: How can SMEs catch up with the challenges of the 4th Industrial Revolution?

Figure 14 | The SIRI Maturity profiles of MNCs and SMEs from The Global Smart Industry Readiness Index Initiative: Manufacturing Transformation Insights Report 2022 [5]



Source: International Centre for Industrial Transformation (Analysis by the Singapore Economic Development Board)

The gap in the Horizontal Integration dimension and the dimensions under the Organization Building Block presents opportunities for further development

Although the maturity of non-SMEs and SMEs show a similar pattern in general across the Technology block, we observed that the gap is more significant in the Horizontal Integration dimension and the Organization block. The Horizontal Integration dimension assesses the integration of enterprise processes with other stakeholders along the value chain. Therefore, extending the digital capabilities of its stakeholders, such as suppliers and customers, is a prerequisite for a company to increase its maturity in Horizontal Integration. SIRI assessments revealed that some companies in Türkiye, mainly SMEs, face difficulties integrating their enterprise processes due to their stakeholders' digital limitations. Companies that intend to improve their Horizontal Integration should train and transform their stakeholders when needed.

The Supplier Digital Transformation Programs conducted by two global OEMs (Overall Equipment Manufacturer) in Türkiye are an example of this kind of initiative. Partnering with MEXT, the OEMs used the OSA to evaluate their suppliers' digital maturity and pain points while guiding and facilitating the next steps. Companies should prioritize such programs to strengthen their entire value chain since the chain is as strong as the weakest link.

Upskilling the supply chain change agents

Supply chain resilience is tested during the COVID-19 and the chip crises. The most preferred response strategies are increasing digital connectivity, operation visibility, and digital literacy. OEMs are enhancing technical assistance team competencies as part of their digital transformation strategies. MEXT, in collaboration with OEMs, created a custom-tailored training. The virtualization of process data through machine retrofitting techniques, data governance for OT and IT convergence enhancing quality standards through computer vision, and part traceability subjects are covered for the automotive industry. The Evolving Role Of Competence Centres For Long-Term Resilience In Manufacturing, a publication by the World Manufacturing Foundation, emphasizes the importance of competence centers in driving digital transformation.[5] Competence centers act as a hub among industry, academia, government, technology providers, and other technology centers.

MEXT analysis on the Turkish automotive industry for the next steps was summarized in The Global SIRI Initiative: Manufacturing Transformation Insights Report 2022;

- Supporting the development of Leadership Competency
- Enhancing asset and system connectivity
- Assisting policy-makers in crafting suitable interventions and incentives for the industry

Understanding Turkish Manufacturers' Priorities

Comparing the most selected KPIs in Türkiye and those selected globally highlights differences in pain points and priorities across company sizes and geographies.

Key Performance Indicators ("KPIs") are measures used to evaluate a company's success or effectiveness in achieving its key business objectives and strategic directives. SIRI's 14 categories are organized into four main groups - Productivity, Quality, Flexibility, and Speed.

As part of the OSA program, companies select five critical KPIs out of 14 as their essential business objectives. The definitions for each of the 14 KPIs can be found in the Appendix of this report.

Table 1 | Key KPIs selected by manufacturers of different profiles in Türkiye

Top KPIs	non-SMEs	SMEs	Best-in-Class (Top 10%)	Broad Middle (Middle 80%)	Bottom Performers (Bottom 10%)
1	Asset & Equipment Efficiency	Asset & Equipment Efficiency	Safety	Asset & Equipment Efficiency	Asset & Equipment Efficiency
2	Planning & Scheduling Effectiveness	Utilities Efficiency	Asset & Equipment Efficiency	Planning & Scheduling Effectiveness	Planning & Scheduling Effectiveness
3	Process Quality	Planning & Scheduling Effectiveness	Process Quality	Process Quality	Utilities Efficiency
4	Inventory Efficiency	Product Quality	Planning & Scheduling Effectiveness	Workforce Efficiency	Inventory Efficiency
5	Workforce Efficiency	Workforce Efficiency	Inventory Efficiency	Inventory Efficiency	Product Quality
KPI category	Productivity	Quality	Speed	Flexibility	

Source: MEXT (Analysis by Digitheta)

Table 2 | Key KPIs selected by manufacturers of different profiles globally

Top KPIs	MNC	SMEs	Best-in-Class (Top 10%)	Broad Middle (Middle 80%)	Bottom Performers (Bottom 10%)
1	Asset & Equipment Efficiency	Product Quality	Product Quality	Product Quality	Workforce Efficiency
2	Product Quality	Asset & Equipment Efficiency	Asset & Equipment Efficiency	Asset & Equipment Efficiency	Product Quality
3	Planning & Scheduling Effectiveness	Workforce Efficiency	Planning & Scheduling Effectiveness	Planning & Scheduling Effectiveness	Asset & Equipment Efficiency
4	Material Efficiency	Planning & Scheduling Effectiveness	Time to Delivery	Workforce Efficiency	Process Quality
5	Time to Delivery	Inventory Efficiency	Material Efficiency	Time to Delivery	Inventory Efficiency
KPI category	Productivity	Quality	Speed	Flexibility	

Source: International Centre for Industrial Transformation (Analysis by the Singapore Economic Development Board)

Companies ahead of the average maturity curve are more likely prioritize Quality and Productivity

There are similarities in the KPI selection of the same profiles in Türkiye and globally. The recent chip crisis, fluctuating freight costs, and supply chain issues have led companies to be more flexible in their planning and scheduling. The inventory management strategy has shifted from "Just-in-Time" to "Just-in-Time" and "Just-in-Case," leading to increased raw material costs. Room for equipment breakdowns, and cost of poor quality almost diminished in production.

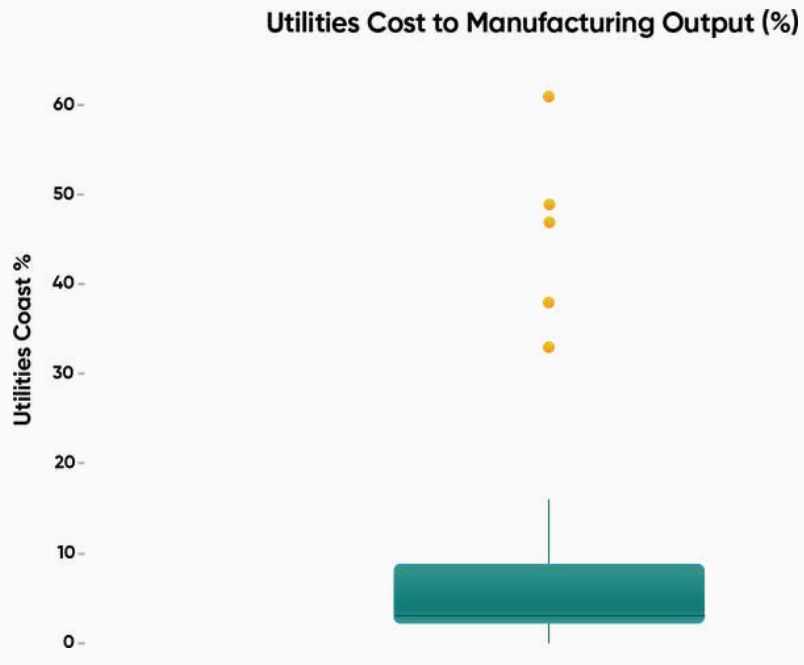
Safety KPI is prioritized among the best-in-class enterprises in Türkiye, but not globally, due to the dominance of Turkish best-in-class companies in hazardous industries like Energy and Chemicals, and operator-intensive sectors like automotive.

Utilities Efficiency is a common pain point in Türkiye, especially on the economic scale

On a global scale, it can be seen that Utilities Efficiency is not prioritized by companies in any of the five different profiles. On the other hand, Utilities Efficiency is one of the top three KPIs prioritized by Turkish SMEs and Bottom-Performers. To understand the case more granularly, we analyzed the cost profile of the companies that prioritized the Utilities Efficiency KPI.

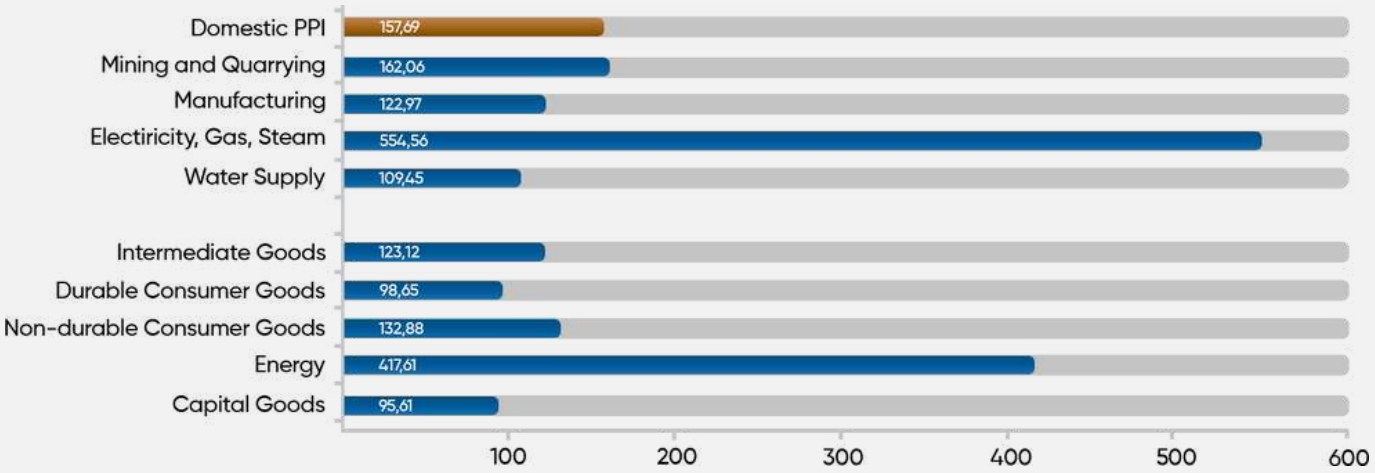
Figure 15 illustrates that Utility costs range with a median of 3% for Turkish manufacturers. At first glance, this might not be a huge cost factor, however, this cost is more than transportation, maintenance, or R&D costs. Utilities are one of the three most essential cost profiles in organizations prioritizing Utilities Efficiency. That explains why SMEs and bottom performers placed the KPI among the top five. Why are utilities more dominant as a cost profile and KPI in Türkiye than anywhere else in the globe?

Figure 15 | Distribution of manufacturers' Utilities costs according to their manufacturing output



Source: MEXT (Analysis by Digitheta)

Figure 16 | Domestic Producer Price Index Yearly Rate of Change (%) (as of October 2022)



Source: TUIK, 2022

Energy prices have risen over the world in the last year. In the EU, industrial producer prices in the energy sector increased by 115.4% over the previous year.[6] However, Türkiye's energy price hikes are dramatic in comparison to Europe. Indeed, as illustrated by the data, the annual rise in the price index in the production and distribution of electricity and gas is almost five times that of the EU, a 554,56% increase in energy.[7]

This situation has diminished the profitability of many Turkish manufacturers, particularly SMEs and companies engaged in energy-intensive operations, such as the cement industry.

As data summarizes, Türkiye has recently become the source of energy-cannibal industries such as cement and arc furnaces. That sharp price increase requires digital solutions such as utility cost monitoring, continuous improvement studies, and production planning based on energy prices for companies desiring to remain competitive and profitable.

Digital transformation will enable green transformation, and the path to carbon-neutral production will require real-time visibility. Similar to how digital solutions enhance lean techniques to achieve operational excellence in production, manufacturers can apply continuous monitoring to reduce energy consumption.

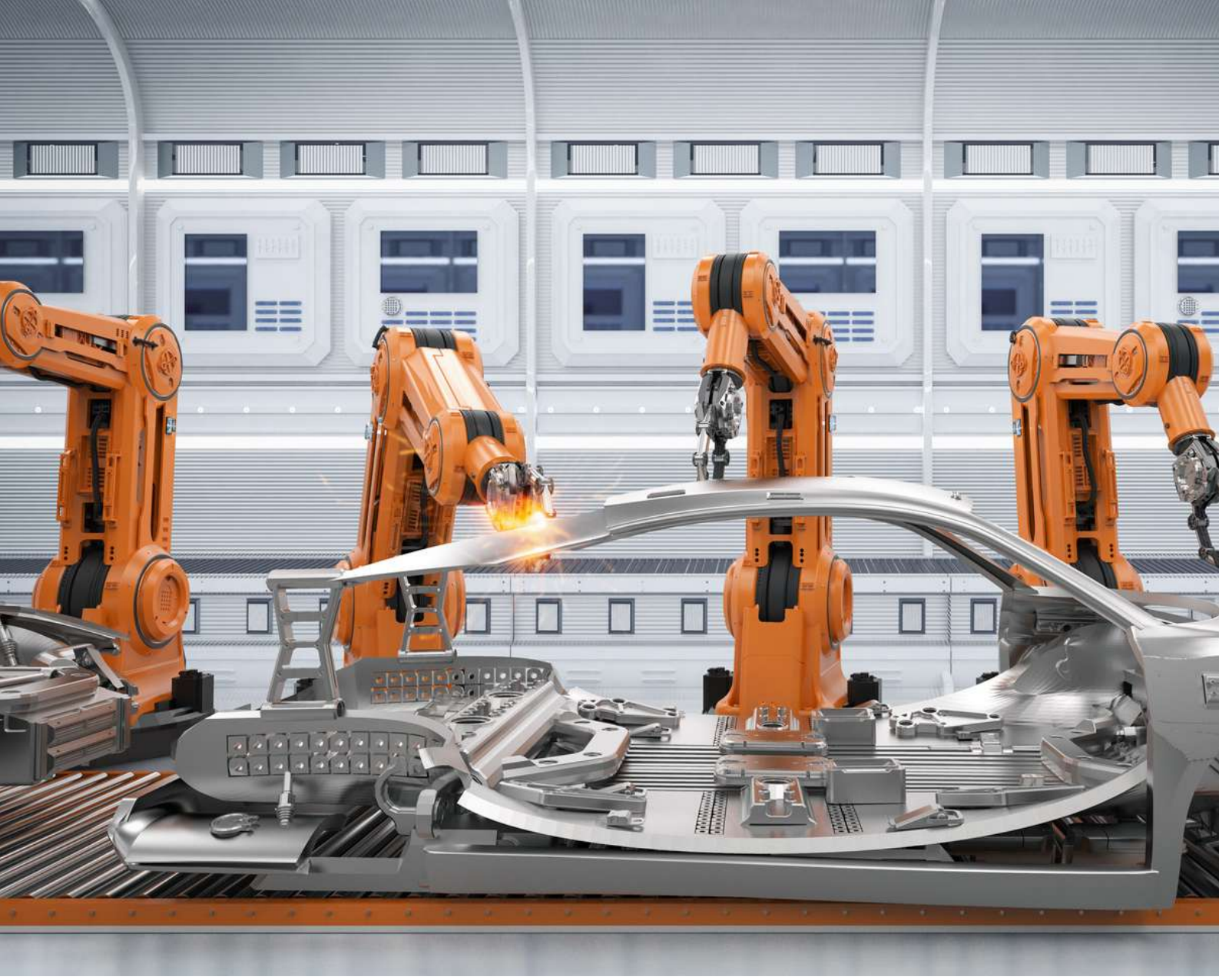
Industry-Specific Insights

One size does not fit all. Each industry has different pain points and opportunities. We conducted a deep-dive analysis into each industry's KPI choices, cost profile, and and global maturity benchmark to provide data-backed analysis.

Despite each industry's maturity, pain points, and priorities differ, there are common steps each company needs to take. Digital Transformation starts with the organization, firstly, with the digital strategy. The company's digital strategy should be summarized in a few sentences and embraced at every level. Companies can work with solution providers and consultancy firms to start the process. However, they should equally invest in training. To benefit from digital transformation, organizations need a competent workforce who can derive value from the generated data. Companies must establish an agile working culture, as digital transformation is a function of the company's collective knowledge. Since the collected data will increase in time, the prioritized projects will also change. Inefficiencies that were not identified before will become visible, and taking permanent corrective actions will continuously improve essential business objectives and positively impact the bottom line.

Within the following pages, we aimed to show a two-page analysis of each industry where there is statistically significant data. Even though there are ongoing assessments on Energy and Chemicals, Food & Beverage, Electronics, Machinery & Equipment, and General Manufacturing sectors, only three industries currently have enough data to derive deep-dive analysis. Our detailed analysis presented the unique SIRI profile of the Automotive, Cement, and Textile industries, their pain points, and opportunities.

As the data showed, the nature of industry plays a crucial role in determining the cost factors and performance metrics that a business prioritizes. Each sector operates differently, leading to varying focuses on cost and performance metrics. To optimize operations and achieve optimal results, companies must understand and embrace their industry's unique demands and challenges, allowing them to tailor their digital transformation initiatives to suit their specific needs.



Automotive

The Turkish automotive industry is one of the leading industries for export with nearly $30B, whereas the EU market roughly accounts for two-thirds of the total exports. OEMs have been trying to assist their suppliers with lean methodology applications in their production processes for a long time. The global automotive industry is highly competitive, and manufacturers operate on low-profit margins. OEMs are challenged to manage unimaginable complexities with millions of product variants where mass customization demands high mix, low volume production flexibility.

Most TIER-1 suppliers are heavily dependent on the OEMs' production schedule and are affected by the last-minute updates through COVID-19 and the chip crisis. Türkiye has the know-how to design and produce its vehicles; however, most companies have not reached world-class manufacturing productivity levels and still struggle with quality and equipment efficiency problems. Some global competitors understood that they were becoming data companies and redesigned their businesses according to megatrends like Tesla.

Pain Points

- Discrepancies in the integrated supply chain, such as demand fluctuations, lead to the bullwhip effect.
- High mix, low volume parts cause challenges in planning and engineering changes.
- The market is competitive with low profitability margins.

Recommendations

- The companies can implement integrated planning by creating a Supply Chain Control Tower for a connected supply chain.
- End-to-end data governance with a holistic master data management system, such as Single Source of Truth architecture, should be implemented.
- The industry, which has already attained a level of efficiency due to lean adoption, can benefit from Big Data and AI applications to make a significant difference in profitability.

The automotive industry is undergoing significant changes with new trends such as electrification, autonomous driving, and mobility. These changes affect not only vehicle design and production but also the entire supply chain. The recent chip crisis has highlighted the need for better information sharing and visibility in the supply chain, as chip supply disruptions are expected to continue through 2023.

To address these challenges, the automotive industry must explore innovative solutions like Catena-X, [9] which aims to create an open data ecosystem for the supply chain. In Türkiye, two major automotive original equipment manufacturers (OEMs) have transformed their suppliers digitally and completed the first phases of their initiatives.

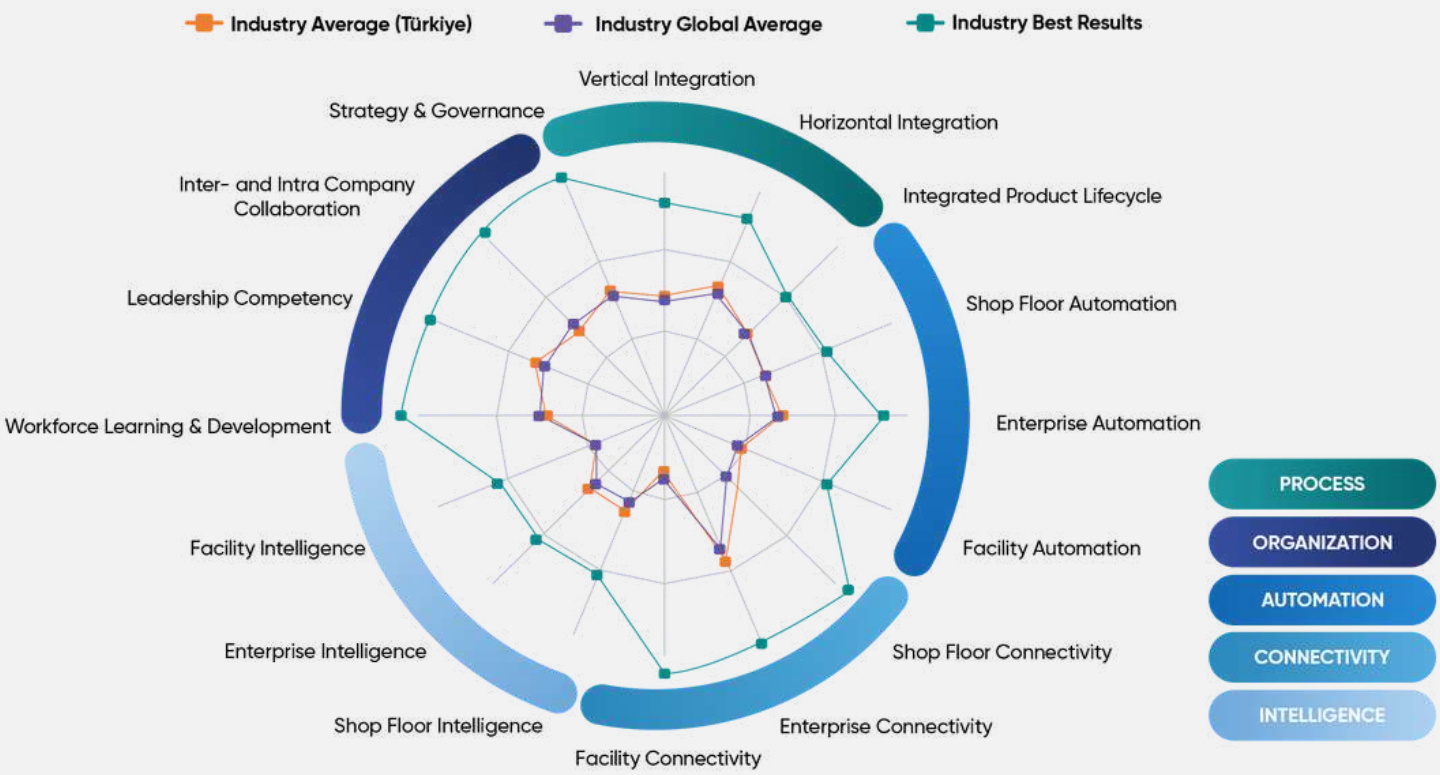
To remain competitive, the automotive industry in Türkiye must adopt forward-looking programs to build new capabilities, adopt agile working practices, establish data governance platforms, and effectively use data to drive decision-making. As shown in figure 20, Türkiye's automotive performance on 16 SIRI dimensions is comparable to the global average. Still, to stay ahead, manufacturers must continuously look for ways to improve their processes and operations.

Table 4 Key KPIs selected by the automotive manufacturers in Türkiye

Top KPIs	Automotive Sector Choices	Choice Percentage
1	Asset & Equipment Efficiency	76%
2	Planning & Scheduling Effectiveness	63%
3	Process Quality	58%
4	Inventory Efficiency	55%
5	Workforce Efficiency	47%
6	Product Quality	47%
KPI category	Productivity, Quality, Speed, Flexibility	

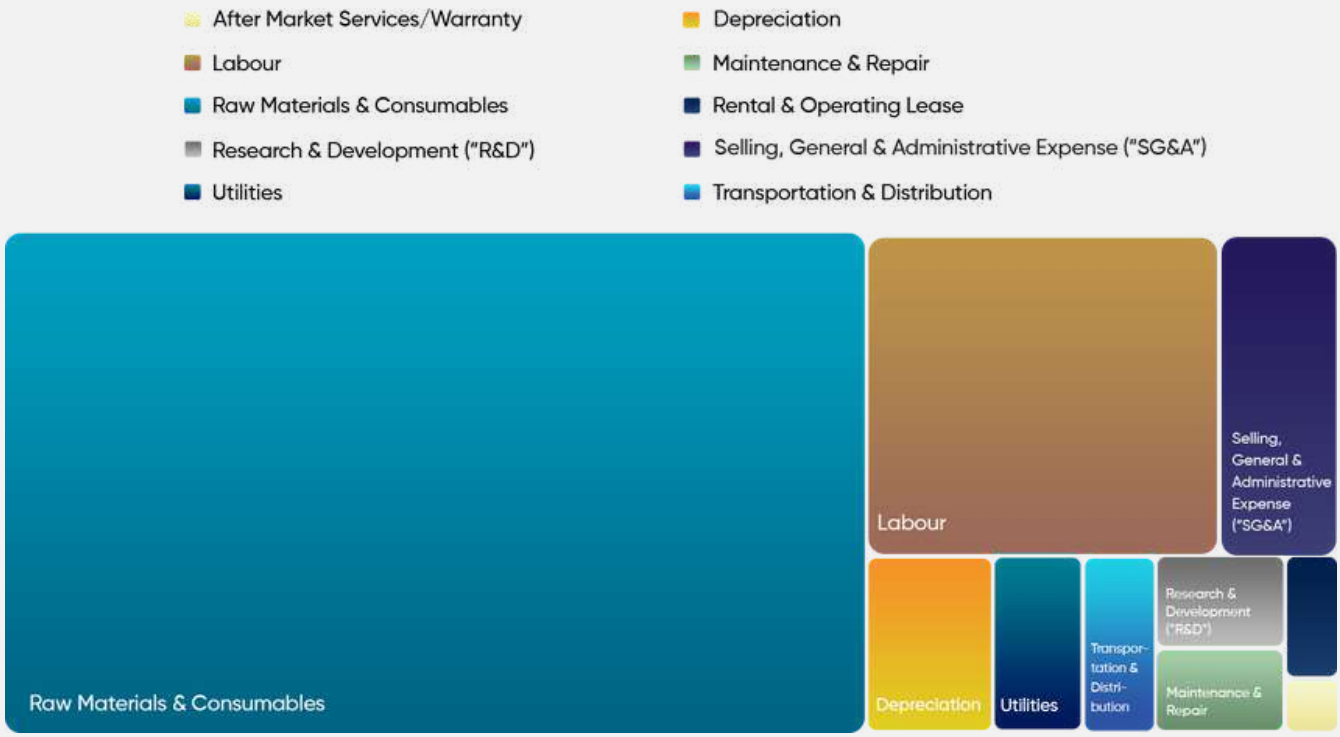
Source: MEXT (Analysis by Digitheta)

Figure 20 | Maturity benchmark for the Turkish automotive industry



Source: MEXT (Analysis by Digitheta)

Figure 21 | Cost profile of the Turkish automotive industry



Source: MEXT (Analysis by Digitheta)

Cement

Türkiye, the largest cement producer in Europe, will be one of the most affected countries by the carbon tax within the scope of the Green Deal. As one of the most energy and carbon-sensitive sectors, the cement industry in Türkiye is primarily considered for digital maturity assessment.

In collaboration with MEXT and Cement Industry Employers' Association (ÇEİS), many cement plants were assessed in five geographical regions of Türkiye.

The SIRI benchmark evaluates the cement industry under the general manufacturing industry. Yet, this report offers a separate analysis because the industry results differ significantly from the other companies in general manufacturing.

In the following page, the pain points of the sector and the opportunities with the captured outputs are given under the operations, organization, and supply chain's digital transformation.

Pain Points

- Energy-intensive nature of the processes requires real-time operational decisions considering energy consumption.
- Political and seasonal effects lead to high demand volatility, and fluctuating coal prices cause process cost vulnerability.
- The production system is designed to maintain continuous production with minimum downtime, thus requiring high equipment availability.
- Converting process data into meaningful results requires significant effort.
- Upcoming regulations under the Green Deal, such as carbon taxation, threaten profitability and competitiveness.
- External stakeholders in the supply chain, such as the suppliers and customers, have digital literacy limitations.

Recommendations

- Production planning focusing on energy management can be adopted.
- Increasing the RDF (Refused Derived Fuel) ratios can offer energy efficiency and process cost optimization.
- High uptimes and critical equipment efficiency can be managed via Integrated Production-Maintenance 4.0 applications.
- Big Data and AI applications that are beyond PID-level optimizations yield process improvement opportunities that reduce carbon footprint.
- Costs of digital transformation projects can be offset by applying incentives or funding mechanisms for sustainable production.
- Organizations like Cement Industry Employers' Association (ÇEİS) and Turkish Cement Manufacturers' Association (TÜRKÇİMENTO) can encourage supplier transformation and awareness training programs.

In contrast to the general manufacturing sector, where discrete production is predominant, the cement industry operates differently, with continuous production being the norm. Here, utility costs play a more significant role than raw material costs.

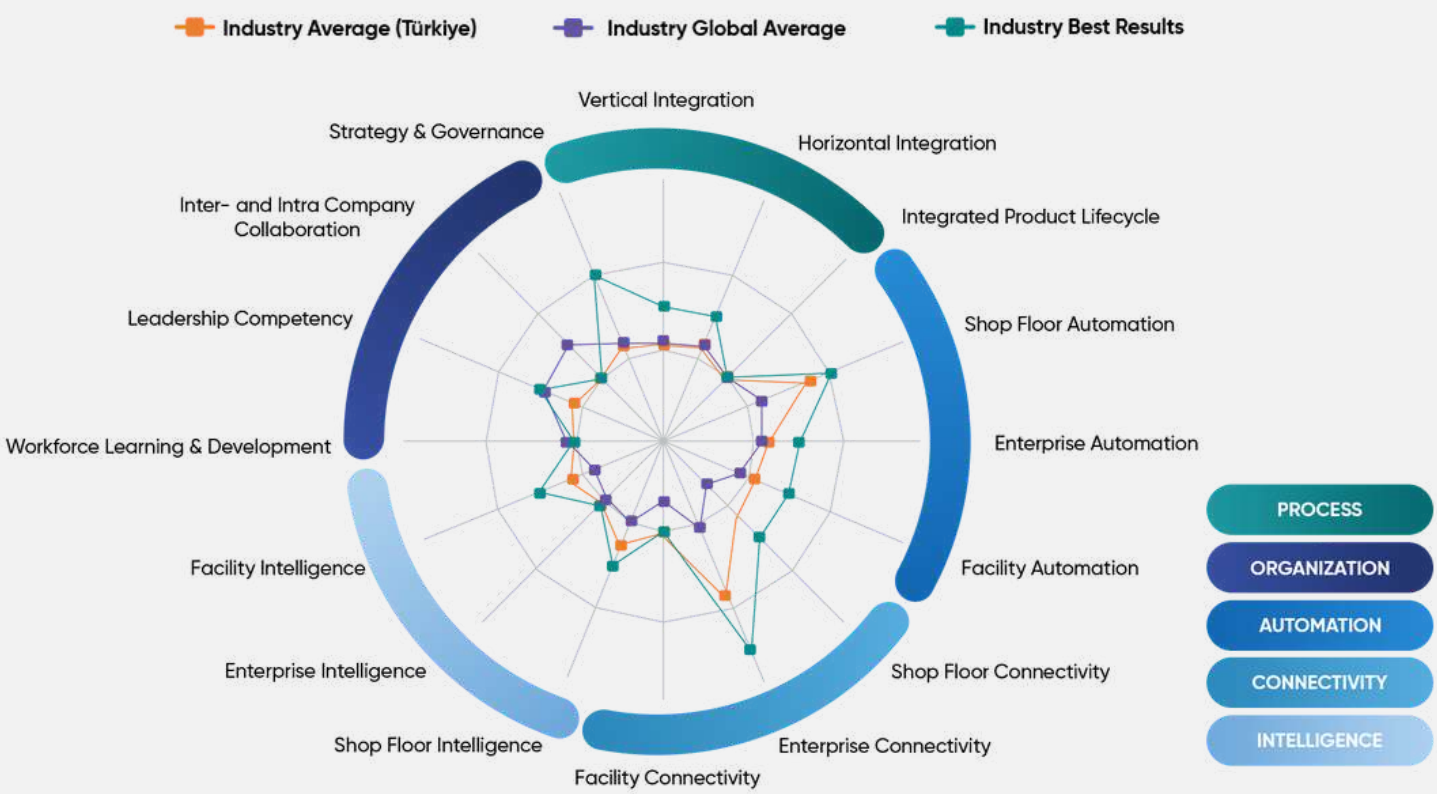
The industry faces challenges in adopting digital transformation initiatives, particularly in establishing a comprehensive data grid for effective data governance and optimization. In the near future, the cement industry's most significant challenge in digital transformation will be integrating alternative fuel management into its existing processes while ensuring production and energy-oriented optimization. To overcome these challenges, the industry must find innovative solutions that allow for the seamless integration of new technologies and processes while preserving the integrity of its production operations. Successful digital transformation adoption in the cement industry will lead to increased efficiency, reduced costs, and improved sustainability.

Table 5 Key KPIs selected by the cement manufacturers in Türkiye

Top KPIs	Cement Sector Choices	Choice Percentage
1	Utilities Efficiency	100%
2	Asset & Equipment Efficiency	86%
3	Process Quality	71%
4	Workforce Efficiency	71%
5	Safety	43%
KPI category	Productivity, Quality, Speed, Flexibility	

Source: MEXT (Analysis by Digitheta)

Figure 22 | Maturity benchmark for the Turkish cement industry



Source: MEXT (Analysis by Digitheta)

Figure 23 | Cost profile of the Turkish cement industry

Source: MEXT (Analysis by Digitheta)

Textile, Clothing, Leather & Footwear

Türkiye's textile Industry, which ranks second in Europe and seventh in the world, has been one of the country's primary export industries for several years. The production capacity is increased, especially with the investments in raw material production.

The Turkish Textile Industry Employers Association (TTSIS) collaborated with MEXT to address the digital transformation maturity of its members. Besides assessing the maturity via SIRI, TTSIS took one step more for its members' digital transformation journey by reinforcing MEXT's unique workshop service.

Detailed action plans were prepared in collaboration with technical consultants and company representatives individually for the selected critical use cases.

In this journey, MEXT first positioned digital literacy training to increase competency with the Turkish Textile Industry Employers Association. MEXT ecosystem partners were involved intensively in supporting company-wide transformation, which will be shared in detail under the success stories section.

Pain Points

- The dependency on equipment providers results in data acquisition problems. ·
- High requirements from end users and global brands' high standards on Sustainable Development Goals (SDGs) challenge manufacturers, especially SMEs. ·
- Batch-level production leads to a lack of visibility in intermediate steps (i.e., finishing and dyeing after weaving). As a result, the production costs are miscalculated.
- Other stakeholders in the supply chain, such as the suppliers and customers, have a relatively lower digital readiness than other sectors, where the industry is challenged to attract a highly-skilled workforce.

Recommendations

- There is an opportunity for data acquisition via machine retrofitting, especially from the facility layer, to address the sustainability requirements by enabling utility consumption transparency.
- Process cost mapping can be implemented via track-and-trace solutions for end-to-end visibility of the process without harming the product.
- Supplier transformation and capability-building projects can be encouraged via NGOs (Non-Governmental Organizations) and associations such as the TTSIS and IHKIB (Istanbul Apparel Exporters' Association).

The industry's first obstacle to digital transformation has been its dependence on machine manufacturers in the data acquisition process. Process diversity and machine customization increase the challenge complexity. The industry needs to monitor the collected data at each granular point from the supply chain to production in an integrated and transparent way. The product memory, where the raw material batch, process parameters, etc., are linked together, should be extended with the utility consumption to support sustainability goals.

Even though the industry is challenged to attract a highly-skilled workforce and digital maturity is relatively low compared to other sectors, embracing an agile project management mindset and taking upper management support can improve KPIs and reduce costs significantly. Process cost mapping provided by end-to-end traceability will form a strong foundation for determining investment steps and focus areas.

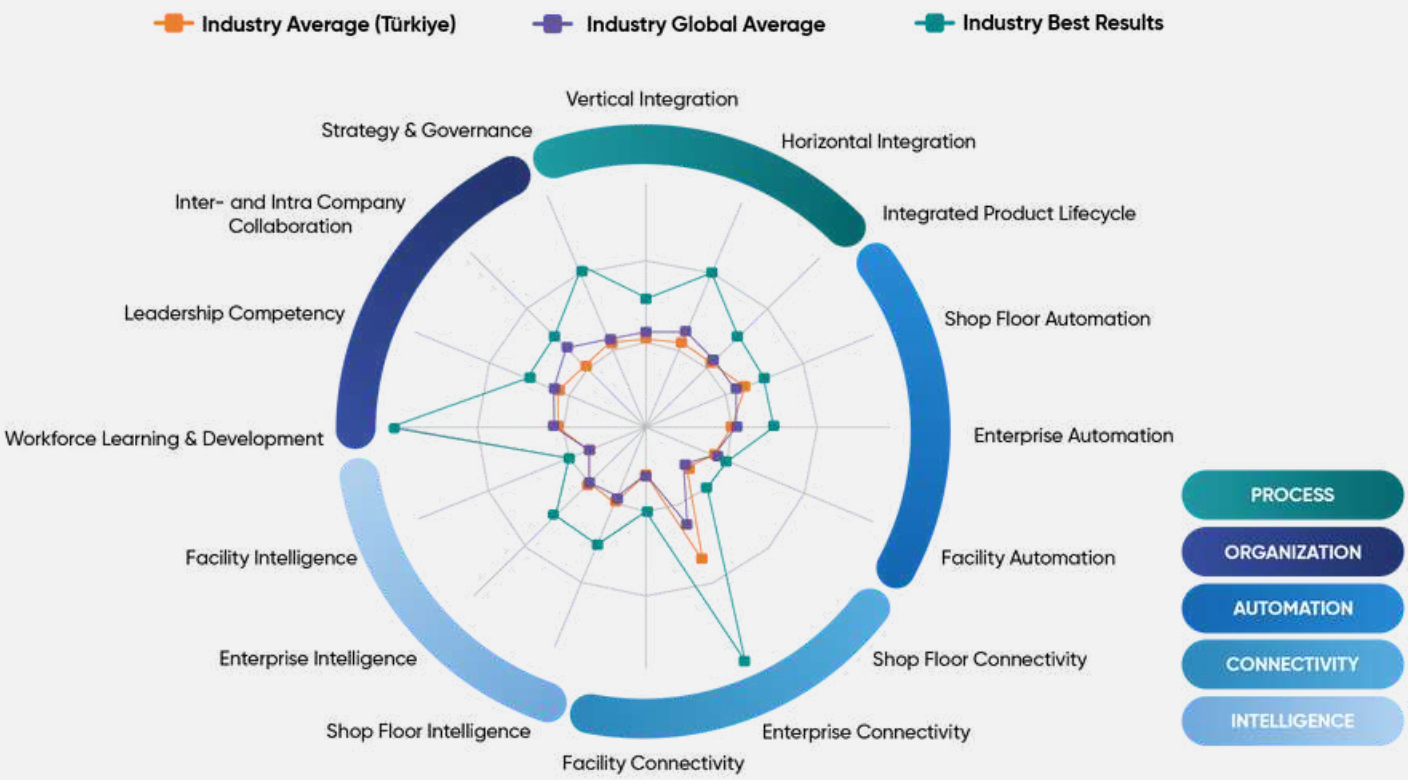
Global statistics for digital transformation failure rates might discourage companies. The truth is that with upper management buy-in and investments in the company's human capital, the right strategy, the right technology, and the right partner involvement are all it takes to succeed in this journey.

Table 6 Key KPIs selected by the textile manufacturers in Türkiye

Top KPIs	Textile Sector Choices	Choice Percentage
1	Asset & Equipment Efficiency	73%
2	Time to Delivery	60%
3	Planning & Scheduling Effectiveness	60%
4	Materials Efficiency	47%
5	Utilities Efficiency	47%
6	Product Quality	47%
KPI category	Productivity, Quality, Speed, Flexibility	

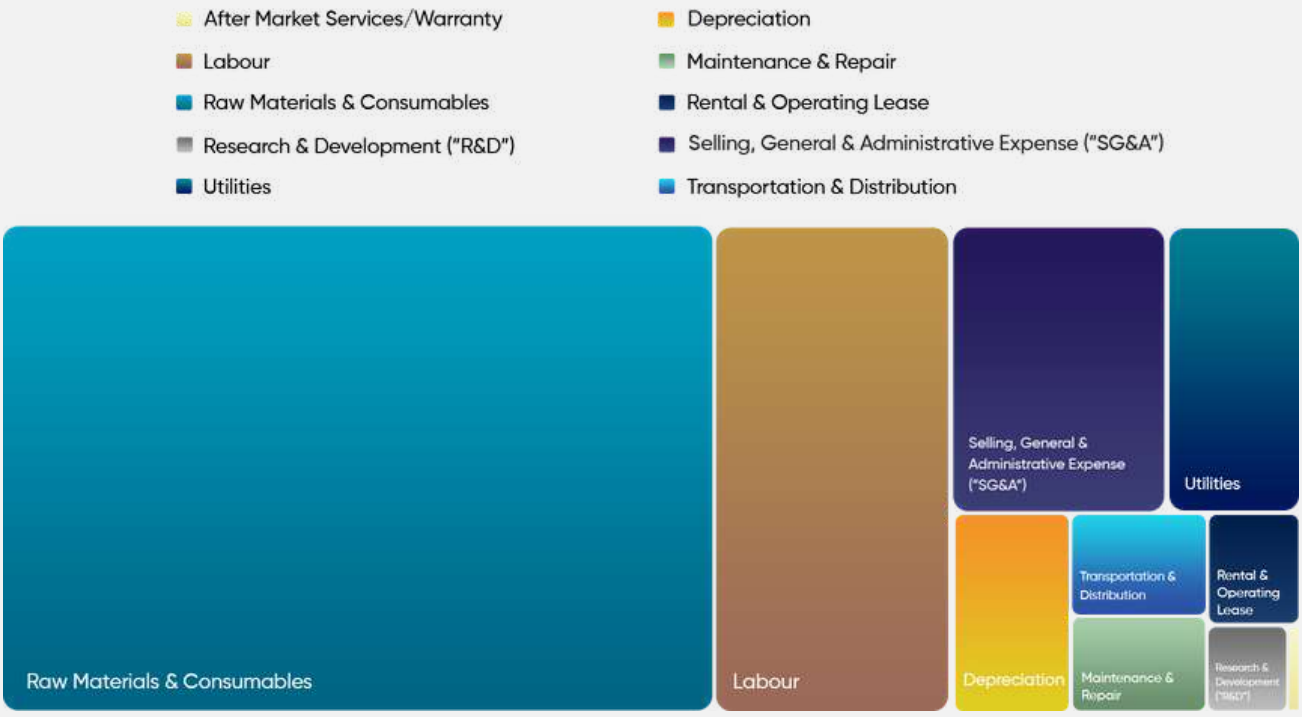
Source: MEXT (Analysis by Digitheta)

Figure 24 | Maturity benchmark for the Turkish textile industry



Source: MEXT (Analysis by Digitheta)

Figure 25 | Cost profile of the Turkish textile industry



Source: MEXT (Analysis by Digitheta)

Our Industry Coverage is Expanding

Deep sectoral insights supported by ongoing assessments for Energy and Chemicals, Food and Beverage, and General Manufacturing industries will be provided in the following insight report when each industry achieves an adequate sample size. Nevertheless, we shared the preliminary findings from the assessments we have conducted so far to draw a general picture of the industries.

Energy and Chemicals (Downstream)

According to the SIRI framework, the Energy and Chemicals (Downstream) industries are grouped together. However, this report only focuses on the Chemicals sector and draws insights specifically for this industry.

Most of the chemical production facilities have been designed to produce continuously. Mixing several ingredients and processing them based on the recipe might seem easy. However, there are several challenges. The impurities in the raw material, even the slight deviations in process parameters, and unexpected production losses are just a few of the daily problems of chemical producers. Equipment manufacturers provide process history databases (PHDs) to store parameters and supervisory control and data acquisition (SCADA) systems for facilities. The most common approach for the industry is process optimization; on the other hand, these techniques require several data from different sources, deep process know-how, and AI/ML techniques that cannot be run solely on PHDs.

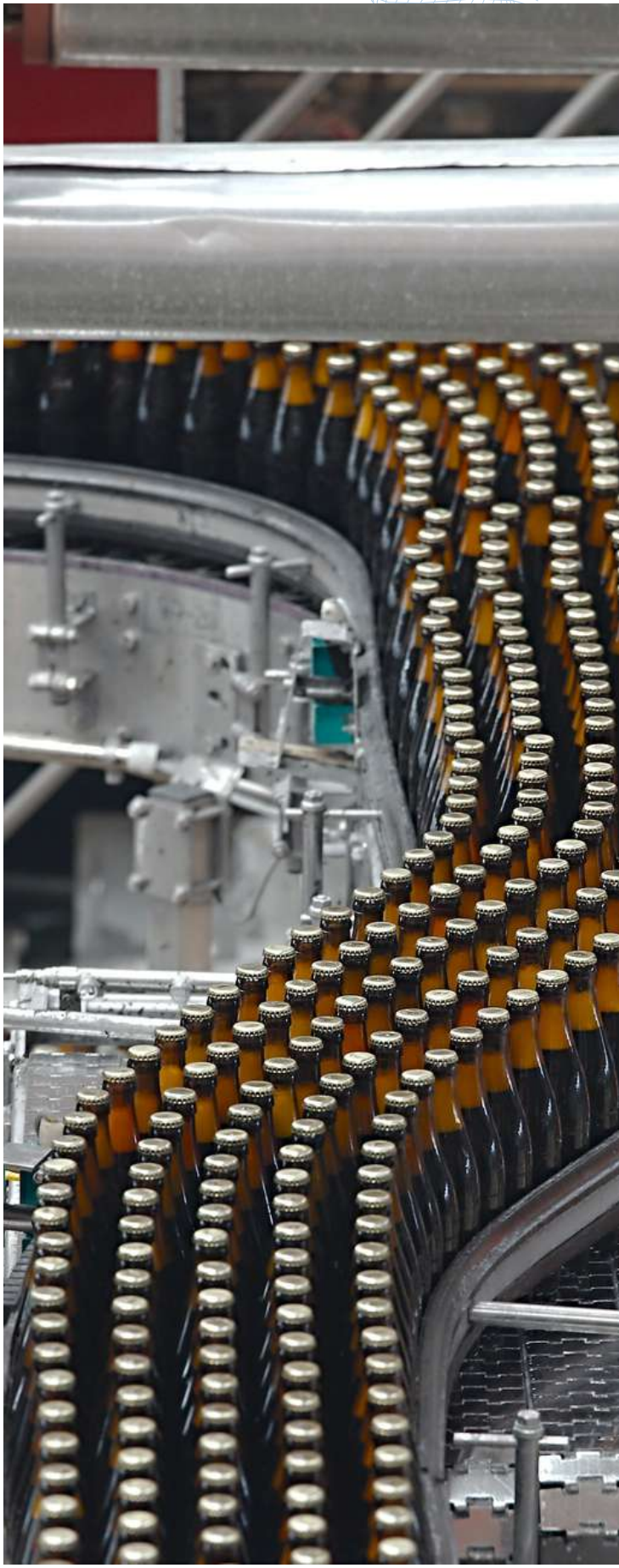
For some of the materials nature, if unplanned shutdowns are not promptly addressed can cause several millions of repair costs. Therefore, predictive maintenance on critical equipment while considering long-range secure communication protocols for large operation sites and assisting maintenance operators with mobile devices is crucial. Moreover, the production site is hazardous and should be regularly audited, and new employees should be trained in a risk-free environment like AR/VR technologies.

Food and Beverage

The Food & Beverage industry, ranging from small to large companies, is eager to embark on and escalate digital transformation efforts. Consumer demands and government regulations require food security and transparency throughout the entire supply chain, from farm to fork. The significance of information flow is emphasized in both company operations and the end-to-end supply chain through integration with suppliers and the service and retail industries.

Evaluations so far show that the product portfolio and production volume, automation level on the shop floor, connectivity of the equipment and systems, and organizational maturity differ tremendously among manufacturers in the Food & Beverage industry.

Collecting product memory details, a paperless factory to digitize data collection from processes, and effective digital customer response management systems with a Single Source of Truth architecture are the most offered use cases. Moreover, improving utility efficiency to minimize carbon footprint, especially in air conditioning and water management systems, are critical.



General Manufacturing

There is a high variance in the General Manufacturing industry due to the differentiation of products. As mentioned in Cement Industry, there is a clear discrepancy between continuous and discrete productions. MEXT undertook the responsibility of technical assistance for assessing the Durable Goods manufacturers in collaboration with BEYSAD (White Goods Suppliers Association), Özyeğin University, and TUSIAD(Turkish Industry and Business Association) within the scope of the Competitive Sectors Program by the Ministry of Industry and Technology.

Given the highly diverse profiles of various industry sectors, more tailored approaches are required to support industry transformation better.

Through deep-dive analyzes, it is evident that the requirements for digital transformation vary significantly among companies. In industries with low variations, such as the cement industry, a viable approach is to identify common challenges and opportunities and to provide incentives and regulations from policymakers and NGOs targeted toward these areas. On the other hand, industries with high variations, such as the Textile, Clothing, Leather & Footwear sector, would benefit from a more tailored approach.

Anticipating the varying SIRI profiles and needs of manufacturers, MEXT conducts special studies for different verticals and collaborates with Digitheta to identify common concerns and opportunities across manufacturers based on the OSA findings. Furthermore, MEXT works closely with organizations such as the Cement Industry Employers' Association (ÇEİS), the Turkish Textile Industry Employers Association, and automotive OEMs to enhance the impact of maturity assessments by providing sector-specific insights and tailored solution packages. The following section will focus on how a Turkish textile manufacturer has leveraged the SIRI program and MMEXTs services to drive digital transformation and execute successful projects.

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SUCCESS STORIES: Karsu Tekstil's Digital Transformation Journey

Karsu Tekstil is a long-established Turkish manufacturer founded in 1973 specializing in yarn production. As a manufacturer with a wide range of export products, Karsu aims to maintain its prestigious brand position by focusing on high-quality and specialized goods, product diversification, and technological innovation.

With a strong desire to transform their facility, Karsu's leadership team decided to execute the Lead framework and SIRI program in 2021 to analyze the Industry 4.0 readiness of its manufacturing facilities and to create an applicable roadmap.

01 Conducting the OSA (2021)

The OSA results for Karsu Tekstil highlighted the key points to consider:

-The maturity profile of the plant was slightly below the 80% Broad Middle average, except for the *Leadership Competency* and *Strategy and Governance* dimensions.

-*Vertical Integration, Shop Floor Intelligence, Enterprise Intelligence, and Inter* and *Intra Company Collaboration* were the prioritized dimensions.

To improve the intelligence level of the plant, process data availability and system interoperability should have been tackled first.

02 Creating a company-specific roadmap

MEXT provided Karsu with a unique digital transformation roadmap with use cases addressing the pain points and prioritized dimensions based on the results of the OSA report.

03 Establishing a use case workshop

Following the presentation of the roadmap, MEXT hosted a workshop with the company to focus on the Machine Remote Monitoring & Controlling use case that was prioritized by the Karsu team. The workshop enriched the discussions on collecting machine data and creating an architecture to harmonize the critical operation inputs from quality and maintenance.

04 Conducting a pilot field study

Karsu decided to begin its digital transformation journey with a pilot after reviewing its OSA results. The company's critical expectation was to visualize machine performance in real-time. The team chose the Single Source of Truth approach for data governance architecture and Machine Retrofitting use case for data acquisition. Karsu selected Digitheta as the solution provider. The pilot study's scope included upgrading the draw frames so that machine data could be collected and an SSOT (Single Source of Truth) architecture connected to the IT stack could be developed.

05 Rolling-out the project

After succeeding in the pilot study, the company decided to scale up the solutions and expand the project scope.

- **The project team embraced the agile project management culture**

The improvement opportunity in Inter- and Intra- Company Collaboration was discovered as a result of Karsu's OSA report. As a result, the project was executed using an agile project management approach, wherein cross-functional teams collaborated to evaluate and deliver client requirements iteratively in short development cycles.

- Several use cases in the roadmap are covered

The machine retrofitting solution in the pilot study has been disseminated to all production lines. A Digital SOP solution is also introduced to improve visibility and control on the shop floor. To manage the collected data by digital systems, KPIs and performance data are visualized using digital dashboards on a single platform designed with Single Source of Truth architecture.

> SIRI enlightened our path for digital transformation to achieve a more transparent and efficient production environment. Our roadmap was predefined before we even started and during the project phase all steps were well-structured and easily integrated.
>
> Volkan SEYOK, Technical Manager, Karsu Tekstil

Conclusion

We intended to represent in-depth and industry-specific insights by generating a Manufacturing Transformation Insights Report specific to Türkiye.

Our analysis revealed that Türkiye has a mosaic profile of digital maturity, with each industry displaying its strengths, limitations, and priorities. Despite these variations, we identified shared concerns throughout the region as a starting point for companies, government institutions, and organizations. Although Türkiye outperforms the global average in enterprise connectivity, significant gaps exist in plant/factory connectivity and intelligence. We emphasized the importance of leveraging data to drive new insights and support real-time decision-making.

Similarly, it is observed that Turkish manufacturers are often behind the global averages in organizational areas. One key takeaway is that Best-in-Class companies, both in Türkiye and globally, have placed a strong emphasis on organizational readiness, supporting our claim that preparing the workforce for future skill sets, and implementing a solid strategy with all stakeholders are critical milestones for a successful digital transformation.

We believe that firms should start by empowering the workforce with an agile mindset and training all levels of the organization on digital transformation. Competence Centers can assist manufacturers with digital maturity assessments, showcasing various technologies and proven use cases, and a vast ecosystem network, all supported by a comprehensive and continually updated curriculum.

As these centers interact with the key stakeholders in various initiatives, they should address lifelong learning for upskilling.

We hope that the insights and critical concerns discussed in this research will inspire manufacturers and decision-makers to take action towards embracing digital transformation.

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Appendix 1

The SIRI's 10 Cost Profiles

Cost Category	Description
Aftermarket Services / Warranty	Describe expenses that the company expects to or has already incurred for the repair or replacement of goods that it has sold. The total expense is limited by the warranty period that the company provides.
Depreciation	A non-cash expense representing the portion of all fixed assets owned by the company that has been considered consumed over an accounting or financial period.
Labour	The sum of all wages paid to employees, as well as the cost of employee benefits and payroll taxes paid by an employer.
Maintenance & Repair	All expenses required to bring capital assets – such as building, infrastructure, equipment, and machinery – back to good working order, or to keep them operating in optimal condition.
Raw Materials & Consumables	Inventory of all component parts currently in stock that have not yet been used in work-in-process or finished goods production. They include both direct materials, which are incorporated into the final product, and indirect materials that are consumed during the production process
Rental & Operating Lease	Costs associated with the use of assets which the company does not own. These include but are not limited to property, plant, and equipment.
Research & Development	All expenses relating to activities for the development or improvement of products or processes, such as product design improvement and production process enhancement.
Selling, General & Administrative Expenses ('SG&A')	All operating expenses which are not directly tied to the cost of making a product. These include corporate, accounting, legal, sales, and marketing expenses
Utilities	Cost of electricity, heat (gas/fuel), sewer, and water used by a factory or plant to ensure the smooth running of both the direct manufacturing process and its surrounding environmental conditions
Transportation & Distribution	All expenses relating to the transportation of goods from one location to another.

Appendix 2

The SIRI's 14 KPI Categories

KPI Category	Description
Asset & Equipment Efficiency	Asset & Equipment Efficiency evaluate a company's capacity to maximize the utilization of its assets and machinery by improving factors including overall equipment effectiveness ("OEE"), the frequency of unplanned downtime, the lifespan of its assets, and unit throughput.
WorkforceEfficiency	Workforce Efficiency evaluates the direct and indirect labor productivity and man-hours spent per task in a company.
Utilities Efficiency	Utilities Efficiency takes into consideration the amount of energy and water consumed, as well as emissions and wastewater produced by a company's manufacturing operations.
Inventory Efficiency	Inventory Efficiency aims to guide manufacturers in minimizing the average volume of inventory required and unnecessary burden stocks, additional costs resulting from higher land and/or building rentals.
Material Efficiency	Material Efficiency assesses a company's efforts to optimize the use of raw materials in its manufacturing process, either by utilizing fewer inputs for the same amount of output or recycling a greater proportion of unused inputs for subsequent production.
Process Quality	Process Quality evaluates ta company's ability to uphold the integrity of the processes within the factory/plant, by minimizing the deviations from the intended parameters and conditions.
Product Quality	Product Quality emphasizes the company's ability in producing a low percentage of defective products – both work-in-process and finished goods – and that all products are manufactured as closely to the target specifications as possible.
Safety	Safety KPI considers the number of workplace safety incidents, ergonomic issues and near misses in the company's facilities.
Security	Security KPI assesses the number of security breaches, the interconnectivity of assets, and the number of penetration attempts in the company's facilities.
Planning & Scheduling Effectiveness	KPIs in this category focus on the manufacturer's level of proficiency to effectively plan and schedule tasks, handle the volatilities of market demand and supply, take on and fulfil orders on short notice.
Production Flexibility	Production Flexibility is where equipment, machinery and computer-based systems can be modified, reconfigured and re-tasked quickly and easily when needed.
Workforce Flexibility	Workforce Flexibility is the ability of a company's workforce to perform a variety of different job functions.
Time to Market ("TTM")	Time-to-Market measures the length of time it takes for a company to conceive a new product, or augment an existing one, and launch it in the market.
Time to Delivery	Time to Delivery is the length of time it takes for a company to produce and deliver the finished products to the end-customers from the initiation of the project or contract.

Endnotes

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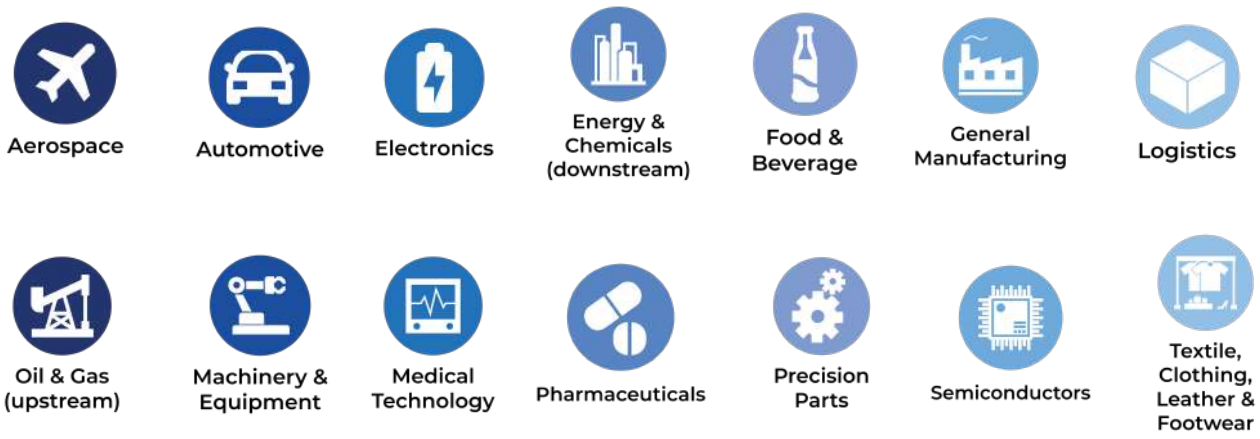
Appendix 3

The SIRI's 14 Manufacturing Industries



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