INDUSTRIAL DIGITAL TRANSFORMATION TOP 25

ARC Special Report
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Digital transformation leaders, across many different industries, share common traits and visions, helping them overcome complex challenges to innovate and stay agile. Industrial innovation continues to accelerate, and leading companies have their transformation initiatives well underway. For those who succeed, the result is a competitive advantage, even during the most difficult global times.

Who are the real leaders in digital transformation? What makes them so?

The ARC industrial digital transformation top 25 highlights companies that are succeeding at integrating digital technology into all areas of business, fundamentally changing the way they operate and deliver value to their customers.

By ARC Advisory Group

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Executive Overview

Industrial innovation is accelerating. Leading companies have their transformation initiatives well underway with digital champions leading designated teams that focus on resilience, disruptive technologies, remote work, autonomous operation, sustainability, the circular economy, climate change, and other critical business-level objectives. We all hear anecdotes about companies that have had success with machine learning, augmented reality, robotics, additive manufacturing, data management, autonomous operations, cloud, edge, IoT, or other core transformational technologies, but who are the real leaders in digital transformation? What makes them so?

Digital Transformation

Leading companies take a strategic approach, integrating digital technology throughout their value chains. Design and engineering, production operations, maintenance, logistics, supply chain, business systems, customers, products, and organizational structure are subject to innovative change as companies examine and update processes and deploy new tools and technologies. With a digital transformation mindset, the core business model by which a company produces and/or offers services to the marketplace can be replaced by new business models that more fully leverage cognitive analytics, digital twins, predictive technologies, or other technologies that enable the company to expand their worldview, embrace competitive excellence as a goal, and thereby move beyond production efficiency to a much more dynamic, responsive, and resilient business model.

We all hear the anecdotes, but who are the real leaders in digital transformation?

Undoubtedly, digitalization in production, whether known as Industry 4.0, IIoT, or Smart Manufacturing, plays a crucial role in opening new opportunities for highly flexible, fast, and high-quality production systems. Such systems can fulfill orders to individual customer requirements. Top companies know that "digital" can't be bolted on – they must intimately weave digital together with their internal and external processes. Traditional organizational silos must be broken down, multi-functional teams must innovate around customers, processes, and employees, and workforce hesitancy must be addressed head-on and overcome.

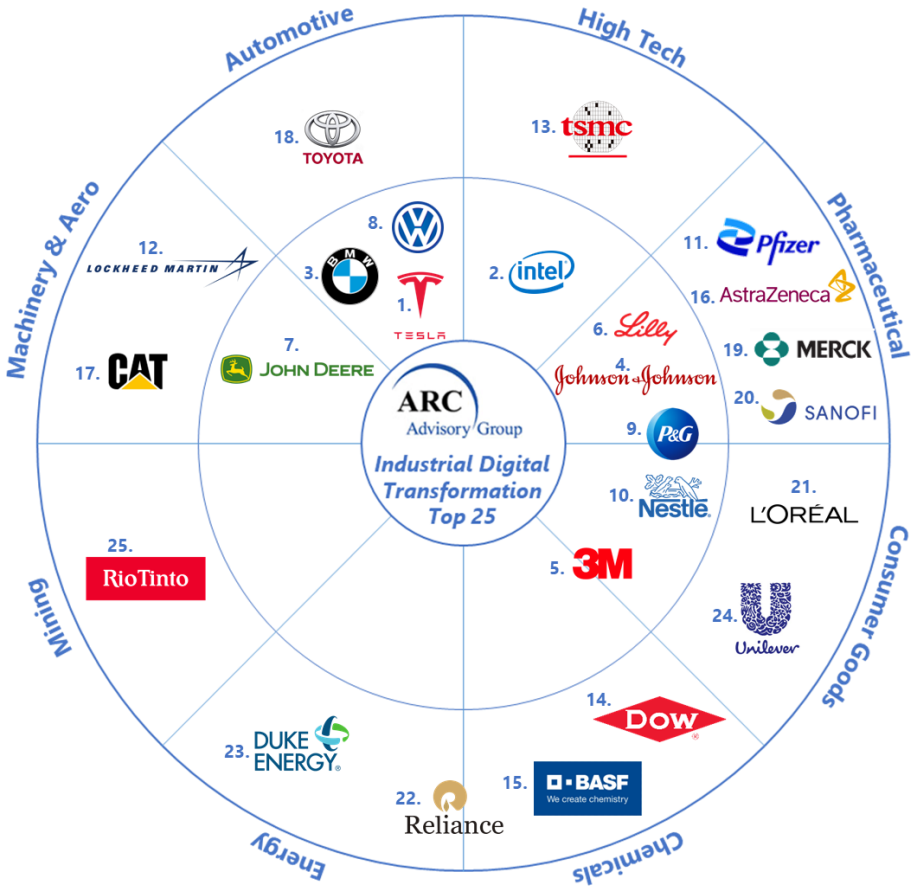
Bold digital strategies may fuel a company's growth as well. Today, some companies are "born digital" and may grow rapidly to overtake existing competitors. These companies are not encumbered by legacy systems, of course, but more importantly, they are unencumbered by legacy thinking and the need to overcome resistance to "the way we've always done it." They can build systems and processes better from the start, and not plan for incremental improvements to eventually achieve top performance.

In one form or another, software is key to digital transformation. For industrial companies, there is a correlation between investment in software and transformational technologies and corporate valuation. Software powers digital transformation, necessity drives innovation, and the whole cycle accelerates year after year. Many leading companies have engaged in this process for some time, but the best organizations understand that the successful, ongoing transformation relies not only on getting the technology right, but also on empowering the right people to guide, interpret, and leverage that technology. The workplace, work methods, and workforce may all need to change, but done well, this can become a powerful source of competitive advantage.

Another massive driver for digital transformation is the pressure companies feel to become more sustainable and significantly change their operations in response to increased pressure from citizens, stakeholders, and governments to address climate, environmental, and circular economy concerns. In fact, these same digital technologies, such as artificial intelligence, are also utilized by shareholders to increase pressure on boardrooms and leadership to quantify sustainability progress. Leading companies recognize that they can't make these changes quickly and effectively – or maybe at all – without substantial digital transformation.

The Top 25 Industrial Companies

This report identifies the global industrial digital transformation leaders. For this research, digital transformation is defined as: "The integration of digital technology into all areas of business, fundamentally changing the way companies operate and deliver value to customers. The organization is typically charged to innovate and improve across multiple dimensions such as: digital/disruptive technologies, culture and leadership, operational agility, workforce engagement, customer experience, environmental, social and governance, and competitive performance." It's not straightforward to identify leaders in such a complex space, but ARC developed a rigorous process



ARC Industrial Digital Transformation Top 25

based on financial performance, a community intelligence based ranking system, and software and sustainability data. Publicly available financial information, ARC primary and secondary research, data from ARC's market database, and the opinions of members of ARC's community of end users were all factored into the determination of the ***Top 25 Industrial Companies in Digital Transformation.*** The result is an analysis and listing of the Top 25 companies together with their scores in various categories, profiles of each of the leading companies, details about the research methodology, and more.

Analysis, Trends, and Findings

The prevailing philosophy behind digital transformation has been that this transformation naturally translates to success. While the notion shows some truth on the surface, a closer look reveals much more complexity.

When looking at the tabulated results of this research, there are some instances where a high or low score or voting results clearly pushed a single company forward. However, looking at the collective results, no single metric, at least at this point, pops out as a key indicator of digital transformation success. In fact, there are instances where what seems like obvious success simply is not obvious upon closer examination, and vice versa.

For example, two companies had contrasting financial performance. One made the list, and one did not. Surprisingly, the company that made the list was the poorly performing one. In fact, it was far ahead of the other in terms of digital transformation core competencies and success. In discussions with the company, it indicated that it was driven to transform by the very market conditions that led to its poor performance. On the other hand, the one that was performing well was lagging with digital transformation, with its strong financial position disincentivizing it from changing.

In another example, the results were reversed, with the market position of the strong financial performer a clear outcome of proactive digital transformation efforts. These contrasting examples are further evidence that no singular indicator, in this case financial performance, leads companies to digitally transform.

One important indicator is the accelerating adoption of software by industrial companies. This metric is captured within ARC's Digital Transformation Index score. While it's true that these companies have been purchasing software for many years, their objectives for doing so (as well as what is being purchased) continues to evolve. Leaders see software-as-a-strategy as a pathway to attain competitive advantage, with digital technologies allowing new levels of innovation, speed, and accuracy. From a shareholder perspective that analysis holds true, as an increasing amount of evidence directly links the relationship between software purchases and industrial company valuation.

Market Signals and Competitive Excellence Galvanize Leaders

For most companies, and this goes for innovators when they started, it is typically overwhelming to determine an effective starting point. Without better ideas on how to develop strong digital competencies, what ARC refers to as "digital wisdom," companies often experience the collapse of their pilots and projects, leading to the internal perception of wasted investment. So, what do leaders seem to be doing differently?

The common thread is *clarity* around a starting point. Effective digital transformation doesn't occur unless the organization connects the change to some external market or customer signals. That starting point is crucial. Innovation leaders focus externally on the market signals shaping their industries, whether specific to customers, competitors, or some new disruption. As a result, it leads them to ask different questions about what motivates the organization to change. Digital transformation occurs when it supports competitive differentiation relative to those signals.

Transformation Requires Culture Change Enabled by Machines and Data

Regardless of how compelling a market signal is, innovators also understand that nothing changes unless company culture is reinvented. The most forward-thinking transformation leaders clearly understand both the importance and challenges of reshaping their cultures, which avoid both risk and change.

Because of these deeply ingrained challenges, these companies emphasize culture change at the executive level, establishing a digital champion leadership empowered to identify and implement change. This change is almost always considered drastic at first, and then it becomes commonly accepted as a standard and the best way of securing the company's ability to compete in digital economies.

As mentioned, these digital transformation leaders begin by identifying critical market signals that compel them to change. They use those signals as a basis for identifying what must change within the organization, how it will change, and what incentives exist for doing so. These include:

- **Emphasis on business outcomes that differentiate**: The company defines ideal outcomes that emphasize speed and accuracy of how a company recognizes and reacts to these external market signals. This provides vision for what needs to change.

- **Transparency of objectives:** Armed with an externally based vision for change, leadership is transparent by communicating what transformation will look like and how it will affect people.

- **Aligned incentives:** By realigning incentives with the vision, transformation leaders can reward transformative behavior. This becomes the lynchpin step for realigning the work culture.

Using this step-by-step process, it becomes evident what people, processes, and data are involved. It also provides clarity on what digital transformation technologies can best be applied to support change.

Transformation Leaders Aren't Afraid to Learn from Others

Engaging in anything transformational requires learning new things and experimentation. Those requirements present overwhelming challenges for industrial companies that are hard wired by controlled and stable operations and transactions. Leaders in transformation understand that inherent contradiction, and they look outward for better ideas. As a result, another consistent characteristic of digital transformation is the presence of strong digital peer groups outside their traditional industrial ecosystems.

Almost all the companies ARC interviewed noted that when they began their journey, they quickly recognized they didn't have all the answers, either within their own walls or market footprint. In fact, their digital champions began by aggressively expanding their sources of wisdom beyond their historic and current resources.

These expanded peer groups always provided return value. For instance, one company was able to make extraordinary leaps in data management and security. In return, it provided a wealth of leading-edge knowledge on transformational ways of managing highly distributed infrastructure.

Success Is Occurring in Pockets, with Leaders Establishing New Competencies

Despite considerable progress, a dose of reality is helpful, particularly for those companies still trying to find a foothold. Apart from businesses that began with transformation as part of the mission statement, no comprehensively transformed company exists.

Transforming to an organization where constant change and adjustment define normal operations is still very conceptual for most industrial companies. In light of that, leaders focus on identifying and growing those initial digital

transformation core competencies that will clearly support competitive excellence.

As a result, these companies typically have established some specific competencies that are well ahead of peers. At the same time, they still struggle in many areas of the business and operations. In fact, they might still have certain aspects of their operations that look relatively primitive when compared to others. That is the nature of digital transformation now, where pockets of innovation occur with new digital competencies that will aggregate to establish fully transformed organizations. Even the leaders will be on this journey for some time.

Sustainability: The Next Major Disruptor

There are two major issues that are keeping industrial executives up at night. As mentioned earlier in the report, the first is maintaining a competitive workforce. The second, and certainly not in secondary order of importance, is sustainability. For industrial companies, sustainability is connected to business and industry survivability based on entrenched and intertwined socioeconomic, political, and cultural roots. It will be the defining business issue as pandemic concerns stabilize.

One remarkably consistent piece of feedback we received was a nod to the important role AI will play in both measuring and meeting sustainability goals. There was wholesale agreement that AI would enable industrial companies to overhaul how they align operations to improve sustainability, and this notion extends into supply chains, it should be noted. Energy efficiency, emissions reduction, leak detection, sourcing, scrap and waste, and similar issues were all noted as obvious places where AI can improve sustainability efforts.

A few also noted the role AI will play on the investment side, based on the immense pressure being placed on industrial companies to re-examine every aspect of their business and operations. In terms of boardroom accountability, AI is replacing humans in poring through the immense data available to track sustainability. This includes new applications of the technology, such as sentiment analytics. The findings produced via AI are then being used to shift policy, investment, and resources toward more sustainable business models and technologies.

ESG Compliance

We are in a critical time of action on climate change. The 2021 United Nations annual climate change conference, COP26 (Conference of Parties) climate agreement and the latest Intergovernmental Panel on Climate Change (IPCC) report, call for action on climate change pointing to irrefutable degradation across the Earth's climate system, atmosphere, oceans, ice floes and on land. This, combined with a shift in corporate mindsets following the past two years of pandemic, is reshaping industry, sparking innovation, and accelerating transformational technological change throughout the sector. COP26 has arguably resulted in the most ambitious international climate agreement to date. Though we still can expect to see 2.4°C warming, all participating nations did agree to return to COP27 with more aggressive goals.

Importantly, the financial community is moving ahead aggressively because climate change is seen as a real a risk to the global financial system. The Glasgow Financial Alliance for Net Zero (GFANZ), a global coalition of leading financial institutions committed to accelerating the decarbonization of the economy, committed to drive their portfolios to net zero by 2050. GFANZ looks after about a third of the world's assets ($130 trillion). This acceleration will pressurize industrial companies that will increasingly embrace digital transformation in response.

A related development from the COP meeting is the announcement of the International Sustainability Standards Board (ISSB). The ISSB intends to standardize environmental, social, and governance (ESG) reporting and integrate climate disclosure with financial disclosure. Instead of today's voluntary and often misleading carbon disclosure, company financial reports will feature audited and assured emissions, climate policies and forward-looking statements. New AI, analytics, tracking, software, and management systems will be needed to develop and report about a company's carbon footprint.

Top 25 Companies

The top 25 companies are representative of multiple geographies and industries. They share a common thread of leveraging digital technologies to transform business capabilities and outcomes, giving them a competitive advantage during challenging global circumstances. While some shifted their digital transformation efforts during the pandemic, all had some level of preparation prior and have an eye toward the future. For them, digital transformation is not an option, it is a necessity to survive and thrive.

Company	Rank	Profitability as % of Revenue	YoY Revenue Growth	Return on Assets (ROA)	Profit per Employee ($USD)	Community View	ARC Analysts View	ESG Score	Digital Transformation Index	Score
Tesla	1	2.2%	28.3%	3.8%	9,752	1231	485	57	44	689
Intel	2	26.8%	8.2%	15.5%	188,960	822	487	90	37	676
BMW	3	4.1%	-6.7%	2.5%	36,577	1051	573	85	44	656
Johnson & Johnson	4	17.8%	0.6%	9.5%	109,398	829	289	91	59	594
3M	5	16.7%	0.1%	15.3%	56,681	924	261	92	30	578
Eli Lilly	6	25.2%	9.9%	16.3%	176,963	400	358	65	59	569
Deere & Company	7	7.7%	-9.5%	6.8%	39,526	730	395	73	51	552
Volkswagen	8	4.1%	-13.4%	2.8%	15,358	411	547	88	44	541
Procter & Gamble	9	18.4%	4.8%	13.5%	131,586	633	261	72	45	541
Nestlé	10	15.9%	-7.2%	11.9%	50,628	624	266	87	60	538
Pfizer	11	22.9%	-19.0%	5.6%	122,497	728	307	66	59	527
Lockheed Martin	12	10.4%	9.3%	17.4%	59,939	374	249	78	54	515
Taiwan Semiconductor (TSMC)	13	41.3%	28.3%	21.3%	324,413	222	58	87	37	514
Dow Inc.	14	3.2%	-10.3%	4.8%	34,062	797	314	82	30	514
BASF	15	-1.9%	-2.1%	-1.3%	(11,734)	686	358	86	30	510
AstraZeneca	16	12.4%	12.4%	7.4%	44,452	568	113	94	59	509
Caterpillar	17	7.2%	-22.4%	6.5%	30,812	656	349	68	51	496
Toyota Motor	18	7.0%	0.0%	4.9%	53,578	554	261	78	44	494
Merck & Company	19	14.7%	2.5%	9.0%	95,500	319	229	82	59	488
Sanofi	20	35.8%	-2.5%	12.5%	151,243	238	157	92	59	487
L'Oréal	21	13.8%	-8.0%	11.1%	50,952	608	148	85	45	476
Reliance Industries	22	6.2%	2.9%	6.3%	26,696	527	238	80	31	476
Duke Energy	23	5.8%	-4.8%	3.1%	50,009	314	397	64	42	474
Unilever	24	11.4%	3.1%	12.7%	45,499	423	143	92	45	473
Rio Tinto Group	25	22.6%	6.4%	16.3%	217,685	240	222	71	30	472

The ARC Industrial Digital Transformation Top 25

Notes

1) *ARC Analysts View* and *Community View* based on each panel's -rank ordering of candidate companies against the definition of Industrial Digital Transformation. (weight 18.5% each)
2) *Profitability as a % of Revenue* = Profit/Revenue (weight 10%)
3) *Year over Year Revenue Growth (%)* = Change in revenue from year to year. (weight 20%)
4) *Return on Assets also known as asset profitability (%)* = EBIT/Total Assets (weight 7%)
5) *Profit/Employee* ($) = Profit/total number of employees (weight 7%)
6) *ESG Score*: Index of environmental, social and governance measures of commitment, transparency and performance. Combination of third-party data and ARC analysis. (weight 9.5%)
7) *Digital Transformation Index*: Based on ARC proprietary database of technology and industry revenue and growth. (weight 9.5%)
8) *Score* = (Profitability as a Percent of revenue x 10%) + (Year-over-Year revenue growth x 20%) + (Return on Assets x 7%) + Profit Per Employees x 7%) + (Community View x 18.5%) + (ARC Analysts View x 18.5%) (ESG Score x 9.5%) + (Digital Transformation Index x 9.5 %)
9.) All raw data normalized to a 10-point scale, prior to computing final score.

The Top Ten Companies

The top 10 companies stand out for showing substantial progress in transforming their culture, adopting technologies, and embracing digital transformation to enable business outcomes. There is no universal recipe for success and no single company has everything figured out but these companies, while not perfect, are pushing full steam ahead.

1. Tesla

Some may argue that Tesla started out as a transformative company rather than one that has recently transformed, given that its intent was to disrupt the automotive industry. The company's growth has been fueled by several bold digital strategies. Founded in 2003, the company's message from day one was not that an electric car could be good but that it could be better.

Tesla's fundamental philosophy internally and externally is to shift perception. Prior to Tesla, the market perception of electric vehicles was a slow, ugly juiced up car with little range. Tesla shifted this perception to one of being a sleek high performance and accelerated mode of transformation. This same strategy is used inside the organization to gain buy-in for digital initiatives and process. For example, when Tesla sets out to automate its internal processes, they try to build it better from the start rather than start a clunky project and hope to get better on revision 4 or 5. This orientation is fundamental in determining what KPIs the company values, as many of them are far different from metrics managed by manufacturers relying on traditional views of success.

By showing value from the start and having internal stakeholders support initiatives, internal employee resistance is minimized. As ARC sees it, this is an example of a company that is comfortable with digital transformation and adapts to business challenges with greater ease quickly. Tesla's digital connectivity has allowed the company to deliver more value to consumers. Their business model is built on the tenet that the vehicles are more like interactive computers with wheels, leading to the creation of an intelligent data platform and connected ecosystem, enabling Tesla to learn from and serve its customers.

In Q3 2021, Tesla has publicly stated it plans to grow manufacturing capacity as quickly as possible. Over a multi-year horizon, Tesla expects to achieve 50 percent average annual growth in vehicle deliveries. This rate of growth will

depend on Tesla's equipment capacity, operational efficiency and the capacity and stability of the supply chain.

2. Intel

Intel's semiconductor manufacturing process runs 24 hours a day, 7 days a week, 365 days a year. Digitally transforming its manufacturing operations around connectivity and IoT have fundamentally changed the way Intel runs its day-to-day business – from the types of products and services produced to how they are delivered. While automation has been used for several decades inside the factories, real improvement and transformation has come from the deployment of widespread IoT and predictive analytics at scale, which have demonstrably decreased time to market, improved resourced utilizations, increased yields, and reduced costs.

Intel focuses on connecting data insights directly with engineers who can focus on solving problems, with an emphasis on designing solutions instead of extracting data. Digital twin and simulations help optimize the factory output. Even though the company focuses on technology, it is an ecosystem play, not just one technology that delivers a full-blown solution. For Intel, it is the combination of the people, the culture and technology all together, that defines its digital transformation. Intel is also committed to corporate responsibility and sustainability throughout their entire business.

3. BMW Group

Digitalization in production, also referred to as Industry 4.0, opens new opportunities for the entire BMW Group production system – enabling fulfilment of individual customer wishes and enhancing the flexibility and quality of production processes. The BMW Group is pressing ahead with digitalization of its production system in the following technology clusters: Smart data analytics; smart logistics; innovative automation & assistance systems and additive manufacturing.

BMW has been taking the next step in the systematic integration of additive manufacturing by scaling up to industrial levels for vehicle development and production. By additively manufacturing metal and polymer parts at various points in the process chain and different sites across the global network, the company has transformed its production process. Looking toward the future, BMW is investing hundreds of millions of dollars over the next five years as it looks to create a seamless digital experience for customers.

4. Johnson & Johnson

Johnson &Johnson's digital strategy includes cross-functional partnerships and a new culture around its digital tools, company-wide. Emerging as a leader in 3D printing, IoT and automated order fulfillment, the company is using artificial intelligence as part of their product development. IoT is being used to track and trace products throughout the entire supply chain, from manufacturing to distributors and to medical facilities such as hospitals. Getting access to real-time information has helped manage inventories, anticipate product demands, and drive high-value manufacturing decisions. In addition, knowing where a product is and whether it is being maintained a proper way (such as temperature control for a vaccine) provides a higher level of quality assurance.

J&J is heavily invested in data science starting with its Data Science Council. The goal of the council is to use data to validate the decision-making process to make a positive impact. The council is made up of members from supply chain, R&D, finance, and HR. Artificial intelligence initiatives are enabling the company to continuously create breakthrough drugs and surgical solutions.

5. 3M

3M has four business groups, 22 operating divisions, 51 technology platforms and tens of thousands of products sold in 200 countries. As part of internal operations, they have connected 240 plants, distribution centers and enabled capability to monitor the flow of products. The company used to operate autonomously in the local country subsidiary structure, but now their digital transformation efforts are driven more to alignment and standardization.

3M uses technology to monitor operations data to streamline, optimize, improve, and accelerate their entire workflow. The company uses data to change the customer experience – becoming more interconnected and able to do business in real time with customers. 3M is using an artificial intelligence platform to develop and deploy AI-based applications with predictive healthcare and supply chain analytics to better serve customers with more agility and efficiency. Data analytics, culture and prioritization are the three enablers driving a robust transformation effort within 3M.

6. Eli Lilly

Eli Lilly's mission is centered around making medicines that make life better for people around the world, and to do that with safety first and quality. They see the digital plant as a way to accelerate improvements. For example, the company reduces ergonomic risks by using robotics for lifting boxes and ensures quality through real-time analytics rather than after-the-fact testing. These technologies also drive cost efficiencies.

The digital plant and technologies that go along with digital transformation, such as robotics, data analytics, artificial intelligence (AI), and the industrial Internet of things (IIoT) - promise greater efficiency. Eli Lilly has been advancing in applying these technologies to its pharmaceutical manufacturing organization, which the company claims has enabled it to make better medicines. The company established a role dedicated to corporate global reliability, which involves helping silos to communicate, making them more comfortable, not always leading but at least interacting.

7. Deere & Company

John Deere uses digitalization to create more dynamic logistics and production planning, improve the visibility and accuracy of materials throughout the global supply chain and add the ability to customize real-time user instructions. Deere's digital transformation starts from product designs and continues all the way through supporting the customers. Deere is not a newcomer when it comes to innovation. More than 25 years ago the company created its Intelligent Solutions Group (ISG), an internal innovation hub consisting of data scientists and engineers. The goal of this team is to develop and roll out advanced technology solutions and processes across the business.

Deere has continually transformed itself to be more agile and project based. In 2020 the company upped its investment to fuel its 5G and manufacturing and 4.0 ambitions. In addition to powering a new suite of high-performance computing analytics, 5G will enable the adoption of edge computing and autonomous devices as well as a larger set of smart applications like real-time locations systems, asset tracking inventory management, wearables, production automation and robotics.

8. Procter & Gamble

P&G has a goal of 100 percent digitization of all its activities: Collaboration among employees, evolution of new products, improved production systems, supply chain & distribution optimization, and customer relationships are at the heart of their transformation strategy. True to its innovative nature, P&G sees data and algorithms as a way to constructively disrupt how it operates, leading to growth. P&G has developed a multi-cloud driven data strategy and data culture that informs every decision of the business. Artificial intelligence, machine learning, and advanced analytics are all seen as crucial to becoming a true digital leader.

9. Volkswagen

Volkswagen has invested heavily in its digital transformation roadmap creating new digital jobs, agile working methods and improved IT processes. The guiding principles adopted in the companies "Future Pact" and digital transformation roadmap govern the strengthening and internal transformation of the workforce and creation of jobs in forward-looking areas. Volkswagen aggressively puts measures in place to pursue greater productivity and production. The company established the overarching framework "TRANSFORM.TOGETHER" to realize its production goals.

One key area of focus is driving automation in assembly by increasing the use of robots, particularly in less ergonomic jobs. Volkswagen also uses computer vision to increase manufacturing efficiency at its factories. The process extracts information from optical data at the plant and then evaluates using artificial intelligence in recognizing, processing, and analyzing images, resulting in significant energy use and cost cutting – as cited by the company.

10. Nestlé

Digitalization covers all aspects of Nestle's business from internal organization to external engagements. The company is advancing as a digitally enabled data powered business. Digital transformation is business-led and consumer-centric. This includes using analytics, automation (all factories are equipped with collaborative robots), artificial intelligence and e-business. The IT organization is part of the digital transformation program delivering value to the business, rather than simply IT systems and services that meet operational targets. Nestle's digital transformation strategy is known as Vision2Life and has four key priorities: bring value to the people who receive

IT services; operate as one global IT team but with local expertise; interlock product management with business stakeholders; and make IT a technology differentiator not just a provider. Their transformation exists in several ways including leadership, culture, technology and ESG. Everyone from procurement, manufacturing, sales, and marketing are involved. Nestle supports over 1 million transactions a day across thousands of applications globally and locally. Digital transformation at Nestle is about business outcomes: increasing capacity, decreasing cost, increasing product innovation and availability of goods. Empowering people with information to make faster decisions is at the core of Nestle's culture.

Companies 11-25

11. Pfizer

Pfizer's CEO defines the company's mission as driving breakthroughs that change patients' lives. As part of that mission, they have embraced digital business transformation to become a leaner, more science-driven patient-focused organization. Three strategic initiatives include the application of digital technologies to speed up discovery and development of medicines and vaccines, enhance patient customer experience and outcomes, and make work faster and easier through the application of automation. Pfizer understands that the age and size of the company tends to foster a mentality of people stuck in the old way of doing things.

To address resistance, the leadership keeps employees engaged throughout the process, solicits their feedback, and provides support along the way. They highlight tangible outcomes during the transition, often gaining proponents of a new way of working. Pfizer, despite being in a highly regulated industry with strict compliance requirements, is an early adopter of cloud technology, and focuses on making sure cloud deployments are as secure, if not more so, than their traditional datacenter environments. The company states this early investment in cloud played a key role in enabling Pfizer to move at the speed required in response to the Covid-19 pandemic.

12. Lockheed Martin

Lockheed Martin is transforming across its entire business to deliver the speed, agility, and insights to its customers. The company is adopting disruptive innovation in their processes, technology, and tools to drive faster deliveries, agile responsiveness, and data-driven insights for their customers. A few key concepts define Lockheed's strategy. The first is digital engineering – model-based engineering, optimizing design and links design, manufacturing, and sustainment teams on a common digital thread to save costs and speed program lifecycles. Second, next-generation software is enabling fast and continuous development. Additionally, digital enablement by investing in process reinvention and business system modernization. Technologies such as 5G networking, cloud, and artificial intelligence provide the foundation for Lockheed's continuous transformational capabilities. Data is viewed as strategic asset and AI-powered predictive analytics is used to glean insights that advance performance from factory to the field.

13. Taiwan Semiconductor Manufacturing

With the advent of Big Data, TSMC gradually shifted toward information-oriented innovation and revamped its decision-making process based on the idea that "everyone is a decision-maker" in a bid to improve its response time and the quality of strategic decisions. It also established an IC design ecosystem ranging from "virtual fabrication" to "open innovation" platforms. Just as the acceleration in digital transformation has made semiconductors more pervasive and essential in people's lives, it has also brought a focus on internal innovation in the semiconductor industry. TSMC has fostered innovation through active collaboration with partners collaborating, developing and optimizing across process technology, electronic design automation (EDA), IP and design methodology. The company also scores high on social governance and is continually improving its emissions and resource use as part of environmental efforts.

14. Dow

Dow's digital strategy is to move from simply being a chemical company that "does digital" to becoming a digital developer of new materials. The company's manufacturing Industry4.0 initiative revolves around customers, employees, and processes. Breaking down traditional organization silos between OT/ET and IT organizations and building an environment of trust, cooperation, benchmarking, and free and ongoing collaboration led to the

creation of a joint innovations team which has been paramount to success. Additionally, the company developed the Dow Digital Operations Center (DOC) which brings together the deep domain expertise resident across the company.

A few examples of the new digitally enabled capabilities developed at the DOC include using drones and robots to help make Dow a safer place to work and enhance the quality of inspection work. Virtual reality is used to help engineers solve problems early and with lower risk. The company has also rolled out innovations that help to track both people and equipment better. Culturally, the transformation vision is woven throughout the company from it being a line item on the financial books, to the CEO, and to every business unit; some have a digital transformation leader who reports to a business president.

15. BASF

BASF takes a holistic approach to digitalization with the use of technology being used to solve concrete issues that translates to business outcomes. For BASF, digital is a tool to make the business better and the company invests in the company culture to make sure the tools are put into use. BASF strives for its vision to make digitalization an integral part of its business to create additional value for customers, grow the business, and improve efficiencies. The company is using digital technologies to integrate the supply chain with customers, suppliers, and partners. Climate protection is a crucial component of the corporate strategy.

16. AstraZeneca

AstraZeneca moved from doing digital to being digital. Its digital factory is enabled by artificial intelligence, image recognition, IoT, robotics, automation, and digital twins. The company built a connected infrastructure of digital and innovative tools to transform, streamline and optimize how they work internally. Some examples include an insight platform or what is called a "control tower" that uses visual analytics to guide decision-making, giving leaders and colleagues real-time access of any study including AI predictive timelines. Data and analytics optimizes and automates study design, planning and management of clinical trials.

17. Caterpillar

Caterpillar looks to innovation as a tool to improve business and how customers engage with Caterpillar and their dealers. The strategy is viewed in layers. The first is connectivity. The second is a digital platform that ingests and transforms data using advanced analytics. The third includes applications to make interacting with customers easier. The company touts several groundbreaking innovations, one of which is their several years of data collection being used to develop proprietary machine learning models that predict unplanned downtime for machines and rebuild schedules for main components. The company looks at its digital transformation as a journey comprised of five key steps: Drive digital transformation from the top; define digital vision; develop a digital strategy; create a digital roadmap; and build a digital organization structure.

18. Toyota Motor

To enable agility and scale, Toyota created a digital transformation and mobility pillar, integrating teams who focus on new business innovation. From a technology standpoint, the company demonstrates transformation in many ways. The first way is in transporting anything that needs to be moved from one place to another. The manufacturing line is optimized to reduce the distance of transport and to increase the use of factory automation.

Additionally, Toyota utilizes artificial intelligence in the inspection of defective products to reduce the amount of human labor. With advanced machine learning the company is transforming to make essential improvements that are preventing defects from occurring in the first place. IoT is used extensively to monitor every detail of the status of equipment and production lines. The company has laid the foundations for carbon neutrality and green factories.

19. Merck & Company

Merck's three key business sectors - healthcare, life science, and performance materials - develop strategies to drive new product developments for the benefit of patients and customers. The company identifies innovation projects with the goal of moving beyond their current portfolio, from initial idea all the way to functioning business model. The company has been investing in a number of technologies, including IoT and artificial intelligence to improve the performance of its laboratories.

In addition to its process-oriented digital transformation elements, Merck is also working on stealth digital strategies, or open standards. These efforts include working with standards organizations for easier integration into the company's manufacturing and laboratory activities. A strong proponent of standards, Merck believes that by deploying, engaging, and adopting more standards it will drive productivity into the organization.

Culturally, the company has an Innovation Committee (IC) that oversees the implementation of innovation projects both between and beyond its business sectors. It ensures that the decision-making process for selecting innovation projects is transparent and consistent.

20. Sanofi

Sanofi aims to bring digital transformation to every aspect of the company. For example, it partners with big data companies to generate predictive patient insights. The company opened its first digitally enabled continuous manufacturing facility among several pilots that are being accelerated across the Sanofi network. The innovations at this facility, which is the company's first "digitally born," have been deployed and are being standardized across other legacy plants.

The new facility features leading-edge technologies that connect the production process with research and development, reducing the time it takes to commercialize new medicines. Collaborative robots (cobots), work alongside employees to monitor operational safety. Autonomous mobile robots transport raw materials and finished products. All the upstream and downstream operations are carried out with intelligent equipment. Sanofi also displays a firm social commitment to fight against disease alongside reducing the environmental impact of its operations worldwide.

21. L'Oreal

L'Oréal has become a "Digital First" company, finding new ways of building relationships with customers, and developing new products and services. It accelerates product development by use of 3D printing, digital simulation, and connected assets. As with most consumer-packaged goods companies, marketing, sales, and product development divisions had been largely distinct silos within the company. The first step toward integrating digital transformation into the business model was redesigning the organization to align objectives. The company also recruited approximately 1,000 employees

with digital capabilities and appointed a chief digital officer to address increasing environmental and social concerns for the future.

22. Reliance Industries

Well before the pandemic, Reliance industries was an early adopter of remote monitoring processes, technology, and distributed work for their plants. As an early adopter, they were quick to extract monitoring from plants and centralize it so that their best subject matter experts could view performance more holistically. While best practices are now evolving to decentralizing remote monitoring, their early identification and adoption of these processes demonstrates forward-thinking, particularly at the time it was done. As a result, when the pandemic hit, they had already well-established teams and vetted processes in place that many other manufacturers were forced to develop and test on the fly.

Reliance Industries' digital manufacturing platform provides real-time business insights to end users. The company aims to co-host all the solutions within the digital manufacturing platform along with innovative digital technologies to drive business objectives and outcomes. Reliance's leadership culture and applications of new technologies and data analytics have been applied to consistently improve process safety.

23. Duke Energy

Recognizing the need for digital transformation in this new era, Duke Energy proactively launched Lighthouse, an employee-driven digital transformation program in 2018, to unlock and accelerate innovative ideas and solutions across the enterprise. A core component of the initiative was an innovation space that connected IT and business units. The goal was to embrace innovative technologies, new ways of thinking, and to prioritize digital objectives to create smart solutions for the company and its customers. The more recent objective is to deliver cleaner energy systems that are more distributed, intelligent, and mobile.

A sizable portion of transformation involves data including information from artificial intelligence to help drive innovation. For example, drones, sensors, smart meters, and cameras are tools that help generate data leading to better insights for the company, resulting in positive outcomes. There are three main areas of focus for transformative outcomes: assets, operations, and the experience created for the customer. For example, collecting data to

undertake predictive maintenance on equipment makes the operations and the process more reliable.

24. Unilever

Unilever actively digitizes all aspects of their business to leverage data and increase digital capability in everything they do. For example, artificial intelligence is used to predict demand, co-create new brands with consumers, and to target customers precisely with the specific products they want. The company has also invested in IoT, robotics and augmented reality. Unilever views digital transformation as a necessity, not an option, to overcome the market challenges faced by consumer goods companies. Unilever uses big data to bring the "right" products to market faster. A cultural transformation underpins the success of digital transformation, and Unilever invests in a skills transformation program across the entire organization.

25. Rio Tinto Group

Rio Tinto's Mine of the Future program aims to equip frontline employees with intelligent tools that allow them to make decisions that improve performance based on contextual knowledge. Rio Tinto's approach is multi-faceted, meshing together technology, employees, and partners. The company has partnered with Caterpillar to supply and support mining machines, automation, and enterprise technology systems. Automation augments the job of the human and creating opportunities for staff to develop their skills to support a digitally transformed company.

Fully integrated mine operation and simulations systems fueled by digital twin technology and artificial intelligence combine data from actual processing plants with historical information. This gives the team in the field and at remote operations centers the ability to access the same information and make decisions in a fraction of time -sometimes a matter of minutes vs. hours or days. Business outcomes are measured through enhanced safety and productivity. which turns into profits. Smart mining is truly transformative, using information, autonomy, technology to obtain enhanced safety and productivity while reducing costs.

Companies of Note

Many noteworthy companies fell out during our initial screening process criteria, typically due to minimum annual revenue requirements, but a few have been identified as leading digitally transforming companies worth mentioning. ARC identified the following five companies based on their demonstrating many of the same characteristics of successful transforming companies in the top ten.

AB InBev

InBev has a comprehensive strategy for digital transformation at scale. First, the company aims to understand the customers' pain points. Before embarking on a solution, a clear identification of the problem trying to be solved is a must. For example, one such problem is solving last-mile delivery with customers asking for small batch sizes and more frequent delivery drops, with autonomous vehicles. The company uses artificial intelligence to predict churn rate and build orders.

Digital twin technologies are used to simulate the brewery processes. The company aggregates a net promoter score data to understand customer pain points, which then translates to optimizing operations from logistics to transport to marketing. Second, the company acts in an agile way to be product-based rather than project-based. Internal development operation teams have been developed and squads of champions exist within the business units and technology teams. Workers are either hired with appropriate skills or reskilled where needed. Innovation at InBev is viewed as a capability not a separate function as ingrained through the organization leading to its success.

Codelco

Codelco's digital transformation business outcomes revolve around analyzing data to respond in real time and better coordinate operations. Through digital transformation efforts, it is addressing its continuous production process, the automation of an inherently manual industry, the safety of the mine, and remote access control. The company understands that technology is not just plug and play but is a tool for a greater goal of reducing costs, increasing competitiveness, and increasing safety. Codelco has created a corporate culture that embraces digital transformation by creating a team effort to

understand how one action could affect an entire business process. Starting with specific operating centers, IoT and data analytics are applied to showcase a demonstrated increase in production. The goal is to roll this out over time to all divisions. Innovation hubs and piloting centers have been key to helping reduce risk aversion and facilitate testing under real world conditions.

E.J. Gallo

Innovation is at the heart of Gallo's values, continuously challenging the conventional way of doing things to remain relevant. The company is highly vertically integrated, owning the vineyards, the sand mines, manufacturing production facilities and glass manufacturing. As part of the company's digital transformation efforts, IT is a strategic partner to the business functions being supported and is relied upon to develop and deliver competitive differentiation in operational processes. This is in addition to the traditional function of managing technology systems of records. By providing direction and influence across commercial-facing functions, the back end, manufacturing, the supply chain, and agricultural portfolios are evolving into a combined horizontal and vertical approach.

Gallo has shifted IT from a fundamental cost play to one that adds capabilities to the business and identifies potential new business models. For example, the grower gateway, provides on-demand access to a vast library of digital resources. It is a "capabilities-driven" business model rather than a revenue driven business model. The gateway interacts with distributors' sales forces to sell wine more efficiently through a mixture of data analytics, business intelligence and machine learning. The CEO supports innovative efforts and talent is recruited based on an innovative mindset.

Georgia-Pacific

Georgia-Pacific produces wood products, paper, pulp, and related chemicals for a wide range of products serving customers in more than 75 countries globally. In industrial circles, Georgia-Pacific is often held up as an example of how market urgency can galvanize a traditional company to change fast and well. Its mantra for digital transformation is to make it easier and faster for its customers to do business with the company. That ideal has driven massive change in how Georgia-Pacific operates. It went all in on its transformation when most companies were still educating themselves about what needed to change and/or were gingerly testing the waters through very

limited technology pilots. With its mantra informing its key team of visionaries, Georgia-Pacific first identified and eliminated what it termed "impedences" that added cost or time to customer fulfillment. That led the company to revamp its supply chain (by insisting on supply chain transparency), develop new incentives for plant performance, rethink customer engagement, and identify and secure the key subject matter experts that underpinned its competitive intellectual property. In going through this process, the company very clearly understood what digital transformation technologies were of value to them and how they could deploy the best mix of off-the-shelf and internally-developed solutions.

Georgia-Pacific has pioneered the development of two key systems that manage a great deal of the competitive advantage they have developed via digital transformation. Cognitive analytics and the dynamic use of machine learning are central to these solutions. From the beginning, Georgia-Pacific clearly identified the desired business outcome they needed to achieve through transformation. The company continues to identify and eliminate as many manual and low-value tasks as possible. Georgia-Pacific also has developed "digital companions," which help its people focus on higher value work that improves the customer experience while also delivering the best business outcome for the company.

Owens Corning

Owens Corning's strategy is centered around operations sustainability, product and supply chain sustainability, innovation, and collaboration to deliver energy efficiency and durable material solutions at scale, and employee safety, health and engagement and community vitality. In order to drive innovation, the company focused on cultivating its executives with skills akin to transformation efforts. The company is a leader in using data and analytics as a foundation to providing best in class products, manufacturing technologies and sustainable solutions for customers. For example, the company relied on a digital twin of the roofing material production process from raw material to finished product to conceptualize their product line and identify and resolve variability. The company has a robust corporate responsibility and ESG program in place to enable expansion of products while reducing environmental footprint and increasing its social handprint.

Digital Transformation Occurs in Every Industry

Some industries experience a greater resistance to change centered around their manufacturing processes that can make transformation slower, more difficult, or less obvious. This can be seen in industries where the manner of production has not effectively changed for the product in decades. These industries can include chemical manufacture, electrical generation, oil and gas production and processing, mining, etc. Regardless, ARC has witnessed digital transformation occurring in these industries, as well. Companies in these industries continue to wrestle with moving from applying technology to accomplishing the same tasks to transforming how business gets done in more efficient, more sustainable, and more precise ways. In some cases, pilot programs utilizing enabling technologies in various areas are underway, but the scaling of such programs across the organization have yet to occur.

New digital technologies combined with data-driven insights can transform operations, boosting agility and strategic decision making, resulting in new operating models. Applying integrated digital platforms enhances collaboration among ecosystem participants helping to fast-track innovation, reduce costs, and provide operational transparency.

The ARC DT Top 25 Team

This report is the fruition of an idea that matured over several years, spurred on by the many experiences with end users, their challenges, and research by ARC team members. These experiences were provided by both leaders and laggards in industrial innovation. End users commonly ask, "what separates success from failure?" ARC began to study the characteristics of success and created the ARC Industrial Digital Transformation Top 25.

As the report came together, several key findings were uncovered. Primarily, the research and data confirm trends that ARC has uncovered and documented for the last 5-7 years. These trends lend credence to the ARC conclusion that digital transformation is not occurring in a straight line.

That is, industrial innovation is typically a messy process. No single route to success exists. Data and technology are enablers, not launch points. Instead, those launch points come from creative problem solvers who, when faced

with intense market disruption, decide that the old way of doing things simply won't suffice.

ARC tapped its global analyst community to contribute to and support various aspects of this report. This included developing suitable metrics, acquiring the necessary financial data, identifying regional companies strong in digital transformation, and more.

The core report team consists of the following analysts:

Marianne D'Aquila
Director of Research

Mike Guilfoyle
Vice President, Consulting

Mark Sen Gupta
Director of Research

Greg Gorbach
Vice President, Digital Transformation

Methodology

ARC developed a rigorous process to identify and rank leaders in this complex space. The ranking comprises three main components – financial indicators, transformation indicators, and collective intelligence (For more detail see the scoring and weighting components section below). Financial indicators, in the form of public financial data, provides a view into how companies have reported recent performance. Transformation indicators are

based on software and Environmental Social and Governance (ESG) data. Collective intelligence is based on selection and ranking by ARC analysts and broader end user community.

Definition

For this research, digital transformation is defined as: "The integration of digital technology into all areas of business, fundamentally changing the way companies operate and deliver value to customers. The organization is typically charged to innovate and improve across multiple dimensions such as: digital/disruptive technologies, culture and leadership, operational agility, workforce engagement, customer experience, environmental, social and governance, and competitive performance."

Candidate Companies Inclusion/Exclusion

A master candidate company list was derived from companies on the Global Fortune 500 or the Forbes 2000 list, using a general annual revenue/sales threshold of $20 billion. This threshold was implemented to keep the list at a manageable level. Candidate companies must operate in industrial industries (Full list of industries included below). Companies were excluded if they have a line of business selling industrial automation or information technology (i.e., Siemens, Rockwell Automation, GE etc.) or if there was an obvious lack of digital transformation effort.

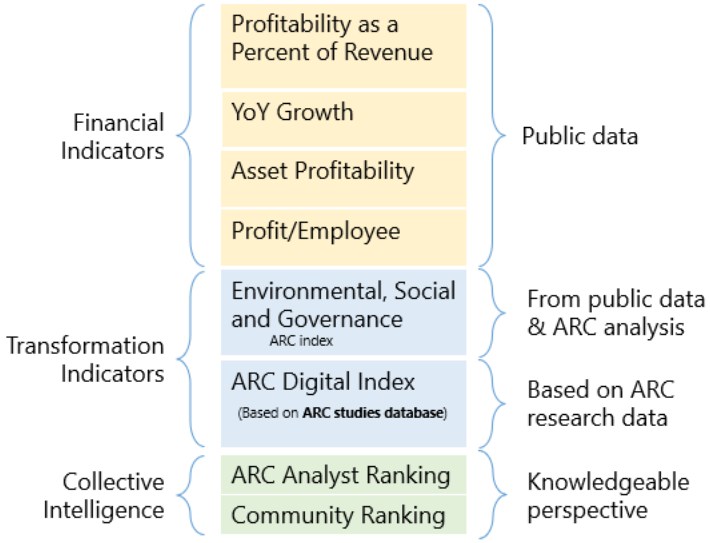
Industries Included

Companies must operate in at least one of the following industrial sectors.

- Aerospace & Defense
- Automotive
- Cement & Glass
- Chemical
- Electronics & Electrical
- Fabricated Metals
- Food & Beverage
- Household & Personal Care
- Machinery
- Medical Products
- Metals
- Mining
- Oil & Gas
- Pharmaceutical & Biotech
- Plastics & Rubber
- Printing & Publishing
- Pulp & Paper
- Refining
- Semiconductors
- Textiles
- Utilities
  - Electric Power Generation
  - Electric Power T&D
  - Water & Wastewater

Scoring Components and Weighting

The scoring comprises three main components – financial indicators, *transformation indicators and collective intelligence.*



Financial Indicators

The financial indicators are public data extracted from the *Refinitiv Eikon (Formerly Thomson Reuters)* database. More specifically, the four subcomponents and their significance are as follows:

Profitability and growth are positive business outcomes of some companies that are well down the digital transformation path. Year over year revenue growth and profitability were chosen as metrics because they are widely seen as strong indicators of digital transformation outcomes. Most of the successful companies have stated their revenue growth and profitability would suffer in the future if they didn't digitally transform quickly enough. Ultimately industrial companies must extract value from assets, so this metric was selected. A major purpose of digital transformation is to create value by enabling employees to work more efficiently. Profit per employee was selected as a metric because it measures the efficiency by which a company is utilizing their workforce.

Transformation Indicators

We believe that ESG is a strong indicator for digital transformation. There is an increasing push across global industries to incorporate ethics and sustainability into business practices. Environmental, social and corporate

governance is a business outcome resulting from a successful transformative process. The ESG scores reflect an ARC assessment based on available company data and multiple publicly available ESG indexes.

For industrial companies, a correlation has been identified between investment in software and other transformational technologies and the company's valuation. Appropriate software and technology research study data – including historical and forecast data for areas such as MES, ERP, Cloud Platforms, Analytics, and others - were used to generate a Digital Transformation Index (DTI) derived from ARC's proprietary research database.

Collective Intelligence

This report relies heavily on the collective intelligence of ARC's community. Collective intelligence component scores reflect the progress companies are making as demonstrated by the level of awareness and visibility in the knowledgeable industrial community as well as ARC analysts.

Over 100 community members and analysts from North America, EMEA and Asia Pacific participated. They come from a diverse group of industries, including high tech, pharmaceutical, consumer goods, automotive, machinery, aerospace & defense, mining, and energy. Industry organization representatives and members of academia are also included.

Sample titles of community members include Global Digitalization Director, VP of Automation, VP of Innovation, General Manager of Transformation, Digital Lead and various C-suite and business group executives. Community panel polling was conducted from July to October 2021 via a web-based, two-step process. Panelists were presented with the entire list of about 200 candidate companies in a randomized fashion. They were provided a brief description of each company's digital transformation and a link to the company website. They were not required to do any additional research, though it was possible to do so. First, panelists were asked to choose up to 25 companies they believe to be digitally transformed. Next, the panelists rank-ordered the selected companies from 1 to 25 with 1 being the most digitally transformed. Companies needed to receive at least one community or analyst vote in order to be considered.

Digital Transformation Score

The four financial indicators, two transformation indicators and two collective intelligence indicators were normalized and aggregated using the aforementioned weighting, into a total score. These scores were ranked from

high to low to arrive at the top 25. Weights were chosen based on a best estimate of correlation to digital transformation. For example, revenue growth and profitability are weighted quite heavily as they are typically stated as a top outcome of transformation. ARC will review and adjust these weights each year to ensure the most appropriate measures are being used.

Looking Forward

ARC will continue its research in all areas related to digital transformation. We want to learn more about what is working – and what isn't – as companies pursue their unique digital transformation activities. We want to hear from technology and service providers who have helped customers achieve interesting transformations, and from industrial companies – technology users – who have accomplished transformations they are proud of.

We intend to publish the Industrial Digital Transformation Top 25 report on an annual basis. With this being our first year, your feedback is very important to us as we will continue to investigate new approaches and measures to adjust our methodology, identify successful digital transformation initiatives, and help the industry as a whole digitally transform.

Please reach out to ARC if you have some results or learnings from your own digital transformation initiative that you would like to share. If you would like to be considered for inclusion on our community panel of judges, please contact us. And if you are willing to provide feedback to help ARC improve the process for next year's report, or to learn more about ARC products and services, please contact us.

For these or any other concerns, please contact **Marianne D'Aquila** at **mdaquila@arcweb.com**

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Acronym Reference:

AI	Artificial Intelligence
CEO	Chief Executive Officer
COP	Conference of Parties
EBIT	Earnings Before Interest and Tax
ERP	Enterprise Resource Planning
ET	Engineering Technology
ESG	Environmental Social and Governance
IIoT	Industrial Internet of Things
IoT	Internet of Things
IT	Information Technology
KPI	Key Performance Indicator
MES	Manufacturing Execution System
OT	Operational Technology
ROA	Return on Assets
YoY	Year over Year

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Founded in 1986, ARC Advisory Group is the leading technology research and advisory firm for industry and infrastructure, including our emerging smart cities. ARC stands apart due to our in-depth coverage of information technologies (IT), operational technologies (OT), engineering technologies (ET), industrial cybersecurity, and associated business trends. Our analysts and consultants based in the US and around the world have the industry knowledge and first-hand experience to help our clients find the best answers to the complex business issues facing organizations today. We provide technology supplier clients with strategic market research and help end user clients develop appropriate adoption strategies and evaluate and select the best technology solutions for their needs. End users are also invited to participate in ARC's Digital Transformation Council.

You can take advantage of ARC's extensive ongoing research plus the experience of our staff members through our Advisory Services. These are designed to assist executives responsible for developing strategies and directions for their organizations. ARC has also introduced a high-level Vanguard Service for end users. Vanguard employs a more personal consultative approach to help Chief Digital Officers and transformation change agents overcome obstacles and drive digital innovation in their organizations. For membership information, please call, write to, or visit our website: www.arcweb.com.

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