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Critical success factors in the digital transformation of industry segments

D. Areces, DTE ehf

This article is about the critical success factors of a successful digital transformation in an industry segment or manufacturing. In brief, a digital transformation is the deployment of new 'digital' processes, tools and technologies driven by an organization's long-term strategy [1], based on the organization's purpose, mission, vision and values. It is a business transformation that maximizes value, sustainability, safety and efficiency rather than a technological transformation. Its digital processes, tools and technologies optimize operations and contribute to new digital products, solutions and services. The evolution must follow an operational plan, driven by a clear transformation leader and fully aligned to the company's operational blueprint. It is essential that the people impacted by the transformation must buy it in, be upskilled and participate in its definition, deployment and aftermath.

As mentioned, this article is about the critical success factors of a digital transformation in an industry segment or in manufacturing. It is neither exhaustive nor the single version of the truth. And it is not a technical article but

DTE's contribution to business thinking on the use of digital technologies for sustainability and efficiency.

Even though the concept of digital transformation in industry segments is well-known and has been extensively covered by the specialized communication media, consulting outlets, country-based standard organizations, technology suppliers and others, it is not always well understood. The main reason is that the vertical views of the different contributors drive communication, and they are not always aligned to the needs and, more importantly, to the understanding of the deployment capability of the industrial players.

There are perhaps three main elements for the limited understanding of what digital transformation is: the lack of a common definition and standard across industries and countries, the lack of a common way to measure the evolution of its deployment and success, and the different names the deployment may be given. For an overview of the Industry 4.0 standards landscape, the global industry standards for industrial IoT document is a good reference. [2]

The author has chosen to use the title of digital transformation for this article instead of fourth industrial revolution, Industry 4.0,

Industrial Internet of Things (IIoT), or smart manufacturing. When different names are applied, they come with a different focus. We decided on 'digital transformation' because it is more inclusive and considers all the aspects of a transformation.

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Optimizing production assets' use and performance

Decrease energy consumption

Applying real-time and forward-looking process control

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Visualizing the melt dynamic of alloying elements

Maximize quality and traceability

Monitoring the liquid metal along the production line

Increase throughput

Using real time product information and process control

Optimize production planning

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www.dteequipment.com

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gence from liquid metals solution combines chemical composition analysis from molten metals based on Liquid-Phase Laser-Induced Breakdown Spectroscopy (LP-LIBS), an artificial intelligence-based cloud platform – the engine of DTE’s metals production ecosystem – and digital elemental analysis services.

DTE’s solution delivers valuable intelligence and predictive insights from liquid metals across the entire value chain and from the plant floor to the business levels of either primary or secondary aluminum producers. The company’s purpose is to transform the metals industry, driving its digital transformation towards Industry 4.0 with the next generation of Industrial Internet of Things (IIoT) analysis technology while contributing to the 1.5-degree challenge.

What is a digital transformation in industrial segments?

As mentioned before, there are multiple definitions of what a digital transformation in industry segments is all about. For DTE, a digital transformation involves deploying digital processes, tools and technologies to maximize value, sustainability, safety and efficiency, generating new digital products, solutions and services.

When referring to external sources, we usually follow PwC’s definition of a digital transformation in industrial segments or Industry 4.0: “...Industry 4.0 focuses on the end-to-end digitization of all physical assets and integration into digital ecosystems with value chain partners. Generating, analyzing, and communicating data seamlessly underpins the gains promised by Industry 4.0, which networks a wide range of new technologies to create value...” [3]

For PwC, Industry 4.0 is driven by digitization and integration of vertical and horizontal value chains, digitization of product

and service offerings, and digital business models and customer access.

Digitization versus digital transformation: Digitization of an industrial operation is one of the components of a digital transformation, and it is, in many cases, wrongly considered the only element of a digital transformation. Experience indicates that deploying technology alone is not the most optimized use of resources. The digital transformation blueprint should define digitization’s proper execution.

In general, digitization can be defined as converting any physical event into ‘digital’ information so that a computer can manipulate it. In industry segments, digitization is understood as a much more comprehensive process that includes:

- Connecting devices, sensors, inputs and outputs ensuring that they transfer data of physical events in digital format
- Verifying that the data is accurate, consistent and transmitted securely
- Collecting the data sent along with contextual information (example: time)
- Storing the data
- Analyzing the data stored
- Generating meaningful and valuable information out of the data collected
- Presenting the information in such a way that decisions can be taken
- Providing additional content to support decision making
- Evaluating the business outcome of the decisions taken by measuring its return
- Building digital models of physical events, assets, and everything else
- Adapting the business model.

Much of this is currently done by companies in the industry segments; however, in most cases, it is done without a clear overall guideline, in a scattered manner, in pockets of the overall industrial process and silos. Indeed, a gradual and scalable deployment is understandable because anything different would

be impossible. However, a digitization effort without a clear digital transformation blueprint will not generate the expected results.

Therefore, for a successful digitization effort, a digital transformation strategy and operational plan must be defined. The digital transformation process, among other things, must specify the digitization strategy and its execution plan.

Why pursue a digital transformation?

Compared to other large market segments such as banking, financials or healthcare, to name a few, most industry segments have been slow to undergo a formal digital transformation. And within the industry verticals, metals – including aluminum – have been one of the slowest [4]. While the Covid-19 pandemic has accelerated the process, the pace is still slow. And even though many metals companies have digital strategies in place, the gap between strategy and execution is significant [5].

What is the rational behind a digital transformation process? While we could present the relevant market trends and their implications for the industrial players as the main reason to embrace a digital transformation, the primary drivers are straightforward:

- to remain in business
- to maximize their competitiveness and growth
- to increase their enterprise value
- because it is a must for all their stakeholders.

Here, a brief description of these drivers:

Embracing a digital transformation to remain in business: Not foreseeing the market trends or embracing the latest technologies to overcome their challenges have put companies out of business. As an example, let’s point to all the assets that have been replaced by phones, from photographic cameras to

Fig. 1

	Potential Business Impact (\$ billion)	Potential Societal Impact (\$ billion)	Total Value at Stake (\$ billion)	Emissions Reduction (mn tonnes CO ₂)	Net impact on jobs ('000)
Smart Sensors	34	8	42	161	(40)
Autonomous Operations	56	19	75	396	(60)
3D Printing	-	3	3	35	-
Connected Worker	85	-	85	-	(201)
Remote Operations Centre	77	7	84	16	(12)
Asset Cybersecurity	21	-	21	-	-
Integrated Platforms	37	69	106	-	(5)
Advanced Analytics	11	-	11	-	(13)
Cumulative total (2016-2025)	321	106	427	608	(330)

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calculators. Or think of companies such as Kodak, BlackBerry, Polaroid, and Blockbuster that could not evaluate the market trends and ended up fading away.

Embracing a digital transformation to maximize competitiveness and growth: In terms of maximizing competitiveness and growth, the Boston Consulting Group [5] states that "...Some improved their mining throughput by 10 to 20% and their procurement productivity by up to 50%, and reduced emissions by 15 to 30%..." In its value-at-stake analysis, the World Economic Forum (WEF) [6], assessing the cumulative value impact over the next ten years of digital transformation initiatives on the Mining and Metals industry, summarized: • more than USD425bn of value for the industry, customers, society and environment until 2025 • a reduction of 610m tonnes of CO₂ emissions, with an estimated value to society and the environment of USD30 bn • an improvement in safety with around 1,000 lives saved and 44,000 injuries avoided. This corresponds to a 10% decrease in fatalities and a 20% decrease in injuries in the industry, see Fig. 1 [6].

Embracing a digital transformation to maximize the enterprise value: It is known that a company's growth and business model drives its market value. Understanding that this is a high-level concept that deserves a more profound discussion and analysis, asset-heavy companies or companies that do not have a robust digital component – among other things – are usually valued one to three times their

reluctant to invest in companies that do not use technology for efficiency and sustainability in today's world. Customers may not buy from companies that are not sustainable or not using digital technologies to trade or provide information. And it will be difficult for companies not pursuing a digital transformation to acquire talent. Millennials and future generations will not join companies if they are not at the forefront of technological development.

Critical factors for a successful digital transformation

There are a number of critical factors that must be considered for a successful digital transformation in industry segments. While some of them stand out, others may need further explanation. Below, a brief description of selected success factors:

- A digital transformation strategy and operational plan, led by the chief digital officer, chief technology officer or other senior managers, must be defined. The company's business strategy and operating plan, derived from its purpose, mission, vision and values, should lead the digital transformation strategy. There must be an overall data plan – along the end-to-end value chain and from the plant floor to the business levels – and data must be considered a new asset class.
- The transformation must be driven by clear business variables and outcomes and not by technology.

- Employees must buy into the digital transformation and be an integral part of its definition, execution and aftermath. Human resources must be the key business partner, enabling the transformation and advising about a new organizational layout for successful implementation.

- There must be a strong alignment and partnership among the major stakeholders and interested parties: companies, customers, employees, governmental organizations and supply chain members, among others.

- The digitization must be based on a scalable system architecture; open technology supported by a thriving ecosystem or platform, boosted by a multiple-sided network effect; system, segment and functional expertise.

Human resources: One of the significant elements usually overlooked during either a digital transformation or the deployment of new technologies is the human resources component. The major factors are employees' buy-in and upskilling and organizational evolution – what Scott Brinker dubbed the Martec's Law. Scott Brinker stated: „Technology changes exponentially, but organizations change logarithmically“ [7], see Fig. 2:

Without the proper buy-in of the employees impacted by the new digital processes, tools, and technology and their proper upskilling to capitalize on the investment made and maximize its benefits, the effort will not be successful. The organization layout and culture must evolve as well. The Harvard Business Review states: "...digital transformation requires talent...in four domains: technology, data, process and organizational change capability..." [8]. Human resources must be a key business partner in this pursuit, ensuring that the proper incentives, upskilling, change management and incentive processes are implemented.

Strategic partnerships among the major stakeholders: A significant challenge of deploying digital technologies in industrial sites has been the lack of strategic partnerships among the key stakeholders. A digital transformation is a journey, not a transaction, where a clear, agile, fast and efficient execution plan must be defined. The suppliers and end-users must think big but take small and measurable steps through jointly defined proof of concepts, where an open and transparent dialog takes place and costs and benefits are shared. Then, in partnership, suppliers and end-users should scale up the proof of concepts to make them what the WEF and McKinsey call advanced manufacturing 'light-houses' [9], leading the digital transformation deployment across the enterprise. →

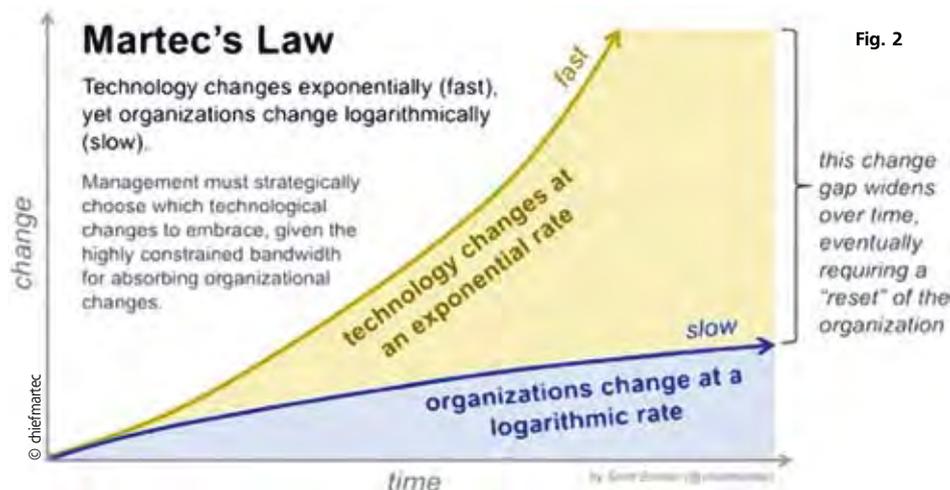


Fig. 2

sales. Asset-light companies or those with digital processes, tools and offers – including recurring revenues, digital interaction with suppliers and customers, services, ecosystems, data managed as an asset – are usually valued five times and more their revenues.

Embracing a digital transformation is a must for the stakeholders: Investors will be

- It must be based on a clear, agile, fast and efficient execution plan, where proofs of concept are developed in partnership with suppliers and, if possible, governmental organizations, where return is measured and overall deployment is done based on the results of the proofs of concept. Think big, take small and measurable steps, share rewards and risks.

Industry 4.0 is characterized by 4 foundational technologies applied along the value

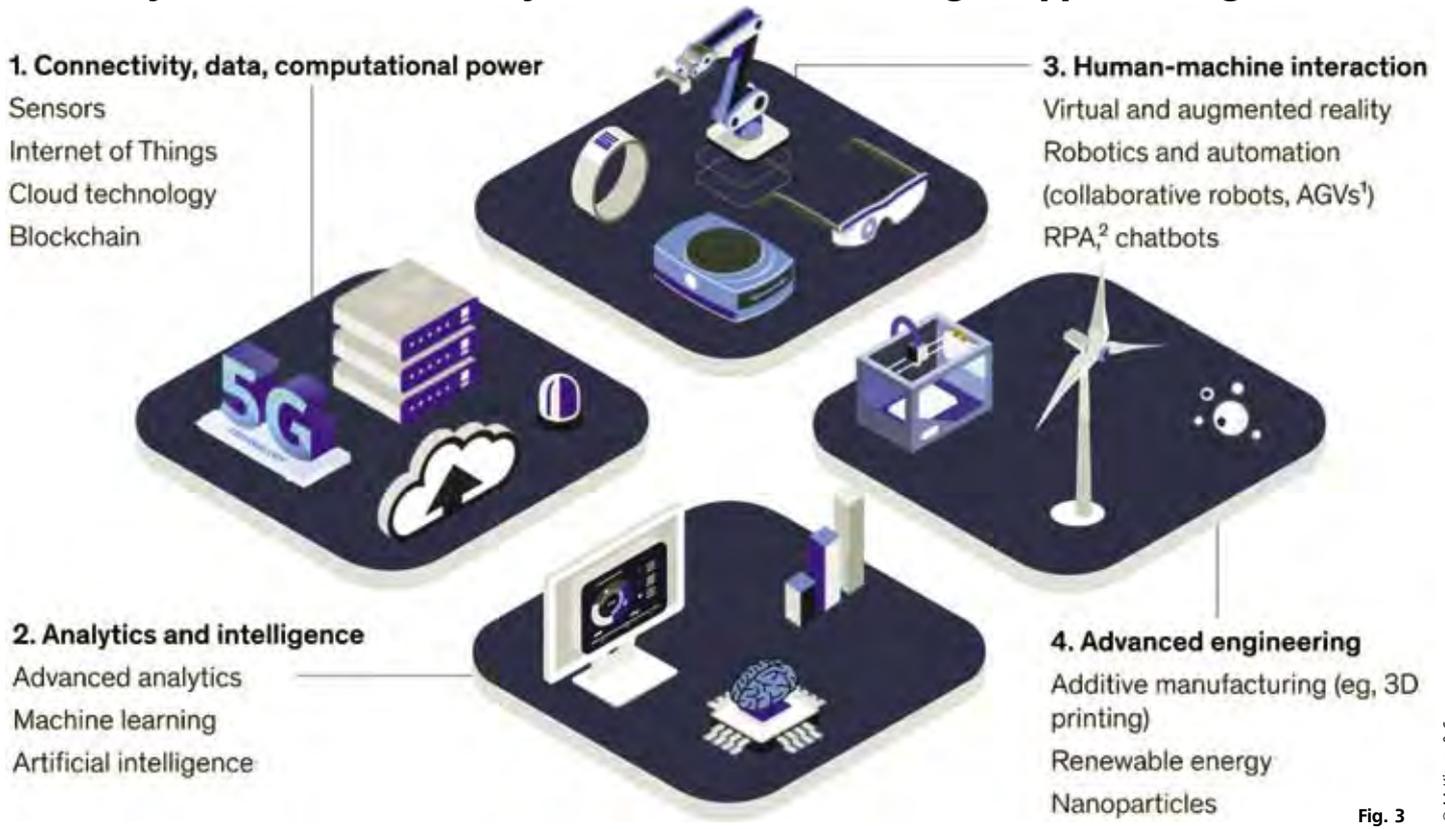


Fig. 3

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In addition, the role of the governments is critical, setting up a clear playground to accelerate the transformation by clearly defining incentives and the way to access them.

Major technologies driving the digital transformation

While we did not want this to be an article about technology, we would like to comment on the technological evolution of manufacturing.

It is unclear when the fourth industrial revolution or evolution started. However, the term Industry 4.0 was originated in 2011 by the German government, promoting the computerization of manufacturing [10]. Industry 4.0, as initially described, refers to the widespread integration of information and communication technology in industrial production [11-12]. The fourth industrial revolution is when the physical, digital and virtual worlds collide, creating intelligent factories.

Simply, we may say that four technological developments triggered the fourth industrial revolution: connectivity (or digitization of analog events), mobility, cloud and analytics.

Today, Industry 4.0 includes four foundational technologies applied along the value chain: (1) connectivity, data, computational power; (2) human-machine interaction; (3) analytics and intelligence and (4) advanced engineering [13], see Fig. 3.

Conclusion

This article aims to guide industrial customers about maximizing value, sustainability, safety and efficiency by embracing a digital transformation, or the deployment of digital processes, tools, and technology, generating digital products, solutions and services.

In the article, we indicated that the business variables defined in the company's strategy should drive technology adoption and not the other way around. We also presented the critical success factors and highlighted that employees' involvement, buy-in and upskilling are a must for a successful deployment of Industry 4.0. Strategic partnerships are a must to go through a transformation journey. To think big, deploy in small proof of concepts, scale-up to develop a lighthouse – or advanced manufacturing site model – are the steps to take. Lighthouses, then, will guide the deployment of digital processes, tools and services across a corporation.

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Author

Diego Areces is chief commercial officer at DTE ehf, located in Reykjavik, Iceland.