



HOW NEW TECHNOLOGIES

ARE TRANSFORMING

MANUFACTURING

IN LATIN AMERICA AND THE CARIBBEAN



Digital economy

Manufacturing



INTRODUCTION

The Latin America and Caribbean (LAC) region is undergoing a digital revolution, and we are convinced that technological innovations have the potential to significantly accelerate and scale the region's development. These technologies are reshaping both traditional sectors and innovative industries. In this context, the main objective of this report is to address the disruptive technologies that are revolutionizing each of the industries in which IDB Invest operates in a structured manner. New emerging business models will be evaluated in the context of economic and social development, the foundation of the IDB Group. The selected models will prioritize inclusion, productivity, and innovation while addressing cross-cutting issues such as environmental sustainability, climate change, and gender equality.

Although new technologies have enormous potential to drive efficiency and open up new avenues of value creation, they also pose significant challenges in terms of governance, security, and equality. The rapid adoption of digital solutions has highlighted the importance of establishing a strong regulatory and investment framework that maximizes benefits while mitigating risks. As a result, the role of different economic agents and their ability to adapt and adopt these innovations becomes a critical aspect of catalyzing sustainable economic and social development.



As we examine the impact and potential of various key technologies in this report, it is important to understand that we are dealing with an interconnected ecosystem that is growing in complexity and scale. Advances in one area, such as Artificial Intelligence or Automation, are fed back and amplified in constructive collaboration with others, such as Big Data or the Internet of Things, resulting in a multiplier effect on value generation. This report aims to highlight how this technological interconnection is reshaping the economic and social context in LAC, providing an analysis that goes beyond the current situation to forecast how new technologies will continue to shape the region over the next decade.

CONTEXT

Latin America and the Caribbean's manufacturing industry is the second highest contributor to the region's GDP (15.7%), only behind the service sector (57.5%), with a tie in third place between the retail industry (10%) and other industries (including construction).

In the last decade, the industry's share of Latin American GDP slightly increased, going from 14.3% to 15.7%. However, this growth has been primarily driven by Mexico, given its unique integration of the country's value chains with the United States and its positioning as a manufacturing hub for inputs ranging from electronic components to automobiles.

In recent years, the global COVID-19 pandemic and geopolitical conflicts have highlighted the risks of excessive external dependence on global supply chains associated with the high concentration of high-end manufacturing in some specific geographies, such as factories of technological devices, electronic and automotive components in Asia and the United States.

In addition, the industry is undergoing a digital transformation that combines the use of new technologies in its production processes and the operations of companies. New digital solutions such as the Industrial Internet of Things (IIoT) and the use of sensors, additive manufacturing, 3D Printing, process automation, robotics, and improved analytical capabilities (big data and artificial intelligence) will digitize the supply chain, improving products and customer expectations.

Faced with this new paradigm, companies should be aware of the challenges and opportunities presented by these new technologies in order to avoid the risk of becoming obsolete and losing market share. Depending on the unique characteristics of each company, they will have to identify which ones best suit their needs in order to invest in them and thus improve productivity and operational efficiency. Because of the high capital requirements for transformation initiatives, lenders and multilateral organizations have an unprecedented opportunity to support the industry's digital acceleration.



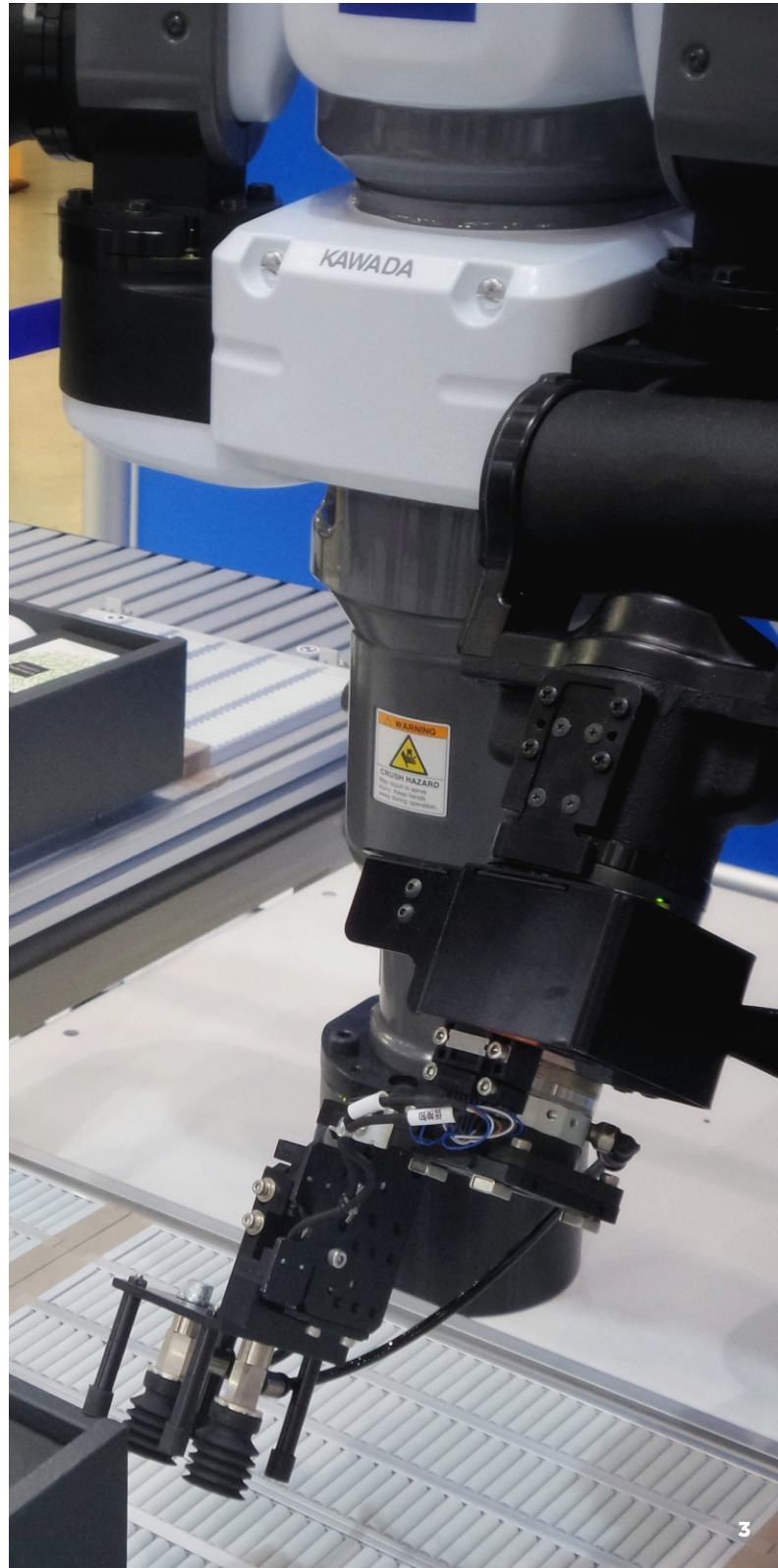
INDUSTRY'S IMPORTANCE IN THE REGION AND IDB INVEST'S OUTLOOK

Given its contribution, the industry plays a strategic role in regional development, which is emphasized in the current scenario in which many multinational corporations are rethinking positioning their productive footprint to locate it closer to their demand or in countries that share their values and global agendas.

In the short and medium term, the supply chain's opportunities of approach could account for an increase of up to USD 78 billion in new goods and services exports, with opportunities for the region in the automotive, textile, pharmaceutical, and renewable energy industries, with Mexico and Brazil being the most favored geographies.

These strategic investments in key sectors have the potential to generate a multiplier effect on society. The injection of capital not only drives the creation of skilled employment but also promotes the development of essential infrastructure in the region, including the construction of new hospitals, housing, and schools, and strengthens the supply chain through an expanded network of suppliers. Manufacturing is also an industry that further contributes to the creation of local jobs with a high level of training and qualification, which is an important component of governments' agendas. It represents about 20% of total jobs, which underlines its importance as the main source of financial support for millions of households. Mexico, Brazil, and Argentina are the most advanced and manufacture most of the products in the region.

It should be noted that the remaining Latin American countries have opportunities to boost industry development in the medium and long term through the adoption of new technologies to increase innovation, productivity, and efficiency.





IDB INVEST'S OUTLOOK

As a result of new technological advances and new patterns of globalization and trade slowdown, the global context has changed.

The region's manufacturing supply must rely on more than just its low labor cost, a usual competition factor with other countries, since many industries already prefer factories with high technology within their own frontiers. Latin America and the Caribbean's productivity is of paramount importance in order to be able to compete in the future.

IDB Invest's primary investment lines in the industry are:

- Increasing productivity, improving the efficiency of production processes, and facilitating innovation and digital transformation.
- Assisting customers in growing and competing by becoming their strategic partner in increasing competitiveness and entering new markets while creating jobs throughout the value
- Promoting the circular economy in industrial operations.

INDUSTRY CHALLENGES AND OPPORTUNITIES

In the strive to ensure business continuity and maintain competitiveness, we find a number of global challenges in the manufacturing industry stemming from the macroeconomic context and the market situation following the pandemic. The following are some of the most significant impacts of the LAC region's current socioeconomic context on these industries:

- Price increase of goods and services owing to inflation
- Product and component shortages owing to disruptions in production and supply chains
- Changes in customer consumption habits towards products from organizations with a reputation for social responsibility
- Lack of legal certainty and governance for long-term investments
- Changes in demand and processes as a result of environmental regulation and tariff regulations
- Skilled labor shortage
- Power shortage
- Promoting the circular economy in industrial operations.

This new reality has had significant implications for organizations' business and operational model, forcing them to adapt their products and restructure their operations in order to maintain margins and be able to cope with new market dynamics. The following are the primary needs faced by organizations in the industry:





To increase productivity: Productivity growth is a lever that allows for greater control over economic results. This factor is especially important in volatile environments such as those currently experienced by the industry. Increasing productivity requires not only incorporating technology that improves process performance but also steering them towards approaches that apply intelligent automation selectively to integrate hybrid machine-system-human operations.

To improve traceability and reduce operational and market risks: The regulatory environment and customer demands are increasingly requiring that companies take responsibility for the externalities that arise from the manufacture or use of their products. Therefore, finding solutions for the traceability of the flow and consumption of power, materials, and products along value chains is an issue that, in addition to serving to optimize, warrants certainty and enables risk reduction.

To improve the responsiveness of the value chain: There are several elements that are not controlled by the organization, with the potential to impact its operational continuity. Armed conflicts, trade frictions, and the very shortage of human and material resources make it more important to have tools that allow planning out the operation as a whole, as well as collaborating with customers, suppliers, and governments in order to establish systems to share information. By means of this, more fluid resource planning will be achieved with greater room for adjustment to respond to unexpected phenomena.

To increase efficiency:

One of the industry's competitive advantages consists in its ability to offer competitive products in the market in terms of price. In this context, in addition to the automation of activities, it is necessary to seek solutions that simplify processes and guide them towards the optimization of energy and resource consumption.

To adjust to new approaches to talent management: Most large companies in the industry and their operating models were devised by previous generations with less focus on digitalization and collaboration. This creates a need to gradually shift the management approach towards more collaborative and inclusive methods in which knowledge and experience are just one component.

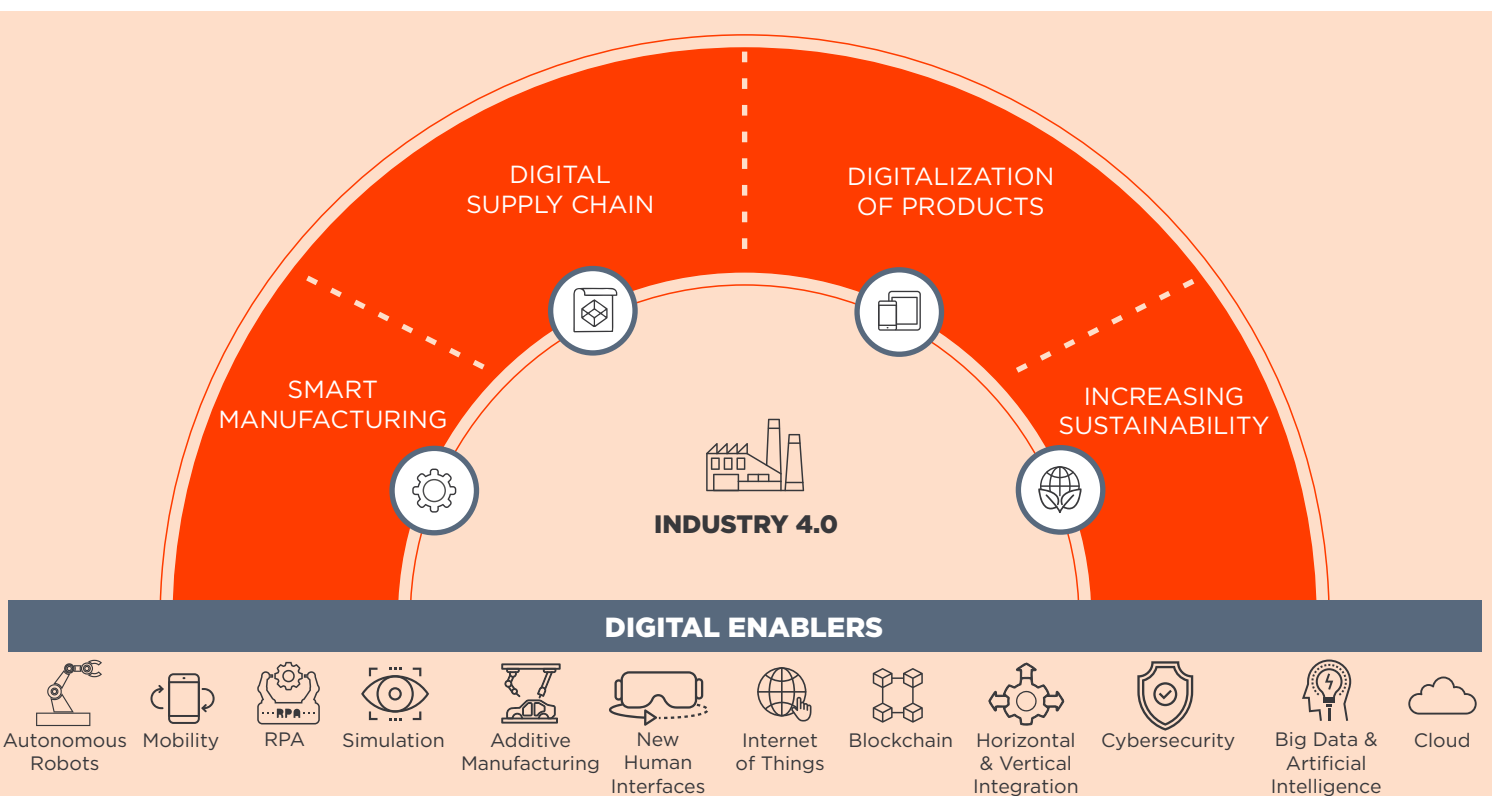
To incorporate environmental goals into the operation: The exploitation of natural resources and the emissions caused by it are significant contributors to climate change. Digital Transformation and its solutions should also be geared toward enabling the measurement of the set goals so that each organization can better monitor its environmental footprint and its direction to governance practices that ensure less pollution and more inclusive approaches of underrepresented groups.

KEY TRENDS

Digitalization is currently causing constant and increasingly accelerated changes in the market environment. This transformational process, accelerated by the use of new technologies, is known as Industry 4.0.

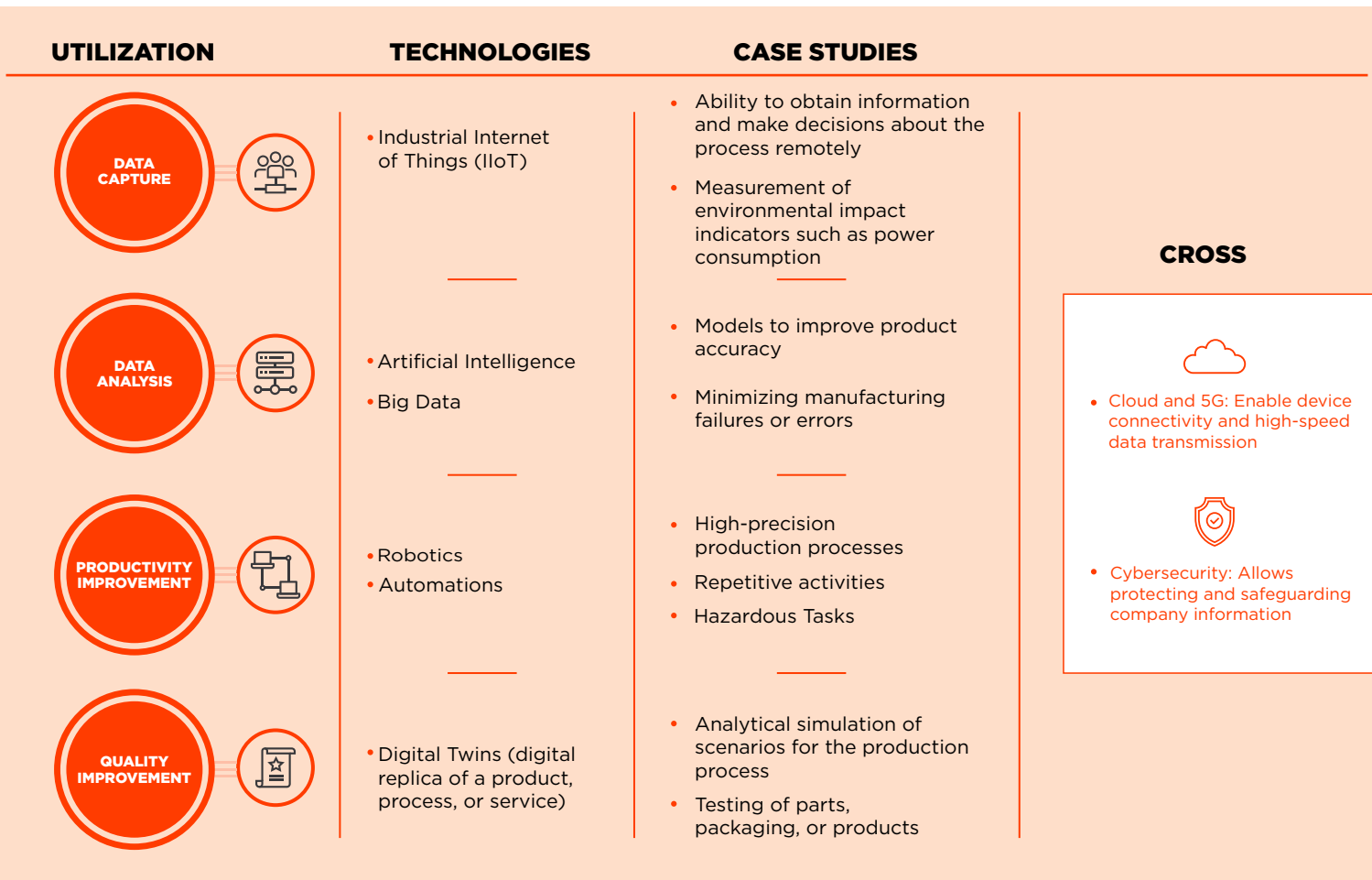
Industry 4.0 is crucial in companies' strategies to seize the opportunities of digitalization in the production systems, value chain, and goods and services offered. The fourth industrial revolution is enabled by combining various physical and digital technologies such as artificial intelligence, cloud computing, robotics, augmented reality, additive manufacturing, and the Industrial Internet of Things (IIoT).

The main goal of industrial transformation is to increase operational efficiency and productivity to ramp up the competitive power of companies. Industry 4.0 is the engine of the digital trends that are taking place in the industry, with the main ones being:



Smart manufacturing: also known as smart factories, refers to the digitalization of factories and the connection of all the elements that make them up (machinery, sensors, production and management systems). Through the integration of all components and the implementation of new technologies, organizations can increase their operational efficiency and productivity and improve product quality, gaining advantages over competitors.

These digital capabilities enable the transition of companies towards a data-driven model, characterized by the importance of data processing, from its capture to subsequent analysis in order to make the best decisions in the manufacturing process. In these factories, the use of digital solutions converges with the following use cases:



In this sense, organizations should focus on integrating operation and information technologies of the production process to share data between machines, devices, and systems directed toward maximizing value in decision-making.

Its appropriate adoption has a direct impact on companies in the industry, as they increase the return on investment (ROI) of digital transformation by producing quicker and thus guaranteeing quality at a lower cost.

Digital supply chain: Digitalization has become a key element in logistics and warehousing processes for companies to achieve their faster delivery goals, order traceability, and cost control.

Companies in the region have a high adoption of Warehouse Management Systems (WMS) and Transport Management Systems (TMS) that are combined with technologies such as Radio Frequency Identification (RFID), barcodes, and mobile devices, such as tablets or smartphones.

These technologies allow companies to have greater visibility and reliability in the management of their inventories, as well as the implementation of paperless processes, electronic payments, and the digital signature itself. While digital solutions are beginning to provide significant benefits to organizations in terms of efficiency, quality of service, and sustainability, Digital Transformation is expected to evolve in logistics operations, such as:

- **Leveraging data usage:** Data collected in logistics activities is extremely valuable for decision-making in production and sales processes. To properly leverage this information and perform real-time analysis, however, all logistics management devices and systems must be linked and seamlessly integrated with the Enterprise Resource Planning (ERP) system and the rest of the organization's systems. To accomplish this, it is crucial to leverage the use of data warehouse and/or data-lake solutions as a foundation for implementing advanced analytical capabilities.
- **Logistics processes automation:** Logistics processes are a natural application area for solutions such as artificial intelligence, autonomous vehicles, and the use of Big Data in conjunction with sensors connected to the Internet of Things (IoT) for real-time monitoring of activities.
- **Transportation and distribution digitalization:** By using geolocation systems in the vehicle fleets, as well as route planning and merchandise traceability systems. These systems will enable organizations to optimize loads on the transportation network, routes based on orders, available vehicles, weather conditions, road conditions or traffic, and provide customers with real-time order tracking.



Digitalization of goods and services: New technologies are changing the way products are provided and sold, improving quality and user experience and optimizing sales processes and customer service in both manufacturing and retail industries.

Within manufacturing, the digitalization of products allows companies to achieve economies of scale, reducing the cost of production and minimizing distribution costs. For example, the use of technologies such as Digital Twins, where a representation of the product is created digitally, the design of these is facilitated and possible defects are forecasted, which also increases quality. Other high-end technologies are also being used to provide better customer service through digital channels.

At its plant in the Pacheco region in Argentina, Volkswagen uses immersive technologies such as VR to train employees on the vehicle assembly line. VR allows workers to learn and practice different production tasks and processes in a virtual environment before applying them on the actual production line.

The retail industry has the most prevalent use of this trend in relation to a more agile response to e-commerce growth than other industries. These companies benefit from the digitalization of goods and services by saving costs through the need for less physical infrastructure, increased revenues by being able to reach a larger sales audience through different digital channels (app and web), and a better customer experience.

In Mexico, Walmart has implemented self-checkout counters, where the customers themselves scan products they wish to buy without the need to interact with store staff. Other cases where retail companies are experimenting with are the use of gamification and augmented reality through their applications to offer more immersive customer experiences.



An example of this is the Cencosud group in Chile, which, as part of its loyalty program, launched an interactive online game called "La Ruta del Ahorro" that consists of a virtual race through different stores, where participants should collect products and dodge obstacles in order to advance in the competition, earning additional points and exclusive prizes.

Increased sustainability: In recent years, governments in the region have shown greater sensitivity by including initiatives associated with sustainability and reducing the impact of climate change in their agendas.

Apart from regulatory issues, another key factor for organizations deciding to venture into this type of initiative is the reputational aspect that is increasingly prevalent in the customer's mind and that, if not addressed, can lead to risks with a consequence that is greater than the costs of implementing solutions to mitigate them.

Currently, organizations use digitalization in their operations mainly for monitoring emission data and optimizing resource consumption. On the other hand, the incorporation of paperless operation models or the use of sensors to capture environmental and resource management data is prominent.

At a more advanced level, the use of management systems is identified for the control of environmental impact metrics integrated with data from the operation and the creation of reports in real-time to monitor sustainability goals.

Within this trend, circular process-oriented business models are emerging, focused on increasing the use of resources through the reduction of waste and recycling of materials and products, with the aim of reducing environmental footprint.

Some of the industrial subsectors in which the concept of circular economy is most advanced in its implementation are vehicle manufacturing and the construction materials industry. For example, in vehicle manufacturing, manufacturers have begun to design products that can be disassembled easily to recycle their components and reintroduce them into the production chain.

The adoption of technologies to advance sustainability issues has an impact on improvement based on respect for the environment, thus fostering sustainable and equitable development by companies.



NEW BUSINESS MODELS

The innovation of the industry and the adoption of new technologies are furthering the development of new business models that capture value derived from digitalization. Companies in the industry will have to pay attention to the changes that are emerging in order to maintain competitive edges.

At NTT DATA, we have observed three innovative business models enabled by digital solutions that are set to change the industry over the next decade:

a. Marketplace Integration


The industry's digitalization is not limited to the automation and improvement of production processes but involves the entire value chain, from the reception of inputs for manufacturing to after-sales services. Specifically, digitalization offers a number of opportunities in the sales area, such as the opening of new channels, direct relationships with the end customer, and the use of analytics to improve product pricing, generating new revenue streams.

Historically, companies in the industry have built up alliances with third parties for the distribution of their products. Complementing this service with its own marketplace focused on direct sales to the end customer can pose difficulties when it comes to reconciling these two strategies, so it is essential to define the scope of each strategy and how they will be complemented in the future.

Accordingly, the first step is to identify which products to integrate into the marketplace. This is especially relevant for large industrial groups that have large product portfolios of various complexity. A rule to follow in many cases, for example, is to start with more standardized products and later include those that require or allow greater customization.

The strategy of creating a digital Marketplace can even create physical points-of-sale, completely disintermediating the process of distribution and sale to end customers. This strategy is the one that Grupo Modelo has followed in Mexico, creating its own network of franchisees: Modelorama, where they directly market the group's beverages.

EXAMPLE: MARKETPLACE INTEGRATION



"Direct distribution to end customers"

Grupo Modelo launches Modelorama to directly market its products through physical stores

PROPUESTA DE VALOR

They offer over 10,000 physical points-of-sale for trading beers, under a franchise model similar to other department stores in Mexico such as Oxxo.

In 2020, they launched Modelorama Now, an app focused on beer delivery.

TECNOLOGÍA

Cloud: They use the AWS solution to generate digital channels that complement physical stores

Big data: Inventory control and demand estimate in each branch

API: Sharing information with third parties and enabling delivery app

ALLIANCES

During 2020, it launched a pilot with Cornershop for trading beer at home, but later released its own app to perform the service

CUSTOMER SEGMENTS

They are focused on medium /low socio-economic customer segments, usually in rural or semi-urban areas

RESULTS

X2 Growth in Number of Stores since 2015

15% of Total Grupo Modelo's Sales

+10,000 Points-of-sale in Mexico

KEY CAPABILITIES AND RESOURCES

- Fully integrated value chain
- Growth model under franchise
- High brand reputation
- Loyalty program


IMPACT

They seek to integrate into their model the distribution of their products to end customers, first physically to later move to e-commerce

MAIN REVENUE STREAMS

- Sale of products manufactured by Grupo Modelo
- Revenue derived from the franchise agreement

OTHER PLAYERS



b. Manufacturing as a service

The marketing of goods and services under subscription or as a service scheme has been expanding from its beginnings in IT to different industries such as finance or power with great success for several years. Subsequently, the adoption of these models in the manufacturing industry has been slower as it faced significant technological challenges, especially in the technological field.

A manufacturing as a service model consists of contracting the manufacture of products under a subscription scheme, that is, instead of having a factory dedicated to the production of one or more products, a smart factory is paid for the shared use where production is shared between different companies.

The rapid adoption and development of emerging technologies such as IoT, Big Data, and Cloud allow the viability of these models since they enable a smart factory where different products can be manufactured in parallel and assembly lines reused according to the productive needs of the parties involved, saving investment in CAPEX and maximizing the time of machinery usage.


This model has a global reach, but focusing on

LAC is especially useful for small and medium-sized businesses that seek to scale operations in an agile manner and without high initial investment costs, shielding their costs competitive advantage in the face of a potential rise in the cost of labor within the region.

There are various benefits derived from the adoption of these collaborative models, from a reduction in carbon footprint by grouping production in a smaller number of factories to the ability to relocate production to regions closer to both the inputs for production and the final market of products, as well as greater flexibility and transparency in production costs.

However, there are also significant challenges to overcome for the model to be successful. For example, it is essential to ensure the compatibility of the products to be manufactured in each factory, both on the technical side (the same machinery can produce different products) and on the capacity side (the factory can meet the expectations of all parties). It is also essential to ensure that the information relating to each production process is completely private and is not shared with third parties.

EXAMPLE: MANUFACTURING AS A SERVICE



"We help design, build, and supply products to make the world a better place"

Flex is a global provider of supply chain and manufacturing solutions

VALUE PROPOSITION

Their mission is to help design, build, and support products. With a global network present in 30 countries, it operates under the principles of social responsibility and sustainability. Flex delivers technology innovation, supply chain solutions, and manufacturing services to a wide array of industries and end markets

TECHNOLOGY

Human-machine interface (HMI) technologies allow everything from cars to smartphones to respond to user interaction

Internet of Things (IoT) Platforms

Sensors: To accelerate IoT adoption

Smart audio and voice

Cloud solutions

ALLIANCES

Global network of partnerships thanks to the dissemination of knowledge

IMPACT

- Improves the efficiency of companies and contributes to their digitalization
- +20 years of sustainable investment

KEY CAPABILITIES AND RESOURCES

- Adapting product portfolio and entering higher value businesses
- Growth in the renewable energy, future mobility, and cloud segments
- Improving operating margins and inventory management

MAIN REVENUE STREAMS

- Flex Reliability: Selling products for the automotive, healthcare, and industrial sectors
- Flex Agility: Cloud, lifestyle, and device solutions
- NEXTracker: Value-added services and circular economy

CUSTOMER SEGMENTS

Company from various sectors that integrate the production phase into its value chain:

- Retailers
- Manufacture
- Auto
- Health


RESULTS

USD 7.8 Billion in Revenue

USD 258 Million Adjusted Net Profit

USD 0.62 Earnings per Share

OTHER PLAYERS



c. Models based on circular economy

Models based on circular economy are oriented toward sustainability and seek to generate semi-closed cycles of production and consumption, where resources are reused and the useful life of products is extended. The emergence of these models goes hand in hand with the increasingly relevant role that sustainability plays in our society and with the efforts that the industry makes to adapt to the demands of customers and governments.

The circular economy is a global trend, but it is not yet equally important in all regions. In terms of LAC, it is an emerging and underdeveloped concept because most initiatives in the region focus on traditional waste management rather than using technology to generate scalable business models that provide greater environmental benefits.

The rapid adoption of these models is crucial to reduce the carbon footprint in the region since, together with the transition to renewable energy, it is the main driver to achieving the challenging sustainable goals for 2030.

In addition to the contribution to the field of sustainability, a circular economy can bring significant social and economic benefits, particularly if the region has a municipal waste recycling rate similar to that of Germany, around 450,000 direct and indirect jobs would be created while the region's GDP would increase by 0.35%.¹

Throughout the preparation of the study Digital Transformation of Manufacturing in LAC (Transformación Digital de Manufactura en ALC) arranged jointly by IDB Invest and NTT DATA, we found the vehicle manufacturing and construction materials industry to be the region's subsectors where the circular economy is most advanced.

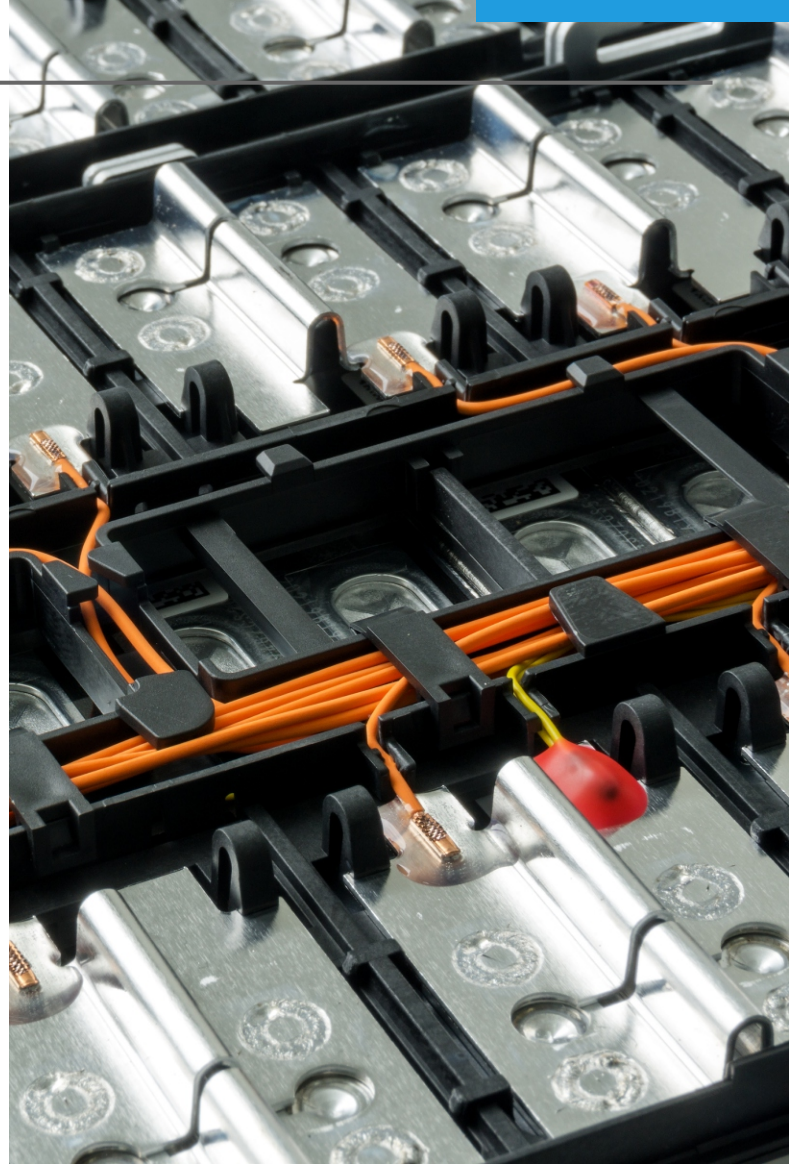
¹Cepal, 2020



Vehicle manufacturers, in particular, have begun to design products that can be more easily disassembled in order to recycle their components and reintroduce them into the production chain. This is explained by the fact that companies focused on building materials seek to reduce the use of fossil fuels to reintegrate the use of waste into the value chain and produce a new product while reducing the extraction of natural resources.

Looking further ahead, the recycling of lithium batteries stands out as the major challenge of the circular economy in the coming decade. Demand for lithium has increased by 33% since 2020, and a global shortage is expected by 2025², owing primarily to the increased adoption of electric vehicles.

In this regard, LAC has the potential to lead the way in battery recycling if certain challenges are overcome, such as the constant advancement of battery technology, the high cost of transporting hazardous materials, and the lack of a clear regulatory framework that furthers the circular economy.



EXAMPLE: CIRCULAR ECONOMY



"Contribute to a more sustainable world through the development of technologies that allow evolving from a recycling collector to a transformation with value"

VALUE PROPOSITION

They enable recycling and waste processing services to contribute to the circular economy in Costa Rica.

It is the first company in Central America to offer a comprehensive service for the recycling of lithium batteries, one of the key points of the circular economy for the next decade.

RESULTS

The lithium battery recycling program began with a pilot test in November 2022 and the results have not yet been published

OTHER PLAYERS



TECHNOLOGY

Cloud: Enable a cloud platform to ensure a traceable, responsible, and secure recycling process.

This tool allows customers to request collections of waste or recoverable materials, receive notifications, and generate real-time statistics of the entire management process.

KEY CAPABILITIES AND RESOURCES

- Pioneering system in the region for the recycling of lithium batteries
- Cloud platform where customers can manage the entire end-to-end recycling process in real time
- Investments in campaigns to raise awareness of the importance of the circular economy

ALLIANCES

Its pioneering program in the region for the recycling of lithium batteries is the result of an alliance with the German Development Cooperation Agency, GIZ

IMPACT

- They offer solutions for waste management depending on their nature
- They further the circular economy in Costa Rica

MAIN REVENUE STREAMS

- Sale of materials extracted in the recycling process
- Recycling services depending on the nature of the waste
- E2E process management platform

CUSTOMER SEGMENTS

Manufacturing companies from various fields, with a special focus on chemicals and the electronics industry.

Recycled materials are marketed for reuse in a country where mining is prohibited

CONCLUSION AND PLAYERS MAP

As has been seen throughout the document, new technologies are accelerating the digitalization of the value chain and the transformation of manufacturing with smart factories. All this while keeping in mind the growing concern for sustainability. Furthermore, it enables companies to achieve two key goals in order to maintain margins and remain competitive overall: cost efficiency and increased productivity.

In conclusion, the following illustration highlights examples of leading companies in the industry, distributed throughout the countries of Latin America and the Caribbean, that are investing in digital transformation efforts and projects.

Map of Players and Relevant Actions in Latin America's Manufacturing Ecosystem



CONTINUE THE CONVERSATION



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