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Brazil 4.0

The Data-Driven Future of Brazilian Industries

The increasing use of software technologies in other economic sectors goes by many names: smart factories, industrial technology, and Industry 4.0. What each of these terms describe is this: the increasing use of software to enhance and expand existing industries. This can range from computer-enabled systems that support assembly lines to data tools that help streamline operations and create new business models.

This trend is the result of the combination of several trends: sophisticated data analytics, integrated computing, and advanced physical systems that can revamp how industries create and deliver products and services. Data and analytics are at the heart of the opportunities brought on by Industry 4.0. Industries use data efficiently to monitor, automate, and streamline physical processes, which has tremendous positive impacts on their bottom line.[1] Today, connectedness and digitalization are spurring a new kind of industry, enabling seamless data flows, and tangible impacts. Processes that were once considered complex, are now simple.[2] Every step in the assembly and supply chain process is connected and informs the other.

Brazil, the largest economy in Latin America with the seventh largest GDP in the world, has begun to take steps toward Industry 4.0.

The level of connectedness in smart factories, for example, delivers unprecedented insight into the functions of the supply chain, from beginning to end, with detail and precision, allowing companies to monitor the status of operations and proactively address issues. This opens the door for improved business models, better services, and new revenue opportunities.[3] Many economies already are reaping the benefits of Industry 4.0, and Industry 4.0, most commonly associated with advanced manufacturing, can now be applied across sectors.

Brazil, the largest economy in Latin America with the seventh largest GDP in the world, has begun to take steps toward Industry 4.0.[4] Brazil is well-known for its oil, gas, mining, and agriculture-based economy, and is increasingly shifting toward the age when the digital and the physical will intertwine. Some of Brazil's major companies have come together to promote

the full use of technological resources available to increase Brazil's adoption and position in preparation for the global embrace of Industry 4.0.[5] The purpose of this paper is to highlight the potential of Industry 4.0 for Brazil and what steps the country can take to achieve the huge efficiency gains of smart connected networks, automated processes, and digitalization over the next five years.

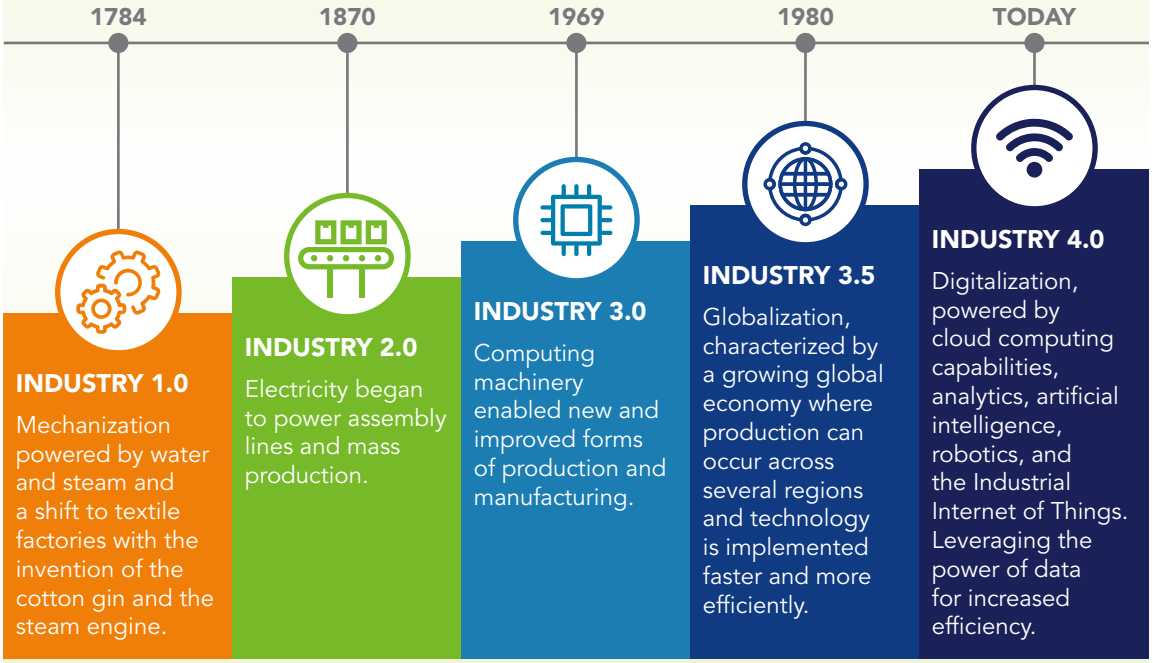
Industry 4.0 is a journey toward a portfolio of products and services that are innovative and data-driven. The end of the journey is marked by true digital enterprises with physical components connected to digital interfaces. A PricewaterhouseCoopers (PwC) survey of several countries' digitalization efforts found that industry leaders from Brazil are beginning to embrace Industry 4.0, with large gains expected within the next decade. The survey found that 41 percent of Brazilian companies can expect additional revenue, 32 percent can anticipate lower costs, and 41 percent of companies can expect efficiency gains.[6]

Expected Gains from Digitalization in Brazil Over Five Years

Source: PwC, Industry 4.0: building the Digital Enterprise

INDUSTRIAL TECHNOLOGY: PAST AND PRESENT

Each era of industrial technology has been characterized by a key trait that was responsible for an essential shift in accomplishing goals and deliverables:[7]



Source: Aberdeen Essentials

INDUSTRY 4.0: OPPORTUNITIES IN NUMBERS

The era of digitalization is here, and companies everywhere are preparing for a future propelled by data, analytics, and the cloud. According to several analyses we are already seeing the impacts of Industry 4.0:

Cost Savings

$85,000
The average savings amount per employee if companies combined five or more of the core technologies of Industry 4.0 in their business processes.[8]

$6 Billion
The additional capital gains from implementing additional Industry 4.0 technologies.[9]

$1.6 billion
Companies' average savings with industrial equipment featuring Industry 4.0 core technologies.[10]

30 percent
cost efficiency of reduced complexity and savings on engineering costs.[11]

Increased Efficiency

20 to 25 percent
decrease in costs for inventory holding.[12]

85 percent
increase in forecasting accuracy.[13]

20 to 50 percent
reduction in time to market.[14]

70 percent
savings in industrial plants with variable speed motors.[15]

In Brazil...

9 percent
of small firms expect the creation of new and improved business models with digitalization.[16]

36 to 38 percent
of small and medium firms expect Industry 4.0 technologies to improve the quality of their products and services.[17]

21 to 24 percent
of small and medium firms hope digitalization will help develop more tailored products and services.[18]

Digitalization: The Eight Technologies Enabling Industry 4.0

Industry 4.0 allows companies to gather, analyze, and use data to develop faster and more efficient processes. Industry 4.0 also changes the traditional relationships between suppliers, producers, and consumers by fostering competitiveness, economic opportunity, and growth.[19]

But Industry 4.0 is more than just the networked industry fueled by data. Behind it are technological paradigms that set the stage for greater industrial power. Data analytics, 3D printing, cloud computing, industrial Internet of Things (IoT), simulation, analytics, augmented reality, artificial intelligence, and robotics are among the new technologies enabling Industry 4.0 advances.

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- **Data and Analytics.** Each of the core technologies supporting Industry 4.0 begin and end with data. This extends from collection and storage to analysis and visualization. Properly using a company's data leads to increased production efficiencies, quality optimization, energy cost savings, and improved machinery.[20] The collection and evaluation of data comes from several sources, and this data helps inform decision making. The agriculture sector, for example, has leveraged the power of data analytics to predict changes in weather patterns and soil maximize yields, and minimize costs. By using sophisticated software algorithms, farmers can accurately predict crop yield and harvest their crop at the best time. Precision agriculture allows farmers to constantly survey their crops and address any issues on the spot.[21]

- **3D Printing/Additive Manufacturing**. With additive manufacturing, manufacturers can build parts freely and with little waste in less time. In the maritime industry, for example, additive manufacturing is changing how ship propellers are manufactured, with a hybrid additive manufacturing method using modernized machining, and grinding techniques. This new approach is a welcome alternative to the lengthy process of replacing a vessel's parts when it comes into port.[22] With faster fabrication options using additive manufacturing, the process can be completed in days with equal precision.

- **Cloud Computing**. Cloud computing has transformed business and communications by enabling businesses to access data from almost anywhere and at almost any time. For industry, cloud computing has meant improved communications and expanded integration of all actors across the supply chain.[23] Cloud platforms enable machinery on the floor to speak directly to systems at the enterprise level, connecting operations with production. Further, cloud software applications and tools allow companies to pull data from across the factory in record time, allowing for the recognition of patterns and the linking of data.[24] Cloud computing has led the development of new business models by allowing the integration of demanding manufacturing and production schedules, logistic solutions, and warehouse management.

- **Industrial IoT.** The Industrial Internet of Things is made up of the connected devices and sensors used in industrial settings — which is narrower than the world of consumer IoT devices. Industrial IoT's connected and networked nature is largely responsible for what we know today as the smart factory and the connected industry. Industrial IoT systems

include the tools, machinery, and general "things" used in the production and delivery of products and services.[25] Industrial IoT systems are the backbone for benefits such as optimization, better forecasting, and improved design functions. In many markets, including Brazil, the automotive and manufacturing industries drive the growth of Industrial IoT.[26] Automotive suppliers, for example, have reduced energy consumption — and costs — by tracking and collecting data from machines and devices to create cloud solutions for energy management.[27]

- **Robotics.** In the past, robots in factories were limited to a specified set of functions, focusing only on one task at a time. Large industrial robots have for decades completed linear tasks, such as moving or assembling components, in the production process. Today, industrial robots can do much more: they are equipped with sensors and operate at high speeds. The applications for robotics in the factory are growing. The automotive industry, for example, is reaping the benefits of advances in robotics to enhance their workers' productivity and to help decrease the strain of repetitive tasks and lifting. Some car plants place robots alongside operators to help with riveting, speeding up the process and reducing physical strain. Previously, this was solely the job of the operator, who loaded rivets by hand on two sides.[28]

- **Simulation/Digital Twins.** Simulated offline replicas of real physical parts, often called "digital twins," are leading industries into a new level of simulation and re-creation to perfect assembly and production. Digital twin simulation technology can display how the real object will behave and perform prior to manufacturing.[29] This not only allows for greater safety and product quality but also leads to immense cost savings. The economic potential of every digital twin in manufacturing is predicted to be more than $78 billion by 2025. The airline industry has begun leveraging the power of digital twin technology with the creation of an electric propulsion system that uses less fuel, creates less noise, and results in fewer emissions. The digital copy reduces the cost of development for the manufacturer and increases production speed.[30]

- **Augmented Reality.** Augmented reality (AR) technology is increasingly used in product development and industrial maintenance. AR enables an immersive experience of the production environment where industrial components are augmented virtually. AR enables users to be part of any given digitized landscape in real time. Companies have implemented AR to train workers in skilled trades. AR helps workers learn and repeat a task and provides on-demand access to instructions and training.[31] Logistics companies use AR to help workers find the faster routes for delivery and distribution, for real time-object recognition, and to red barcodes in real time.

- **Artificial Intelligence.** Artificial intelligence (AI) encompasses technologies like data analytics and robotics, but its reach extends further than that. AI-based systems augment industrial operations and supply chain management, improving production and efficiency every step of the way. AI is the technology behind generative design, a process that creates many complex and creative designs.[32] AI in the production process enables machine self-optimization, where machines adjust their parameters based on historical data. Oil refineries implement AI for maintenance by having machine learning models estimate the amount of time before machinery and equipment failure.[33] The models analyze thousands of data points to arrive at an accurate conclusion, resulting in cost savings and shorter time to market.

The Path to Brazil 4.0

In Brazil, industry leaders are quickly adopting Industry 4.0 technologies for enterprises of all sizes and sectors. Brazilian companies are aware of the opportunities brought on by digitalization, spurring the creation of new business models, revenue streams, and operations processes. They also have a keen understanding of the challenges they will face on their path to Industry 4.0. Some of these challenges are internal and will require shifts in mindsets and corporate culture, others are due to external actors and will require the support of policy leaders and significant investments in workforce development and skills training. Nevertheless, industry leaders are standing firmly by their commitment to Industry 4.0 and its unprecedented advantages. To prepare for these challenges, leaders are encouraged by partnership possibilities with diverse stakeholders and sectors. In Brazil's leading economic sectors, agriculture, mining, and the oil and gas industry, we are already seeing ways digitalization is helping optimize and enhance existing processes.

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A 2015 Siemens Customer Survey on Digitalization interviewed more than 250 Brazilian companies to gauge how important they considered digitalization and where they placed it in their priorities. The respondents — from industries like minerals and mining, oil and gas, metals, chemicals, biomass, and others — largely considered digitalization to be a switch from using information, processes and systems that were originally analog to a digital format.[34] Automation, data management, and optimization of workflows followed. When asked about the specific impacts of digitalization, most respondents expected increased resource efficiency. Many expected improvements in decision-making, energy efficiency, service processes, quality, collaboration, transparency, and faster time-to-market. New business models and a smaller environmental footprint were also on the list.

These expectations mean that the companies surveyed had a high understanding of the benefits of Industry 4.0 and were prepared for digitalization to become an integral part of their business strategy. In fact, well over half of respondents had fully or partially developed an overarching digital strategy. The survey showed that most of the barriers to full adoption of digitalization are challenges that come with any change or evolution to how things are commonly done.

Brazilian companies began their shift toward Industry 4.0 by focusing on improving production processes to increase productivity. The National Confederation of Industry Brazil (CNI) argues this focus on bottom-line advances will not help Brazilian companies fully leverage new technologies.[35] Because Industry 4.0 connects all stages of the production and delivery processes, a one-dimensional approach ignores valuable growth opportunities like new business lines. Brazilian companies and SMEs are embracing or seeking to embrace Industry 4.0, but first there are challenges and issues that are ingrained in corporate culture and country values that must shift. To experience the benefits of full digitalization, Brazilian companies need to address internal challenges such as the high costs of digitalization, the challenge of IT implementation, and cyber risks. Externally, Brazilian companies are concerned about the lack of skilled workers, identifying technology partners, and the country's telecommunications infrastructure.

What Barriers to Adoption Can Brazilian Companies and SMEs Expect on the Road to Industry 4.0?

Key internal obstacles to Brazilian companies adopting Industry 4.0	Potential solutions and approaches/ lessons learned from other adopters
High costs of digitalization	One of the pillars of Industry 4.0 is cloud computing. The cloud enables new and improved business models and services. Adopting cloud services often results in lower costs and higher returns on investments for customers than on site IT infrastructure.
Challenging IT implementation/integration	Integration and implementation may seem like a challenge due to corporate culture and barriers to adoption, but once these obstacles are removed and new IT implementation is done in stages, companies will realize this is not so difficult. Companies and SMEs should consider that cloud and IT service providers' business models rely on creating a smooth integration and implementation process for their customers.
Cyber threats	Cyber risks and vulnerabilities are major concerns for companies across the globe. Protecting critical and industrial infrastructure is essential for Industry 4.0 to thrive. Advances in cybersecurity, including in identity and access management and encryption, are steps toward secure and reliable systems.
Lack of a skilled workforce	A joint effort among government, academia, and companies is necessary to address this issue and target it collaboratively.
Telecommunications infrastructure in Brazil	The shift towards 4.0 depends largely on multi-stakeholder involvement, including government. Brazil needs policies that can help promote Industry 4.0.

Key internal obstacles to Brazilian companies adopting Industry 4.0	Potential solutions and approaches/ lessons learned from other adopters
Difficulties identifying technology partners	With this challenge in mind, the International Chamber of Commerce (ICC) has begun hosting Brazil's Alliance 4.0. The Alliance is a public-private coalition that will, among other things, include a digital matchmaking platform to connect service providers to Brazilian industries.
Government bureaucracy	Joint effort between academia and companies is necessary to demonstrate the importance of 4.0 within the government, pushing the state toto embrace Industry 4.0 and advance related technologies, without creating burdensome bureaucratic and regulatory obligations
Adjusting to the new Data Protection Law	A thorough and collaborative education process to prepare companies (especially SMEs) to adapt to the new rules created by the recently approved Data Protection Law (LGPD).

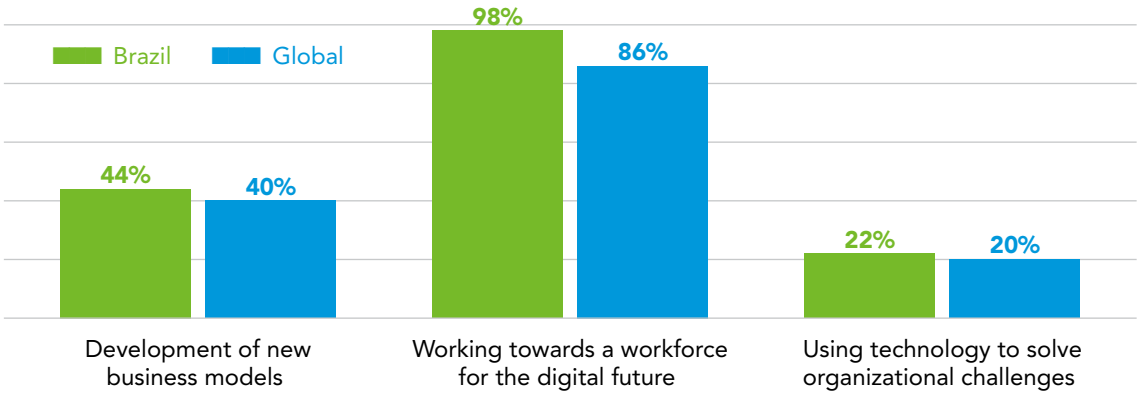
How Is Brazil Preparing to Embrace Industry 4.0?

The path to Brazil 4.0 needs to be collaborative and involve educators, government, and the private sector. Data and surveys show that Brazil's executives are ready for digitalization but need to iron out organizational, economic, and cultural aspects before moving forward. Overall, there are positive signs that decision-makers at Brazilian companies and SMEs are harnessing elements of their large and diversified economy to promote digitalization across various sectors. Brazilian decisionmakers' strengths lie in their ability to look to the future while addressing the challenges of the present. A complete digital transformation is not limited to the private sector, and the technological forces behind Industry 4.0 permeate everything from the way products are made to the way we communicate with our peers. Brazilian policymakers have led several government-backed measures to promote the long- and short-term economic well-being of Brazil's business environment.[36] Greater support is necessary for Brazilian companies to fully thrive in the era of digitalization, and collaborative partnerships and long-term strategic planning are encouraged for a successful shift to Industry 4.0.

In a survey of more than 700 business leaders, Deloitte found that Brazilian executives are doing well to prepare their organizations and workers for digitalization.[37] Leaders are optimistic due to increased infrastructure investments and social security reform that signal government

support and create a business-friendly regulatory environment. Brazilian industry leaders have demonstrated a keen understanding of the future of their economy and the benefits and opportunities of Industry 4.0.

Preparing for Industry 4.0



Source: Deloitte Global and Forbes Insights for World Economic Forum

Industry 4.0 in Brazil's Main Sectors

Oil & Gas

In its digital transformation, the oil and gas sector seeks to address factors such as new energy sources, population growth and urbanization, and carbon regulations.[38] Industry 4.0 technologies in the oil and gas sector could create between $1.6 and $2.5 billion trillion in revenue.[39] Harnessing digital solutions for oil and gas can help companies reduce costs and increase production. The oil and gas industry's digital transformation will depend on data-driven analytics and evaluation to transform operations, integrated ecosystems, new customer engagement models, and the use and promotion of new energy sources and carriers.[40] Companies are working on solutions that involve instrumentation, process control, and electrical equipment. Software solutions that draw on the core technologies of Industry 4.0, like simulation and augmented reality, allow engineers to view themselves as avatars inside an oil platform and make decisions in real time with all the necessary information.[41] By optimizing operations, the oil and gas industry has an estimated $275 billion revenue potential. The oil and gas industry is ready to embrace digitalization and drive growth and revenue: Eighty percent of decision-makers in the sector believe accurate information at the right time is critical to business.[42] This requires data-driven, real time insights and analytics. In addition, industrial IoT can help oil and gas companies gain insight from drilling parameters and geological models. Transportation, pipelines, and storage can make use of the network sophistication and data-driven insights, while petroleum refiners and retailers can expand their visibility and employ different forms of connected marketing.[43]

Mining

The mining industry faces many real world pressures: meeting the high demand for raw materials while also satisfying the strict standards of production. The digitalization of mining must involve real-time information flows and communication across the different actors and machinery involved in the mining process.[44] Mining companies that have embraced Industry 4.0 find themselves tackling previously unsolvable challenges with the help of Industrial IoT and artificial intelligence, among other technologies. Embedded sensors in remote oil wells, for example, can return large amounts of accurate, real-time data for analysis and insight.[45] The mining sector also makes use of robotics and automation with assisted and remote-control equipment and autonomous drilling and related process, delivering safer and more effective mining performance. The industry is driven by a need to remain competitive in an evolving market and improve permeance. The digitalization of mining may involve an overhaul of existing business models to build onto and develop new revenue sources.[46]

Agriculture

Agriculture is under intense pressure to adopt innovative technologies and optimize production. Demand for food production grows continuously, and society will need to increase the food production rate by more than 70 percent in the next three decades; in the meantime, 8 percent of the world's population will be undernourished within the next decade.[47] To help eliminate the issues of food scarcity and hunger, the agricultural sector can turn to Industry 4.0 technologies to optimize, streamline, and maximize food production. For example, the industry can collect more data about production with crop sensors or use satellite imagery to collect data for predictive analytics, a technique that has resulted in greater yields of higher quality.

Preparing for Brazil 4.0

To fully reap the benefits of Industry 4.0, Brazil must address pressing policy and technical challenges and issues. The benefits of digitalization are enormous, but they will be hindered if the issues below are not managed properly and collaboratively.

Digital Trust and Security

The protection of critical infrastructure and industrial systems is key for the full development and potential of Industry 4.0. Without trust, companies will be hesitant to implement new technologies. The core technologies that make up Industry 4.0 must be safeguarded and protected from malicious actors. Advances in authentication protocols and encryption are key to ensuring the security of these systems. Sectors that employ industrial control systems — like manufacturing, communications, and energy — are highly networked and connected, making them especially vulnerable to cyber incidents. To develop Industry 4.0 trustworthiness that maintains confidentially, integrity, and availability, technical solutions like strong authentication solutions and encryption must be in place.48 This requires partnerships between government and industry. Both actors should explore solutions jointly, with open dialogue.

Standards

The success of Industry 4.0 will require industry-led standards to maximize opportunities at the network level. Governments and groups on all sides can work together to develop voluntary standards that encourage interoperability and portability in the digital economy. Countries must seek to promote international harmonization of relevant tariffs and rules.

Worfkorce Development

Developing the workforce of the 21st century will be a crucial component of the adoption of Industry 4.0. Workers need to be trained and retrained with the digital skills that will allow them to create, design, develop, lead, manage, and operate core technologies like data and analytics, artificial intelligence-based systems, cloud services, augmented reality, and more. Upskilling and reskilling require a concerted effort between government, industry and educators to address and solve the issues facing today's workforce. In Brazil, the development of a technology environment should encourage parties involved to develop their workforce in order to allow Industry 4.0 to flourish and enable new employment opportunities, resulting in economic development.

Cloud Adoption

The cloud is a major component of Industry 4.0, allowing for on-demand access to data and communication. Connectedness and networked models all depend on successful adoption and implementation of the cloud. Cloud computing has opened the door for many other technologies, including analytics, industrial IoT, and robotics. Embracing the cloud as an integral business component enables the shift toward digitalization in any industry. The long-term cost savings, convenience, flexibility, security, and availability of cloud make it relevant to all business models.

Brazil has progressively developed a technology environment in which cloud computing is a key component. Incorporating cloud as an integral business component should be a natural result of its digital environment that would not only enable related technologies but also enhance the public administration's capacity to cross data and implement different public policies.

IT Infrastructure

IT readiness and appropriate telecommunications infrastructure are necessary for Industry 4.0 to thrive across Brazil. One of the external challenges to Industry 4.0 adoption identified by Brazilian companies was the lack of necessary IT infrastructure in the country.49 The core technologies of Industry 4.0 require extensive and affordable broadband access. Working toward IT readiness will encourage companies to pursue Industry 4.0 and propel the Brazilian economy to lead the shift toward Industry 4.0.

The Road Ahead

Industry 4.0 will soon become ubiquitous across every sector of the economy. In Brazil, decisionmakers have the opportunity to integrate digitalization across their major industries, from large companies to SMEs and everything in between. But Industry 4.0 requires certain technologies to emerge to their full potential, with the help of stakeholders and major actors in the economy. For Brazil, this means that academia, government, and the private sector must come together to address existing challenges and allow Industry 4.0 to flourish. These policy challenges have solutions, but there must be an open dialogue among stakeholders and a joint effort in educating on the importance of Industry 4.0 to make things happen.

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Think Deeply

Give Back

Look Forward

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