

# **Accelerating 4IR in ASEAN: An Action Plan for Manufacturers**

The question is not why but how to embrace the Fourth Industrial Revolution that is reshaping the production landscape. A structured, value-driven approach will equip regional players to leapfrog onto the global stage.



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# Executive Summary

Manufacturing is a core driver of economic growth for the Association of Southeast Asian Nations (ASEAN), contributing about \$670 billion, or 21 percent, to the region's 2018 GDP and expected to double to \$1.4 trillion by 2028.<sup>1</sup> Additionally, ASEAN has about **\$250 billion to \$275 billion in incremental value at stake by 2028**, a 35 to 40 percent increase in manufacturing value added (MVA) from gains in productivity and unlocking additional revenue streams such as new products and quality improvements by embracing Fourth Industrial Revolution (4IR) technologies.

The rise of the 4IR technologies poses a major threat to ASEAN manufacturing and its growth potential. Manufacturers' low-cost competitive advantage is gradually being eroded as competitors in advanced economies use new technologies to achieve significant improvements in cost, speed, quality, and sustainability. Contrary to the threat, 4IR also presents regional manufacturers that embrace the digital revolution with a significant opportunity: the ability to leapfrog onto the global manufacturing stage. It is therefore crucial for ASEAN manufacturers to accelerate their 4IR adoption or risk being left behind.

First and foremost, governments play an important role in driving manufacturing growth in ASEAN. However, most ASEAN countries and their governments are not yet ready for the digital revolution of 4IR, with the steps to support the rollout of technological initiatives in manufacturing remaining unclear.

Given the significant manufacturing value at stake, the imperative for 4IR implementation is a foregone conclusion. Therefore, the main challenge that leading manufacturers in the region face, regardless of industry, digital maturity, and constraints, is how to accelerate the implementation in a structured and value-creating manner.

This boils down to three essential questions:

1. What are the near-term 4IR opportunities to maximize a company's value?
2. How can solutions be implemented in a sustainable and structured manner?
3. How can the expected operational disruptions be managed to ensure business continuity?

To address these questions and ensure a successful scale-up in 4IR, manufacturers must adopt an iterative and bifocal approach that interlaces near-term use-case execution with a long-term road map. In essence, this calls for a problem-led approach that addresses specific pain points, supported by a "North Star" vision to guide the development of a strong partner ecosystem, robust infrastructure, and organizational enablers.

A six-point approach can chart the 4IR journey for ASEAN manufacturers:

1. **Focus on critical pain points.** Identify immediate problems to solve based on key value drivers specific to each manufacturing archetype: commodities, specialized, mass market, and intermediates.
2. **Identify the right technology use cases.** Understand how a problem needs to be solved and the available 4IR use cases that can be part of the solution. Develop a point of view on targets to be achieved and the ROI required for any investments to be made.

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<sup>1</sup> The ASEAN region includes Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam.

- 3. Conduct collaborative sprint-based pilots.** Co-create solutions with vendors, and test and learn in pilot sprints with fit-for-purpose governance.
- 4. Build a partner ecosystem that aligns with the long-term vision.** Choose an appropriate partnering strategy—best of breed, cornerstone partners, or single-service integrator—based on both internal and external considerations. Internal considerations include the organization’s ambition, internal capability, and capacity to manage partners. External considerations include the vendor landscape and interoperability of key solutions.
- 5. Establish a scalable infrastructure.** Ensure a step-change transformation with an immediate focus on four decision points: a reliable and scalable connectivity infrastructure, intelligent E2E cybersecurity, a universal Internet of Things (IoT) platform, and manufacturing and business systems.
- 6. Sustain the transformation momentum.** Install organizational enablers, including a digital transformation strategy, an organizational structure, capabilities and metrics, and process redesign with emphasis on man–machine interactions and continuous improvement efforts.

Finally, taking a structured, experimental approach to 4IR transformation is not a standalone mission. IT and OT partners across the ASEAN manufacturing ecosystem as well as governments have vital roles to play:

- Governments must continue to invest in building manufacturing-specific capabilities and skills while promoting innovation in manufacturing.
- Manufacturers need to stop waiting and act now to start on the 4IR transformation journey.
- Solution and technology providers need to earn the right to play, educate the market on the importance of infrastructure, and enter the conversations through the major infrastructure decision points with use-case proof points.
- Manufacturing platforms and application providers need to fortify their value propositions by offering interoperable and integrated solutions.
- IT enterprise platforms and application providers need to focus on flexibility and leverage their ERP system entry point to expand into the operational technology (OT) space.
- OT OEMs should consolidate their positioning and maximize opportunities to expand into higher value-added services.

The rise of 4IR will shape the future for ASEAN manufacturers and the region’s manufacturing landscape. Now is the time for leading manufacturers in Southeast Asia to seize the opportunities to become lighthouses for advanced manufacturing and leapfrog onto the global stage.

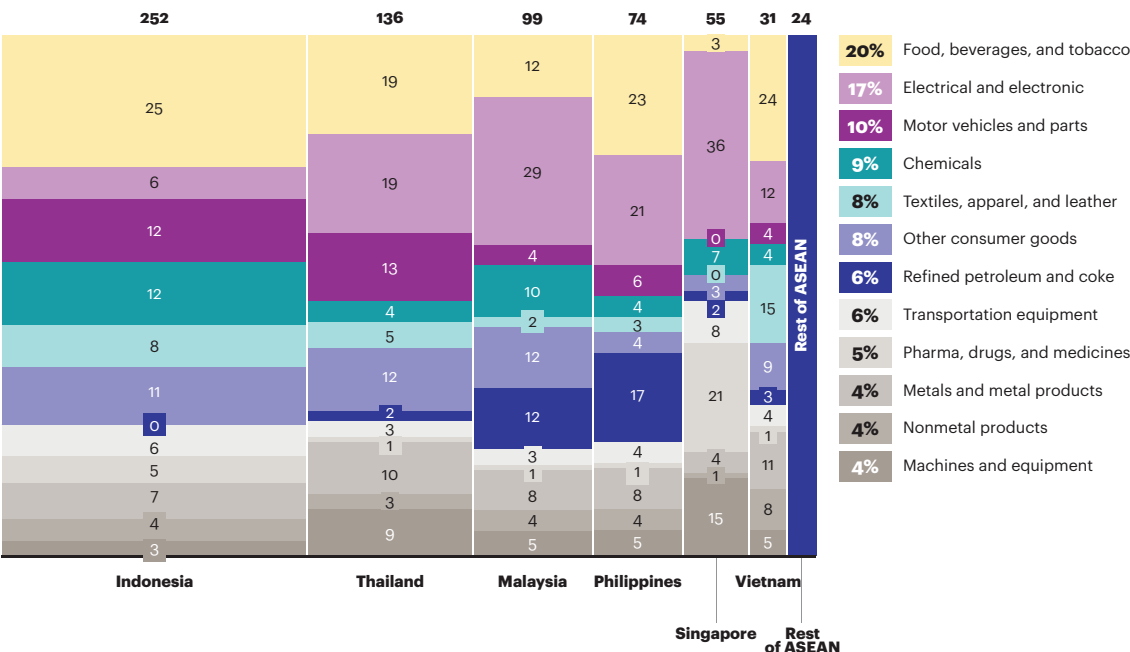
# Making the Most of 4IR in ASEAN

## Manufacturing is propelling ASEAN’s growth and will be impacted by 4IR

Manufacturing is crucial for the ASEAN region. It is a core driver of economic growth—contributing about \$670 billion, or 21 percent, to the region’s 2018 GDP—with more than a third coming from Indonesia alone (see figure 1). By 2028, manufacturing is expected to contribute almost \$1.4 trillion to the region’s economy, driven by strong growth in domestic markets as improving regulatory environments attract companies, particularly multinational corporations (MNCs), to increase investments in the region. This is both a nearshoring strategy to cut supply chain costs and a lower-cost alternative to China. The contribution would be even bigger taking into account the relevant manufacturing processes within the sizable oil and gas sector. The oil and gas sector alone contributes to about 5 percent of the region’s 2018 GDP, which is an additional \$90 billion, but this is excluded from the total manufacturing value added (MVA) because of official classifications (see Appendix on page 31: Oil and Gas Contribution to the GDP of Six Major ASEAN Economies).

Figure 1  
**Manufacturing contribution to the ASEAN economy**

**Manufacturing value added**  
(\$ billion, 2018f)



Notes: Manufacturing is based on the International Standard Industrial Classification of All Economic Activities. Rest of ASEAN includes Brunei, Cambodia, Laos, and Myanmar. Data for 2018 is extrapolated based on open-ended growth rates applied to the United Nations Industrial Development Organization's 2017 MVA. Outputs from vertically integrated companies are measured at their final output. For example, Pertamina Fuels is excluded from manufacturing and classified under wholesale and retail fuel.

Sources: IHS Markit, United Nations Industrial Development Organization; A.T. Kearney analysis

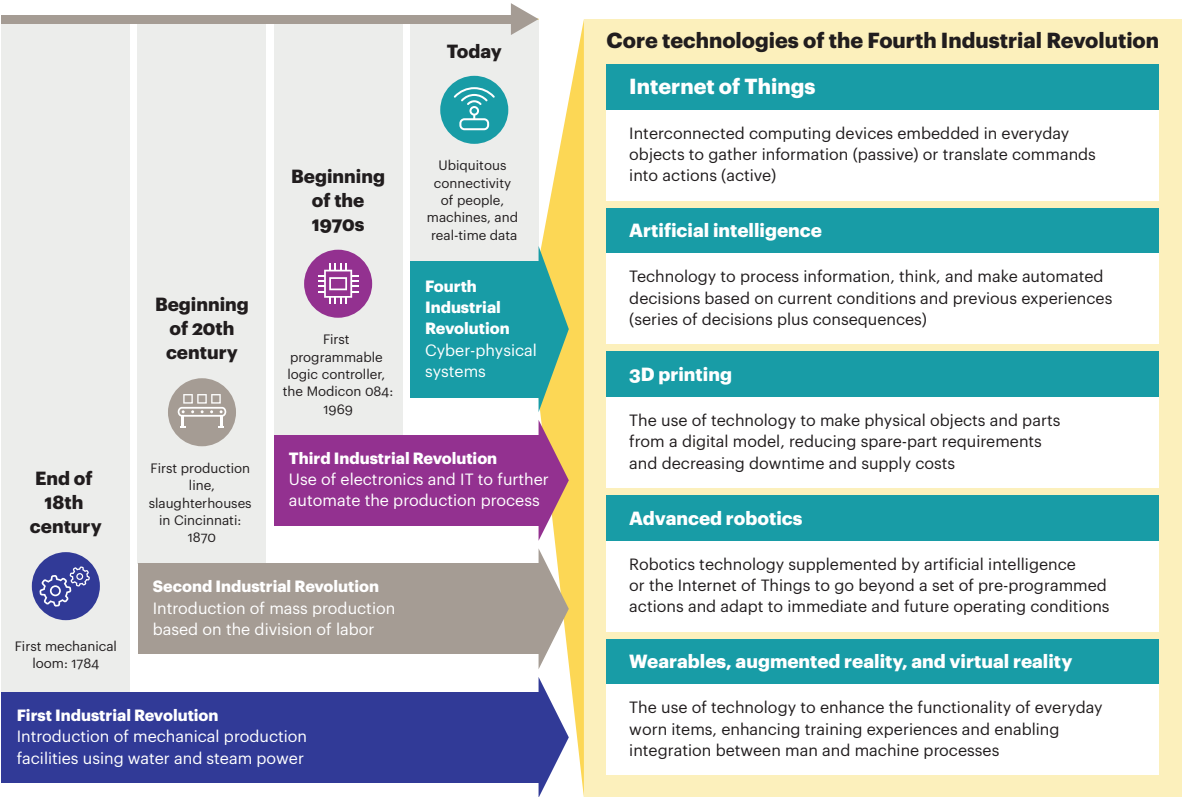
As the Fourth Industrial Revolution transforms the nature of production and reshapes the global manufacturing landscape, ASEAN is facing a significant disruption. The 4IR poses a major threat to the region’s manufacturers, which largely rely on the region’s low labor costs for competitive advantage. Many of them risk being left behind as new technologies enable competitors in advanced economies to significantly reduce costs and dramatically improve speed, quality, and sustainability.

The Fourth Industrial Revolution poses a major threat to ASEAN manufacturers, which largely rely on low labor costs for competitive advantage.

The Fourth Industrial Revolution is characterized by an intelligent and connected ecosystem of people and machines, underpinned by five emerging technologies that have been used across the manufacturing value chain to help companies derive strategic value (see figure 2).

Figure 2  
Five advanced technologies are transforming manufacturing

Timeline of industrial revolutions



Source: A.T. Kearney analysis



- **Internet of Things (IoT).** One of the fastest-growing technologies and expected to reach maturity across the manufacturing value chain by 2030, the IoT is highly valued by companies with a wide range of distributed and mobile assets that would like to enhance their asset connectivity, conduct remote analytics, and improve business intelligence.
- **Artificial intelligence (AI).** Likely to be one of the most impactful technologies with a diverse range of solutions at various levels of maturity, including machine learning, decision-making, and computer vision, AI has many applications across industries and will enable new levels of automation, resulting in both economic and social implications.
- **3D printing.** A rapidly maturing technology with multiple government initiatives conducted globally through research centers and public-private projects, 3D printing is disrupting the traditional manufacturing processes and democratizing the personalization of products. However, its impact is still mostly limited to prototyping and for high-mix, low-volume products unless its accessibility and affordability improve.
- **Advanced robotics.** Similar to AI, advanced robotics has a diverse range of solutions at various levels of maturity, including soft co-bots, autonomous vehicles, and remote robots. Manufacturing and transportation are the key industries that will undergo a revolution, significantly reducing their long-time dependence on labor and reverting the offshoring trend.
- **Wearables.** Growing and maturing technology that allows the integration of man and machine to the greatest extent, wearables is rapidly maturing. The range of applications has continued to evolve and expand to significantly drive improvements in manufacturing performance. These include increasing safety awareness and injury prevention, hands-free training through augmented reality, and anytime monitoring through remote processing.

With its proven ability to deliver a step change in manufacturing performance across the value chain, 4IR is redefining the competitive landscape. The resulting benefits for speed, quality, cost, and sustainability have reversed years of decline for traditional manufacturing powerhouses such as Europe and the United States, where labor costs are high, and substantially leveled the playing field between advanced and developing economies (see sidebar on page 6: Three Companies Use Digital to Gain a Competitive Edge).

Likely to be one of the most impactful technologies, AI has many applications across industries and will enable new levels of automation, resulting in both economic and social implications.

Most manufacturers recognize that 4IR presents a major opportunity, with the leaders anticipating a potential 3 to 5 percent increase in their return on invested capital from multiple areas (see figure 3 on page 7). The profitability driver tree will provide a useful framework to guide manufacturers on better understanding and detailing the varying functional improvements and associated benefits that can be derived through 4IR implementation.

For example, manufacturers may potentially derive between 3 to 5 percent functional improvement in yield with benefit implications on both cost and quality. However, as with most technologies, 4IR implementation will require careful orchestration as proven use cases need to be brought together to derive real benefits.

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### Three Companies Use Digital to Gain a Competitive Edge

#### Adidas smart factories

In 2015, more than 20 years after closing all but one of its 10 German shoe factories, Adidas opened its Speedfactory in Ansbach, Germany. The smart manufacturing facility is highly automated with robots controlling tooling and production line changes. Combined with the nearshore benefit of being in Europe instead of Indonesia or Vietnam, it has cut down the time-to-market from 18 months to just four. On the back of this success, Adidas announced plans in 2017 to build a similar factory to cater to the American market. A 74,000-square-foot facility near Atlanta is now making shoes using automated digital manufacturing. For multinationals such as Adidas, the ability to cost-effectively nearshore manufacturing plants is win-win: improving supply chain agility and presenting opportunities for strong publicity campaigns.

#### Boeing's AR wire harnesses

Wiring aircraft is a highly complex

task requiring engineers to navigate thousands of cables and inputs, historically using a "wire harness"—a PDF document with a road map to find and connect wires. Workers find specific wire numbers using the document's search function, translate instructions into real-world activities, and then take the appropriate actions. Boeing had been seeking a way to easily communicate this vital information to workers over a lightweight headset. In 2015, the company deployed a voice-controlled wire harness hosted on Google Glass, an augmented reality headset. Workers can see clear instructions as they carry out their tasks and get real-time expert assistance. By improving access to information, assembly time decreased by 25 percent, and error rates were significantly reduced.

#### Cisco energy management

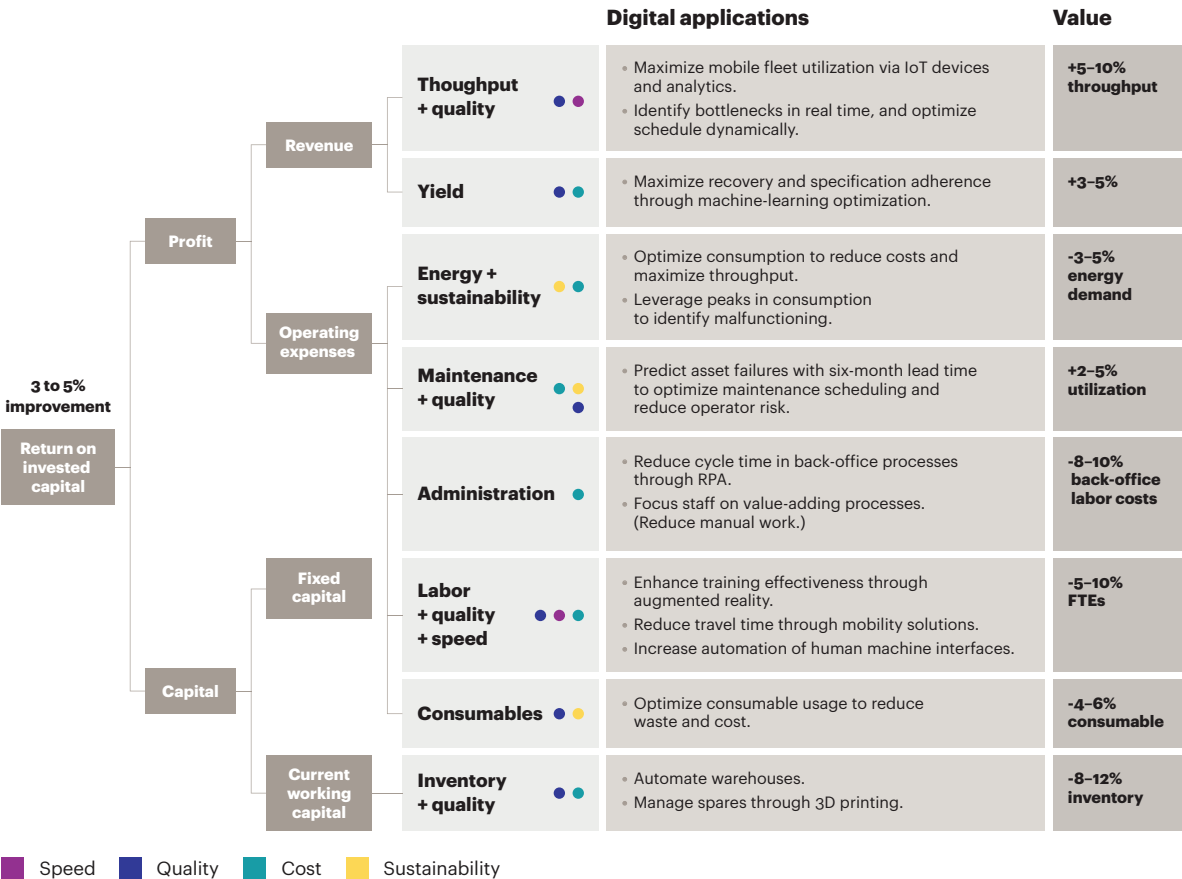
Cisco produces more than 38,000 stock keeping units across more than 100 outsourced

manufacturing nodes. In such complex operations, energy costs were often overlooked even though some processes were consuming high volumes of electricity. In 2017, using newly installed cross-plant sensors at a Malaysian plant, Cisco was able to benchmark the plant's heat chambers against one another for the first time. Collected data identified suboptimal operating parameters, noting that one chamber consumed much more energy than the other, despite their throughput being on par. Modifications to operating parameters enabled a 20 percent reduction in energy consumption. Furthermore, awareness about energy consumption helped identify optimal operating hours for testing as electricity prices vary depending on the time of day. Pilot programs suggested a \$1 million per year saving at a total cost of \$200,000. Cisco plans to deploy this at more plants across the region.



Figure 3  
**4IR can deliver a significant increase in profitability for manufacturers**

**Profitability driver tree (example)**



Notes: 4IR is the Fourth Industrial Revolution; RPA is robotic process automation; FTE is full-time equivalent. For value, the applicability and impact can change based on industry and geography. Very rarely can multiple levers be absorbed in one go; it will take time.  
 Source: A.T. Kearney analysis

## Significant challenges in getting ASEAN 4IR ready

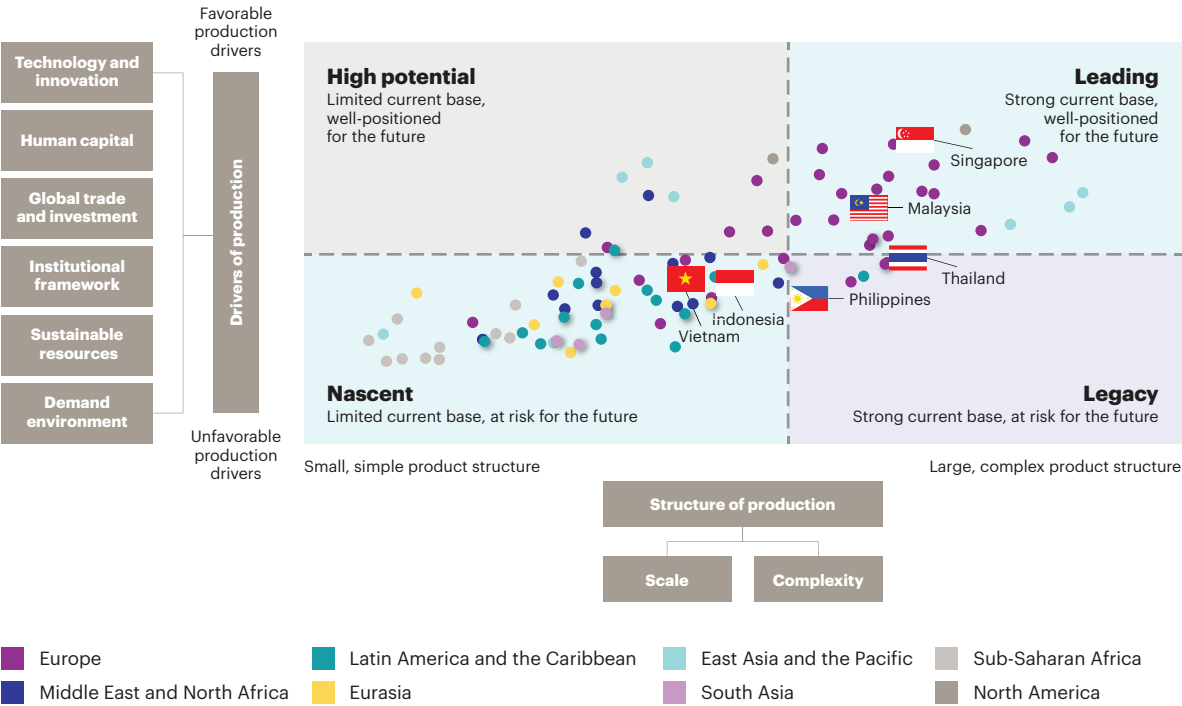
### The region is at risk of being left behind

ASEAN is lagging advanced economies in terms of 4IR implementation and overall digital maturity. Most countries in the region are not ready for 4IR, partly a reflection of the lower levels of economic development, but also driven by the fear of job losses and a focus on service industries. A 2018 World Economic Forum and A.T. Kearney study evaluated countries on their readiness for advanced manufacturing, including 4IR, along two important dimensions: drivers of production and the structure of production (see figure 4 on page 8).<sup>2</sup> The study found a big variance in readiness across the region, with only Singapore and Malaysia being well-positioned for the future—leaving the remaining ASEAN nations at high risk. Singapore is a front-runner in developing its 4IR strategy, with manufacturing-specific initiatives focused on capability development, immersive overseas business missions, and a smart industry readiness index to

<sup>2</sup> Drivers of production refer to six main enablers that allow a country to capitalize on emerging technologies and future production opportunities: technology and innovation, human capital, global trade and investment, institutional framework, sustainable resources and demand environment. Structure of production looks at the complexity and scale of a country’s current production base.

Figure 4  
**Most ASEAN countries are not ready for the Fourth Industrial Revolution**

**World Economic Forum country readiness framework**



Note: The average performance of the top 75 countries is at the intersection of the four quadrants to create the archetype borders.  
 Sources: World Economic Forum; A.T. Kearney analysis

enable manufacturers to self-assess their preparedness levels.<sup>3</sup> Singapore’s Agency for Science, Technology and Research even built a model factory that allows manufacturers to co-develop and test the latest technologies.

For many ASEAN leaders, the prime concern about 4IR pertains to the impact on jobs. There is a perception that technology will replace humans, hurting the livelihoods of many manufacturing workers and stifling ASEAN’s economic growth. In 2018, several reports examined this assumption and surmised that job losses may not be as big as anticipated.<sup>4</sup> The nature of roles will change, and in many sectors, more jobs will ultimately be added. A joint Cisco–Oxford Economics study released in September 2018 predicts that 4.3 million roles will be displaced in ASEAN’s manufacturing sector over the next 10 years, to be replaced by 4.9 million new ones. Traditional manual labor-based efforts will be substituted by higher-skilled cognitive roles such as IT, cybersecurity, and analytics. For example, engineers will no longer be focused on walking the factory floor to inspect machinery, collect data, consult reference manuals from original equipment manufacturers (OEMs), and replace parts based on a defined schedule. Instead, engineers and data scientists will work together to optimize conditions and processes by analyzing data and recommendations collected through sensors and processed by machine-learning algorithms.

<sup>3</sup> The Economic Development Board, in conjunction with Enterprise Singapore, has run numerous business missions to Germany, inviting manufacturers to view advanced manufacturing products and capabilities in person, according to an April 2018 media release from Enterprise Singapore

<sup>4</sup> *Shaping the Future of Production*, World Economic Forum, 2018; *Technology and the Future of ASEAN Jobs*, Oxford Economics, 2018; *Developing the Workforce for a Digital Future*, Australian Industry Group, 2018

Slowed by the need to safeguard employment, most ASEAN governments are still in the early stages of developing national 4IR strategies. While Singapore has taken the lead with its 4IR initiative, Indonesia, Malaysia, Vietnam, and Thailand are just getting started on the digitalization path in the manufacturing sector. National strategies are mostly focused on strengthening workforce capabilities by establishing training programs and new educational institutions as well as building a strong ecosystem to foster investment. However, government focus and policies primarily remain oriented toward service industries and e-commerce. Direction and support for rolling out 4IR in manufacturing remain limited. This is largely because manufacturing covers multiple industries, requiring not only more intervention and technology development, but also a significant amount of collaboration among and between companies and governments across a region that is becoming more interconnected through trade and investment.

### ASEAN manufacturers are not yet prepared for 4IR

As part of our research for this report, we interviewed a broad range of leading manufacturers across ASEAN—including food, beverage companies, and heavy industrials manufacturers, both multinational corporations and large regional companies. The objective was to understand where they stand in their manufacturing digital journey, their 4IR approach, and the obstacles they face in implementation. What we learned is that while the larger companies are at the higher end of the digital maturity scale relative to the overall manufacturing sector, most of the region's manufacturers are in the early stages of their digital journey and are operating in an outdated model that is more in line with the Third Industrial Revolution of about five years ago.

In contrast to small and medium-size enterprises (SMEs), awareness and understanding of 4IR technologies is high among larger companies. Nevertheless, 4IR adoption remains slow and patchy. A 2018 survey of more than 230 manufacturers across ASEAN showed that only 15 to 25 percent have fully adopted major 4IR and related technologies such as cybersecurity, cloud, automation, big data and analytics, artificial intelligence, and IoT.<sup>5</sup> There are five main reasons for this:

- 1. Enduring low labor costs.** Regional companies in traditionally labor-intensive industries such as tobacco manufacturing in Indonesia are, in particular, less inclined to view 4IR and digital initiatives in general as a priority. According to a solution provider in Indonesia, “many manufacturers feel that current manual processes are adequate, the cost of investment is not justifiable, and if they are too early, then they are wasting money.” In fact, manufacturers fear that by moving first, they will incur higher costs while making it easier for industry peers to replicate the processes. With the exception of Singapore, factory wages remain low across ASEAN and are hindering 4IR adoption even among some global corporations that have a presence in the region. As one MNC representative put it, “The cost of a robot is still \$40,000. For that same cost, we can employ three to four people in our Indonesian factory.”
- 2. No immediate customer demand.** Although digital products, including personalized offerings that are available online, are starting to gain popularity in ASEAN countries, customer demand does not yet require manufacturers to incorporate seamless and agile processes. A Vietnamese company in the oil and gas industry noted that although the company would love to offer more app-based services, many truck drivers do not yet own smartphones. On the other hand, in more sophisticated and largely automated industries, such as petrochemicals, there is an urgency to “out innovate” competitors. An international petrochemicals company with operations in Malaysia sees the potential for 4IR to not only

<sup>5</sup> Cisco Manufacturing Readiness Survey 2018

improve productivity of an already skilled workforce, but also influence market perceptions and decrease operational risk.

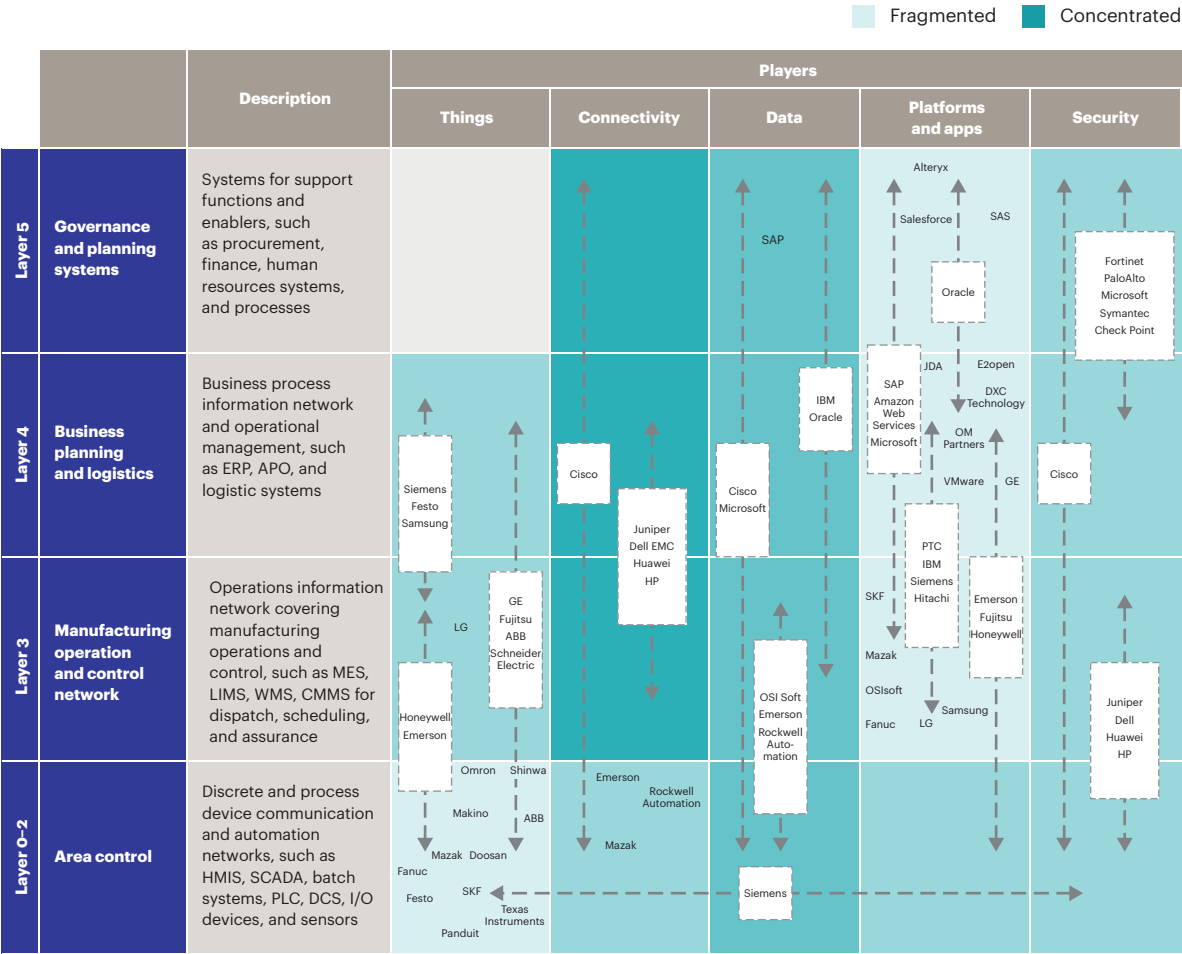
**3. Difficulties in accessing required experts.** Access to skilled talent and experts remains a crucial challenge for manufacturers; global talent is too expensive for many of them. An industrial manufacturer with a large plant network across ASEAN lamented that manufacturing is not attracting top local talent, creating a real skills gap in advanced manufacturing. Moreover, the adaptation of 4IR solutions to specific industries and processes “requires experts that are not easily found in the region and have to be imported from expensive Western countries.” With the exception of Singapore, fewer than half of the people who complete secondary education in ASEAN countries go on to tertiary education, according to UNESCO. Even fewer choose courses related to science, technology, engineering, or math (STEM). Multinational corporations have a natural advantage in this space because they can rely on their global experience and talent to kick-start initiatives and ensure challenges are addressed effectively. However, more advanced regional companies are looking to partner with educational institutions to directly upskill their workforce. A leading petrochemicals manufacturer we spoke to had just established a one-year data scientist training program with a university, with the expectation of enrolling 50 selected employees.

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**4. A complex and fragmented supplier ecosystem.** Manufacturers are often unsure how to navigate the complex and changing 4IR supplier landscape, particularly with the convergence of IT and OT. Market players have diverse offerings that are diverging from their core propositions. Manufacturing equipment OEMs such as Siemens are moving into software and industrial automation solutions through acquisitions and partnerships. For example, Rockwell Automation is partnering with global company PTC to expand its IoT and augmented reality offerings. Enterprise IT companies such as SAP have diversified into operational analytics and intelligence, while Microsoft has invested \$5 billion over five years in Azure IoT solutions and is developing a partner ecosystem of manufacturing solutions that include system integrators and independent software vendors. IT network providers such as Cisco have further expanded horizontally into adjacent infrastructure services, including data computing and security. Historically, while OT players have been the point of call, the emergence of more functionality from the IT space is raising questions about identifying the best partners to deliver the right balance of operational understanding and new age innovation (see figure 5 on page 11). An ASEAN agri-business unsystematically pilots 4IR use cases opportunistically recommended by OT providers. However, the company is unsure if they are the highest-impact use cases or the most suitable solutions and remains uncertain of how to navigate multiple interdependent providers during scale-up.

Figure 5  
**Many manufacturers struggle to navigate the 4IR supplier landscape**

**Manufacturing ecosystem**



Notes: There are two dimensions to the manufacturing supplier landscape: the operating environment (as defined under ISA-95) and architectural elements (similar to the ICT stack). “Things” refer to sensors, machines, robots, wearables, systems, and people. 4IR is the Fourth Industrial Revolution. ERP is enterprise resource planning; APO is advanced planning and optimization; MES is manufacturing execution system; LIMS is laboratory information management system; WMS is warehouse management system; CMMS is computerized maintenance management system. HMIS is HMIS is health management information system; SCADA is supervisory control and data acquisition; PLC is programmable logic controller; DCS is distributed control system; I/O is input/output.

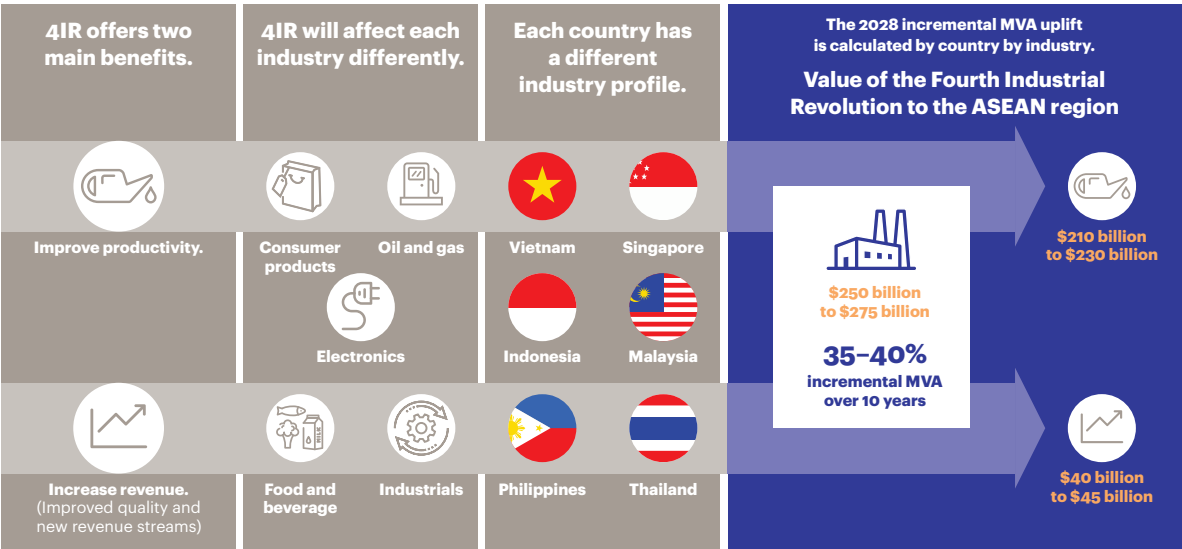
Source: A.T. Kearney analysis

**5. Unclear and very short-term oriented business cases.** The costs of acquiring and implementing new technologies can be considerable, making it hard for manufacturers to justify business cases. Investment cases may also not meet the required one- to two-year payback period because they are often founded on individual use cases. While use cases such as advanced robotics and 3D printing may require a high upfront capital investment, the cost of equipment such as IoT sensors, is falling rapidly, and more flexible investment options are appearing in the market. The subject-matter experts we interviewed globally say manufacturers are often misled by glossy marketing images of sophisticated robots, overlooking the fact that much of the value of 4IR comes from low-investment analytics use cases. Manufacturers need to recognize that infrastructure can be shared between use cases and that a strong business case will consider the integration of multiple functions and benefits, with less focus on point solutions, which may not justify the investments. By taking a larger view of investments, even seemingly high payback periods can become manageable.

# Substantial value is at stake for ASEAN and its leading manufacturers

By 2028, ASEAN has about \$250 billion to \$275 billion in incremental value at stake which is 4IR led, representing a 35 to 40 percent increase in MVA (see figure 6). This would largely be driven by productivity gains and additional revenue streams such as new products and quality improvements. Manufacturing in the region is expected to double over the next decade—from \$670 billion to \$1.4 trillion—driven by strong growth in domestic markets and capturing outflows from China. The 4IR can safeguard this expansion and propel the region to become the next global manufacturing hub.

Figure 6  
The value of ASEAN manufacturing could skyrocket



Note: ASEAN is the Association of Southeast Asian Nations; 4IR is the Fourth Industrial Revolution; MVA is manufacturing value added.  
Source: A.T. Kearney analysis

Productivity gains from 4IR will, first and foremost, be a product of industry-specific use cases. The productivity impact will be 6 to 9 percent in the industrial manufacturing and automotive sector, 5 to 8 percent in food and beverage, and 4 to 7 percent in other manufacturing industries.<sup>6</sup> The total incremental productivity gain by 2028 is expected to be about \$210 billion to \$230 billion, driven by decreases in production costs, higher yields, improved quality, and more efficient time to market.

Furthermore, 4IR can also help improve topline growth by enabling companies to develop more innovative and better-quality products. For example, BMW is using 3D printing to produce a lighter and stronger roof bracket for its i8 Roadster. The complex component and its required flexibility were previously impossible to cast. Today, BMW can print more than 600 brackets in each batch without additional support. Manufacturers globally expect 4IR to add between 8 to 14 percent in revenue over five years. However, considering ASEAN’s less mature starting point,

<sup>6</sup> For this study, we assumed this impact will occur over a 10-year period with a backloaded ramp-up profile, wherein 25 percent of total gains are achieved in the first five years and 75 percent are delivered equally over the final five years. To calculate the benefit, we multiplied the productivity impact percentages by estimated expenditure on a per industry, per country basis. Estimated expenditure: MVA x (1 minus average net margin)



we assume this growth will be distributed over 10 years. Hence, a total revenue margin contribution of \$40 billion to \$45 billion is expected by 2028, against a total revenue uplift of about \$450 billion.<sup>7</sup>

## Three Big Questions Hampering Implementation

Despite so much value at stake, ASEAN manufacturers continue to face obstacles in implementing 4IR. Some of the issues include the following:

- “There are multiple technologies for 4IR, but what are the applicable solutions for us as manufacturers? How do we prioritize the solutions?” —**industrials manufacturer**
- “A large-scale rollout for 4IR is highly unlikely as it impacts on our current operations. There are too many solutions and providers that we need to assess, and we don’t have the necessary capabilities. Besides, it is difficult to justify the payback for such a significant investment.” —**agribusiness company**
- “Are the solutions secure? We have a significant level of confidential information.” —**petrochemicals manufacturer**

With so much value at stake, there needs to be a strong imperative for ASEAN manufacturers to clearly identify priority roadblocks in their path to digitalizing their manufacturing operations and devise a structured value-driven approach to accelerate 4IR implementation.

The biggest obstacles for ASEAN manufacturers are in execution. In addition to the limited availability of use case implementation in the region, manufacturers also face the prospect of undertaking a guided discovery process to select the right use cases, run pilots, develop business cases that make sense, and ultimately scale pilots that they have run. Regardless of the size and digital maturity of companies—as well as constraints imposed by labor costs, customer expectations, access to skilled workers, supplier ecosystem complexity, and company budgets—manufacturers’ main challenges boil down to three crucial questions:

### 1. What are the near-term opportunities for 4IR to maximize a company’s value?

- **Major uncertainty about solutions and priorities.** Although numerous use cases and solutions are available, there is uncertainty about where to start and how to prioritize the use cases. “Most of our plants are already automated, but not 4IR [ready]. Where are the applicable solutions? They are mostly in logistics, but not yet in manufacturing.” —**semiconductor manufacturer**
- **Steep costs and myopic business cases.** There is a perception of significant investment requirements and narrow consideration of productivity benefits. “We are focused on rolling out a single ERP and CRM system. Widespread adoption of 4IR use cases are limited because we require a one-year payback period.” —**industrials manufacturer**

### 2. How can solutions be implemented in a sustainable and structured manner?

- **Lack of clarity about scalability.** There is uncertainty around scalability of pilots across machines, factories, and geographies. “We have been piloting use cases for years, but scaling is a struggle as each factory is different.” —**agribusiness company**

<sup>7</sup> To ensure like-for-like comparisons, we converted the revenue uplift back to an earnings before interest and tax (EBIT) figure to align it with productivity. Net margin was estimated based on the average net margin from top listed companies on a per industry and country basis.

- **Complex and fragmented supplier and solution ecosystem.** Manufacturers struggle to navigate a complex ecosystem to support sustainable E2E changes. “We are ready to invest, but we need assistance from vendors. Which is the best solution? There are so many scattered solutions, but limited E2E solutioning.” —**automotive MNC**
- **Significant challenge in stepping up capabilities.** Manufacturers have difficulty accessing appropriate digital skills not only in terms of understanding available 4IR solutions, but also for operating, troubleshooting, and deriving insights from data. “We have simple single input-output controls but need the right skills to work the more advanced technologies.” —**cement manufacturer**
- **Inadequate connectivity and data infrastructure.** There is a lack of a suitable connectivity backbone and data collection and management infrastructure to support 4IR technology. “Intermittent issues with Wi-Fi connectivity on the production floor can be detrimental to the utilization of the new technology as the technology is extremely reliant on always being connected.” —**automotive MNC**

### 3. How can the expected operational disruptions be managed to ensure business continuity?

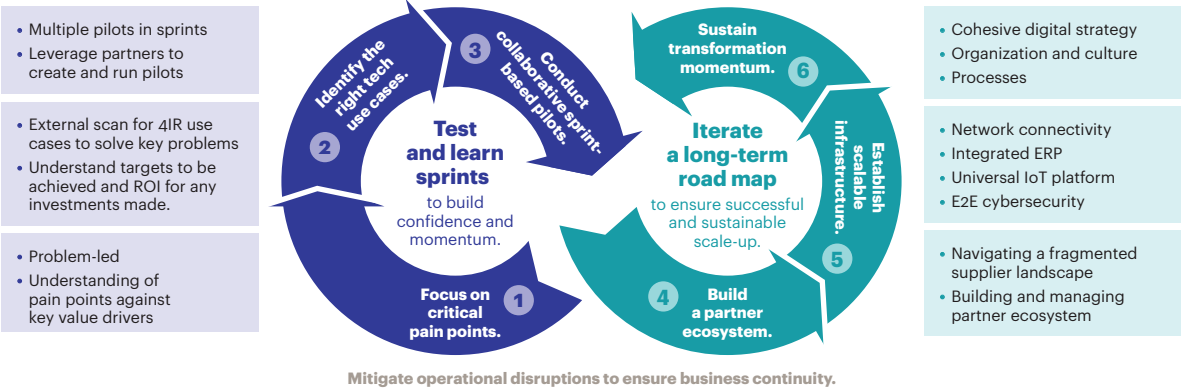
- **Concerns about business interruption and continuity.** Manufacturers face the risk of operational disruption and need to consider non-invasive solutions that are implementable while the plant is running. “Some of our plants are [more than] 25 years old. They aren’t designed to be connected. We [will] have to shut down the plant to upgrade the systems, and we can’t afford that.” —**petrochemicals company**
- **Cybersecurity risks during pilots and scale-up.** Manufacturers are concerned about sandboxing pilot environments to avoid disruptions and guarding against cybersecurity threats with widespread connectivity and numerous endpoints. “Security for connected solutions is a top priority across the network, data and OT and IT systems. It needs to be E2E and centrally managed” —**solutions provider**

## A Bifocal Approach to Meeting the 4IR Implementation Challenge

ASEAN manufacturers’ 4IR journey requires navigating a sea of systemic and other challenges before finding solutions in a highly dynamic technological landscape. The rapid pace of technological advancement and the region’s limited 4IR proficiency mean there is a dearth of solutions that are mature enough for plug-and-play deployment, requiring co-development with manufacturers. To traverse the uncertainties surrounding new and scattered solutions, a fragmented partner base, and limited capabilities, ASEAN manufacturers must devise an experimental and iterative bifocal approach by interlacing near-term use-case execution with a long-term road map for advanced manufacturing. This calls for a focus on solving specific problems at hand without losing sight of the broader vision—a “North Star” common and aspirational target-state ambition to guide them toward the digital transformation of manufacturing operations that their future rests upon. Keeping this “North Star” in mind is important to achieve step-out advancement and avoid incremental progress over time, a risk stemming from the short-term and sequential focus on discrete use and business cases.

ASEAN manufacturers can use a six-point approach to chart their 4IR journey (see figure 7):

Figure 7  
**ASEAN manufacturers need an experimental and iterative bifocal approach to 4IR**



Note: ASEAN is the Association of Southeast Asian Nations; 4IR is the Fourth Industrial Revolution; ERP is enterprise resource planning; IoT is the Internet of Things; E2E is enterprise to enterprise.

Source: A.T. Kearney analysis

- 1. Focus on critical pain points.** Use advanced technologies to resolve critical pain points to improve speed, quality, cost, or sustainability.
- 2. Identify the right technology use cases.** Understand how a problem needs to be solved, and recognize the available 4IR use cases that could be part of the solution—and not the other way around (that is, what can we do with IoT?). In parallel, develop a point of view on targets to be achieved and the ROI required for any investments to be made.
- 3. Conduct collaborative sprint-based pilots.** Leverage supplier-led pilots to test solutions, how they fit into the operating environment, and their effectiveness in solving the problem.
- 4. Build a partner ecosystem that aligns with the long-term vision.** Create a partner ecosystem early based on an appropriate partnering strategy that aligns with the organizational ambition, target-state infrastructure, and level of maturity.
- 5. Establish a scalable infrastructure.** Understand what infrastructure is required to effectively and sustainably scale pilots across network.
- 6. Sustain the transformation momentum.** Ensure that organizational enablers are in place to push and maintain transformation momentum.

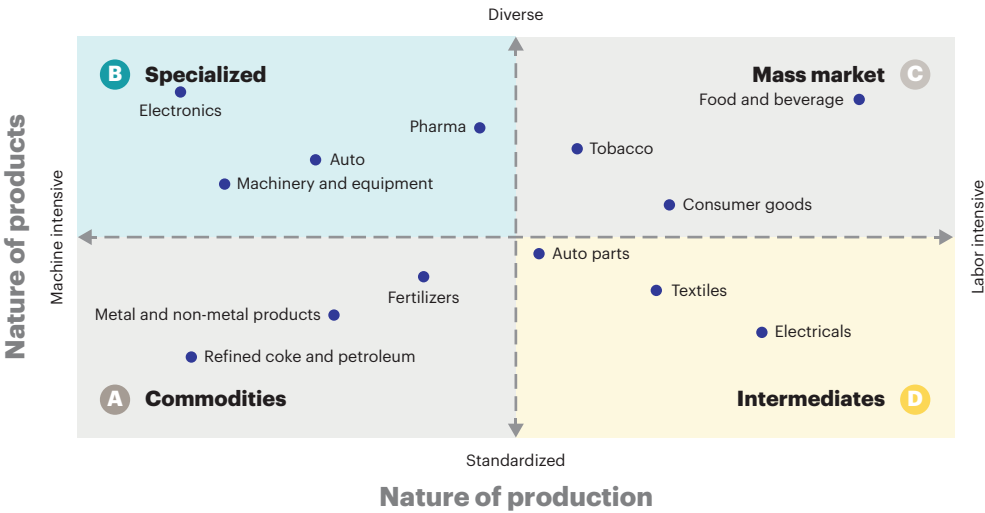
## 1. Focus on critical pain points

Initiatives for 4IR need to be problem-led. Often, the hype surrounding new technologies overshadows the basic question of what is the problem that needs to be solved. This can lead to counterproductive efforts where technology solutions are forced to fit or superfluous. A structured, problem-led approach involves collecting and understanding the manufacturing pain points across the business and prioritizing them according to the most important value drivers. Recognizing the manufacturing archetype is the first step toward identifying the major value drivers and prioritizing problems that need to be solved.

The manufacturing archetypes in this report have been defined based on a combination of the nature of products manufactured (diverse versus standardized) and their production methods (mechanized versus labor intensive). Each of the four archetypes has a specific set of differentiating characteristics (see figure 8):

Figure 8  
**Technology solutions need to be tailored according to manufacturing archetypes**

**Industry by manufacturing archetype**



Note: This is a generalized classification of industries. Manufacturers often have a portfolio spanning multiple industries, and within these industries, they may have products that fall under a different archetype. For example, a company may manufacture consumer goods that include both shampoo and pharmaceuticals. Within pharmaceuticals, over-the-counter drugs share more similarities with the mass market archetype, whereas specialty drugs may be by nature more specialized. Archetype identification should be applied at the appropriate business unit or product level.

Source: A.T. Kearney analysis

- **Commodities** are characterized by standardized products with minimal differentiation in the market. They generally undergo machine-intensive process-based manufacturing where the manufacturing is continuous in motion and mechanically driven with limited labor intervention. Examples of industries that fall under this segment include raw materials, agriculture, oil and gas, mining, and other mass-produced products such as chemicals. In addition, the operating environment for these industries is likely to be hazardous with safety as a prerequisite for operations.
- **Specialized** industries have diverse, high value-add products that target distinct requirements in the market. Thus, R&D capabilities are a competitive factor for these industries. Products undergo discrete or hybrid manufacturing with a high level of mechanization and precision. Examples of industries include automotive, high-value electronics (such as semi-conductors), pharmaceuticals, and industrial machinery.
- **Mass market** industries are also characterized by a diverse set of products with large volumes that cater to differing market requirements. The products are likely to be of lower value-add and faster moving than in the specialized industries. Products are generally an output of discrete or hybrid manufacturing, but because of the lower value-add, they tend to be more manual intensive across the manufacturing process. Examples of industries include food and beverage, fast-moving consumer goods, apparel, and tobacco.

- Intermediates** have products that are relatively standardized and can be components for other products, similar to commodities. However, unlike commodities, they are usually produced via discrete or hybrid manufacturing with a higher level of manual intervention. Examples of industries include automotive parts, electrical components (such as memory cards), textiles, and consumer white goods.

Based on the differentiating characteristics, each archetype will have distinct prioritization of their value drivers and the associated pain points to be resolved.

Ten manufacturing value drivers address speed, quality, cost, and sustainability outcomes (see figure 9). Although pain points vary by archetype, and indeed by company, there are broad similarities in the way each archetype prioritizes its main value drivers. For example, asset utilization, safety, and environmental responsibility are consistently the top concerns for heavy industries such as chemicals, which require continuous machine-intensive production in hazardous environments. Through the course of our interviews, we heard pain points relating to asset utilizing ranging from basic visibility issues (“lots of machines, lots of parts, while our team focuses on the major pieces of equipment; it would be helpful to see what assets I have and whether they are running or not”) to more sophisticated optimization challenges (“it would be ideal if we could accurately predict when parts need to be replaced to optimize MRO costs versus downtime”). These, however, would be lower priorities for mass market and intermediate archetypes with labor-intensive production.

Figure 9

**Manufacturers prioritize different value drivers in line with their archetype**

	Factors:	Commodities	Specialized	Mass market	Intermediates
Speed	Time to market		High R&D, innovation-driven		Essential inputs to other products
Quality	Quality		Complex specifications, high precision	Consumer health standards	
	Traceability			Critical product integrity (for example, allergies and organic)	
	Reliability				
Cost	Labor productivity			Low margin, reliance on manual labor	Low margin, reliance on manual labor
	Materials cost				
	Asset utilization	High capital costs, high volume	High capital costs, specialized equipment		
	Planning effectiveness		Complex supply chain, high cost of delays	Multiple suppliers, perishable goods	
Sustainability	Safety	Remote, hazardous environment			Dangerous working environment
	Environmental responsibility	High risk of pollution and contamination			

Priority:  High  Medium  Low


Note: Priorities are relative to the other value drivers within the industry.  
 Source: A.T. Kearney analysis

On the other hand, specialized manufacturers producing advanced semiconductors and data communications hardware value fast time to market, quality, planning effectiveness, and asset utilization. Products are innovation-driven with complex specifications that require high-precision machine assembly and a multitude of parts sourced globally. Manufacturers are under pressure to have flexible production processes that can keep pace with new product development (“new lines come out every six to 12 months as new chips or other components get released; this means new processes, tooling, etc.”). This is made more difficult by complex product specifications with a low margin for error (“a small deviation in temperature when setting one layer means the whole product must be scrapped”). For a detailed breakdown of pain points and value drivers by archetype, see Appendix on page 31: Pain Point Prioritization and Solutioning by Archetype.

## 2. Identify the right technology use cases

Armed with an understanding of the main problems, it is important to understand the root causes, all possible solutions, and the potential operational and financial implications. One mistake that many manufacturers make is jumping straight to the technological solutions and searching for applications without first considering other aspects such as process or organizational pain points, targets to be achieved, and ROI. Identifying 4IR use cases will therefore be a vital part of the general problem-solving approach:

- **Identify the root cause of the problem.** Clearly articulate a pain point into a problem statement, and consider all touch points. Which systems, assets, people, and processes need to be fixed to solve the problem?
- **Examine available solutions.** Study the potential technologies, level of maturity, and available uses cases, particularly the ones implemented by customers, competitors, and suppliers. Understand and establish the target outcome from implementing the potential solutions.
- **Engage vendors for joint solutioning.** Identify potential vendors and use cases, and conduct discovery workshops to jointly create potential solutions. Understand the pricing, investment requirements, and ROI, and readjust the solutions if needed to ensure they are financially sustainable for the organization.



Identifying IR use cases will be a vital part of the general problem-solving approach.

For example, a petrochemicals manufacturer will have safety as its top priority and aim to achieve a zero-injury environment (see sidebar on page 19: ASEAN Petrochemicals Firm Focuses on Use Cases). Workplace injury could either result from abnormalities in machine function or be caused by human error. Although training, process controls, and incentives could be effective, 4IR use cases could also be part of the solution. Remote monitoring of conditions via IoT sensors, combined with artificial intelligence models to identify areas of concern (such as gas pipeline corrosion), can prevent leaks or failures. Connected wearables to track remote worker locations enable real-time communication and assistance, and automated emergency notifications can improve worker safety. Augmented reality simulations can be incorporated



## ASEAN Petrochemicals Firm Focuses on Use Cases

For a petrochemicals company with operations across multiple business units primarily in ASEAN, it was crucial to take a structured approach to 4IR, not only to deliver benefits, but also to ensure that the broader organization was engaged and excited about a digital transformation.

At the outset, the company set up a central digital transformation office to drive the program company-wide. Cross-business unit workshops, including operations, IT, human resources, and finance, were conducted to identify pain points across the

business and align priorities. Although 28 pain points were identified, the manufacturer knew it would not be feasible to run all these initiatives simultaneously. Pain points were prioritized into waves of eight to 10 use cases based on business priorities (such as costs, employee satisfaction, and customer experience), size of impact and organizational readiness to address them (process and infrastructure maturity and technology maturity).

Two use cases were deployed initially. The central team

conducted an external evaluation of available technology solutions and vendors, conducted a selection with business stakeholders, and designed a pilot that was executed with the support of vendors. At the same time, the central team also concentrated on building enablers for sustainable transformation, such as augmenting skillsets (data scientists, DevOps and UX), a robust employee engagement and change management plan, and data governance and discipline.

into immersive off-site training for faster time-to-competency and to better equip workers for dangerous situations. Selecting these potential use cases will depend on the context, level of maturity, and infrastructure enablers, such as in-plant Wi-Fi for wearables.

### 3. Conduct collaborative sprint-based pilots

Given the limited implementation of use cases within the ASEAN environment, business cases are difficult to justify, driving manufacturers to pursue short-term cases with payback periods, which in certain cases could be less than one year. To alleviate the challenge of limited information and minimize disruptions to operations, manufacturers can undertake pilots in a controlled environment to test the efficacy of solutions in a real-world setting, learn valuable implementation lessons, and demonstrate results to build confidence and momentum for wider implementation across the business. While piloting may seem like a fluid process—with no clear view of outcomes and solutions being deployed as they are built, structure is crucial for success.

Three moves can provide the right balance between agility and structure:

**Test sprint-based solutions.** The fundamental rule of piloting is to fail fast. A sprint-based approach produces minimum viable products that can be tested and refined with minimal costs, delivering value faster (see sidebar on page 20: Johnson & Johnson's Test-and-Learn Approach).

- Prioritize pilots into sprints based on the potential impact, solution maturity, process readiness (for example, adequate infrastructure and capabilities to support pilot), and available resources.
- Develop pilots to operate in a contained environment (such as single geography, product line, machine), with clearly defined scope, measurable key performance indicators (KPIs), and evaluation criteria.
- Include architectural elements such as data management and connectivity solutions.

# Johnson & Johnson's Test and Learn Approach

Johnson & Johnson, a global manufacturer of healthcare products known for its focus on innovation, has an objective “to become an intelligent and autonomous cyber-physical manufacturing system, seamlessly integrated into the supply chain.” To achieve this, the company took the following structured seven-step test-and-learn approach to prove use case applicability and business value:

- Conduct targeted sprints with specific practical scope.
- Run simultaneous pilots across

segments to maximize learning.

- Prove feasibility by testing in the real world.
- Quantify potential impact and value.
- Gain insight into specific capability and skill requirements.
- Assess and select supplier options.
- Drive to a deployment and scaling decision (yes or no).

This approach has been tried and tested on high-profile use cases,

including its real-time release process that received FDA approval in 2016. Johnson & Johnson has been able to achieve continuous manufacturing enabled by the integration of questions and answers into its manufacturing process through automated sensors and parameter-based decision making to either move to the next step in the process, or halt production. Not only has this improved quality, it has also significantly reduced cycle-time required to scale products from months to a few days.

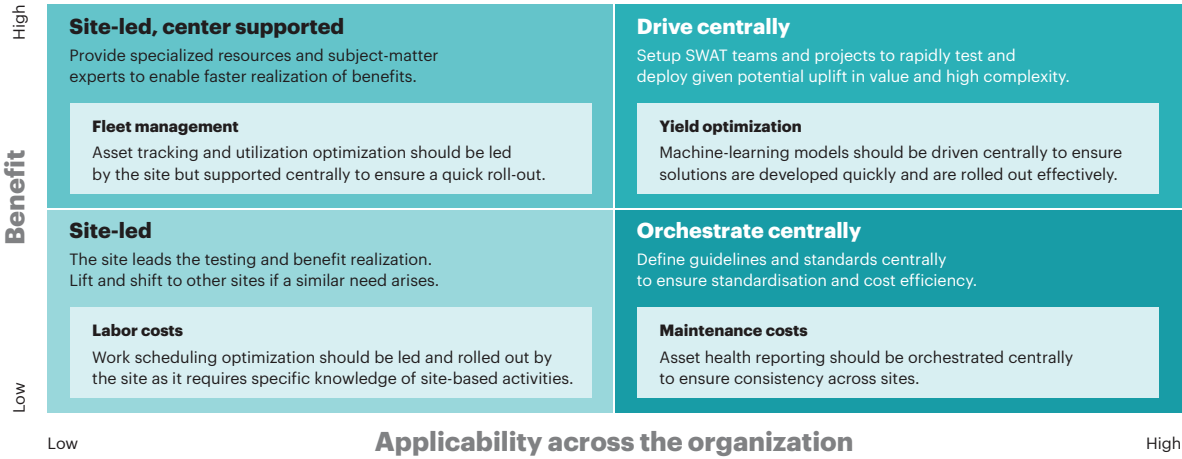
**Co-create with partners.** Because ASEAN manufacturers, with the exception of MNCs, have limited opportunities to learn from peers, they must look to international examples to guide their transformation efforts. Partners provide an effective conduit to accessing global experience tailored to the local context.

- Engage two to three solution providers and partners in pilot co-creation workshops to obtain a clearer understanding of the available technologies, and use the design and implementation expertise of partners to improve solutions.
- Ensure internal participation in pilots to engage and upskill an internal team.

**Establish a pilot governance framework.** Structure is vital for ensuring pilots are targeted and lessons learned from past pilots are applied to subsequent ones.

- Establish a strong governance framework around selecting and running pilots, including vital decision-makers, selection criteria, and meeting cadences (see figure 10 on page 21). High-impact solutions that are applicable across the organization should be driven centrally to ensure consistency and coordination, whereas smaller point-solutions—specific to a particular factory—could be site-led, with central oversight, to ensure agility and local input.
  - Designate clear transformation responsibilities to the right individuals, either through a centralized digital team or via integration with organizational KPIs. Some successful ASEAN manufacturers have a central digital task force comprised of people with business, technology, data, and project management skills to coordinate all initiatives, provide support, and ensure a high standard of execution.
  - Standardize repeatable artifacts and activities such as templates, baselining, and benchmarking approaches.

Figure 10  
**Establish a governance framework for pilots (Example: building material industry)**



Source: A.T. Kearney analysis

#### 4. Build a partner ecosystem that aligns with the long-term vision

Along with identifying the problems and employing suitable use cases to run pilots for solving specific problems, manufacturers must also work toward their broader vision of digital transformation. The first step in navigating the complex manufacturing ecosystem is to choose from one of three broad partnering models:

**Best of breed.** Cherry-pick the best providers for each solution.

- **Advantages.** High degree of control, opportunity to put capability into the market years ahead of competitors, and opportunities to co-pioneer and co-invest with leading vendors to create solutions and new revenue streams
- **Disadvantages.** High degree of uncertainty and risk, high management and implementation effort requiring access to new skills, capabilities, and funding for execution
- **Suitability.** For more advanced manufacturers with big 4IR programs with sufficient internal capability to understand their 4IR architecture strategy (and how it fits together) and directly engage with vendors to select cutting-edge solutions for each element within their architecture. They will also need to have capacity to manage a large number of partners

**Cornerstone partners.** Build deep relationships with a small number of companies, and tap their network of partners.

- **Advantages.** Balancing between control and manageability and the ability to form stronger bonds with fewer major players
- **Disadvantages.** Reliance on cornerstone partners to manage and adapt their partner ecosystem to deliver results and a risk of vendor dependence (though lower compared with a single-service integrator model)
- **Suitability.** For manufacturers that require a high degree of adaptability but don’t necessarily have the capability or bandwidth to directly curate an E2E ecosystem (These manufacturers will rely on a small number of cornerstone companies to define their architecture strategy and manage a compatible vendor ecosystem.)

**Single-service integrator.** Rely on a single strategic partner to design target architecture, and assemble providers to deliver solutions.

- **Advantages.** Ability to start a 4IR transformation despite a lack of access to digital and technological capabilities and skills, ease of vendor management (single point of contact for all issues), and the ability to simultaneously upskill the internal workforce
- **Disadvantages.** High vendor dependency, often higher cost in the longer term (with system integrator margins), and an initial limited understanding of architecture and implementation process
- **Suitability.** For manufacturers with a lower degree of maturity, which either have a small 4IR agenda, or lack the capability, resources or desire to engage multiple partners (These manufacturers will nominate a strategic service integrator partner to advise them on their architecture and coordinate the vendor ecosystem to deliver solutions.)

The most advanced companies would typically select partners that offer top-of-the-line solutions.

The choice of partnering model depends on internal factors such as the manufacturer's 4IR ambition, internal capability, and resource availability as well as the vendor landscape and interoperability of key solutions. The most advanced companies with ambitious 4IR programs and a high level of internal capability would typically select partners that offer top-of-the-line solutions, taking it upon themselves to manage multiple best-of-breed partners (see sidebar: ASEAN Petrochemicals Company Opts for Best in Breed). Given the fragmentation in the ecosystem and complexity of 4IR architecture, most manufacturers would need to engage at least a few key partners on major architectural decisions, where solutions fit, interoperability, and flexibility (not being locked into a proprietary system) are crucial. For example, cybersecurity is a top concern for many manufacturers, particularly with the scale of connectivity in 4IR. Hence, a strong partnership with an E2E vendor that can provide a comprehensive solution across layers and locations may be preferred over an indirect subcontractor or an assembly of vendors covering different areas.

### ASEAN Petrochemicals Company Opts for Best in Breed

A petrochemicals company on the leading edge of technological innovation in ASEAN chose the best-of-breed partnering model. It internally orchestrated multiple players in the ecosystem—from OEMs to enterprise IT firms, technology consultants, and

infrastructure companies—to maintain control of its architecture blueprint and ensure that the company got the “latest and greatest” technology, particularly in the design of a new plant. The company has a high degree of confidence in its engineering

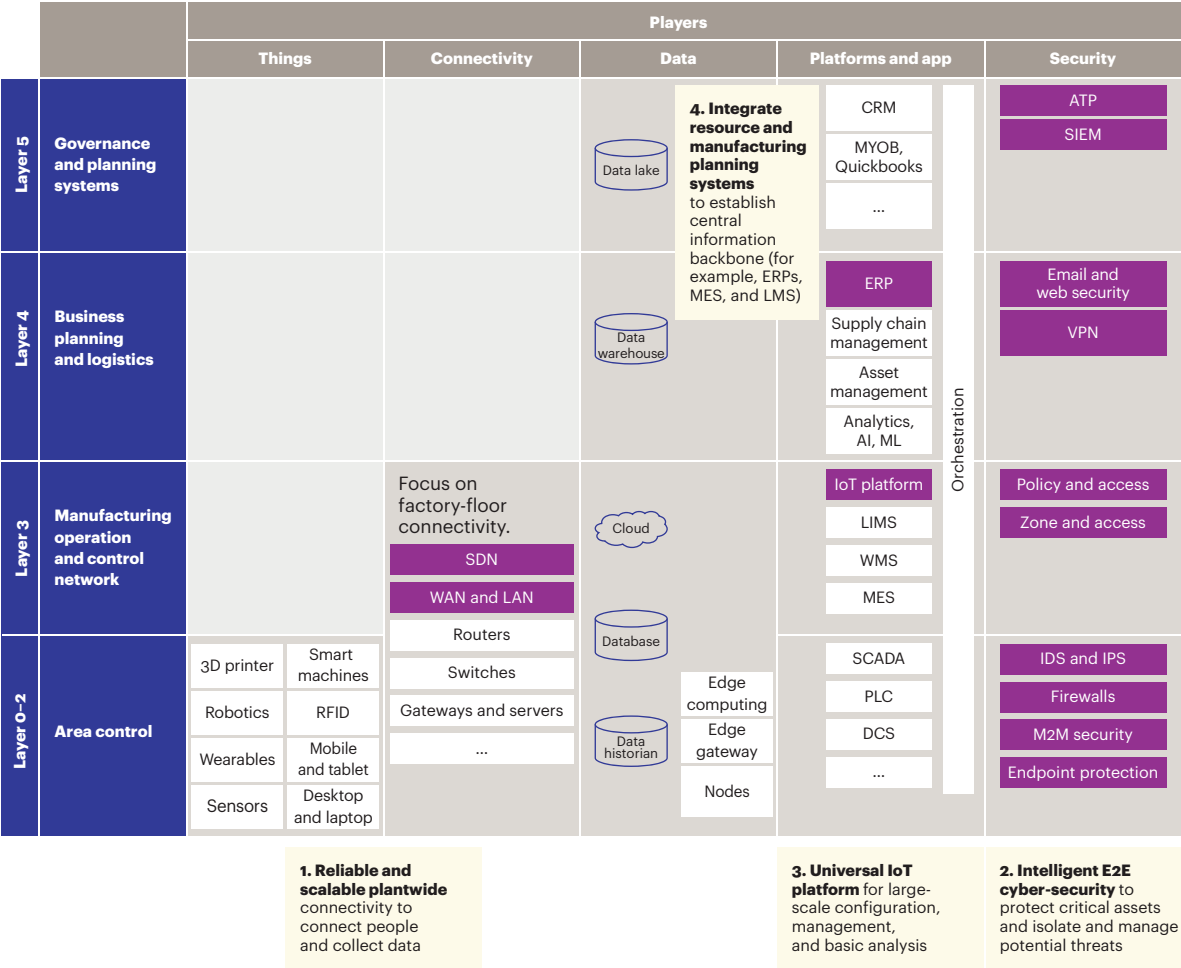
capability and has made a conscious effort to “be less conservative, and more innovative and experimental.” This manufacturer provides the collaboration platform to engage best-in-class providers to design and execute on the architecture.

## 5. Establish a scalable infrastructure

The architecture for 4IR is complicated (see figure 11). Therefore, instead of small incremental improvements, best-practice organizations prefer to design a “North Star” (a target-state vision) for their E2E architecture to guide the pilot sprints and ensure an ambitious step-change transformation. However, many ASEAN manufacturers lack the capability to conceptualize such a complex E2E architecture design. To help them navigate the complexities of the ecosystem and architecture, we have identified four major decision points across the manufacturing 4IR architecture that require immediate attention:

Figure 11  
**There are four major decision points when conceptualizing the manufacturing 4IR architecture**

### Manufacturing ecosystem



Notes: 4IR is the Fourth Industrial Revolution; RFID is radio-frequency identification; SDN software-defined networking; WAN is wide area network; LAN is local area network; ERP is enterprise resource planning; AI is artificial intelligence; ML is machine learning; IoT is the Internet of Things; LIMS is laboratory information management system; WMS is warehouse management system; MES is manufacturing execution system; CRM is customer relationship management; SCADA is supervisory control and data acquisition; PLC is programmable logic controller; DCS is distributed control system; ATP is advanced threat protection; SIEM is security information and event management; VPN is virtual private network; IDS is intrusion detection systems; IPS is intrusion prevention systems; M2M is machine to machine; E2E is enterprise to enterprise.

Source: A.T. Kearney analysis

**1. Build a reliable and scalable connectivity infrastructure.** Connectivity is a prerequisite for collecting data from equipment, people, and the environment. Therefore, the connectivity infrastructure forms the backbone of most use cases and acts as the highway on which data travels between people and machines. Given the need for varying levels of sophistication depending on use cases—ranging from a basic wireless sensor network for most sensor data to software-defined networking or programmable networks for large-scale management, manufacturers must assess the following when selecting the infrastructure and implementation partner:

- Reliability, scalability, and security are the biggest considerations for connectivity and data transmission. Operability in various plant conditions—for example outdoor locations exposed to adverse climates, ease of implementing rules-based configurations across sites, and control over network access—are key considerations.
- When selecting a partner, consider ease of installation, maintenance and upgrades, compatibility across devices, and the level of customer support, particularly for incident resolution.

**2. Install intelligent E2E cybersecurity.** Data is a manufacturer's intellectual property and plays a central role in implementing advanced 4IR manufacturing practices. Extracting, moving, computing, visualizing, and analyzing data will involve security risks. The scale of any security breach or damage to customers could be significant and impact not only a specific manufacturing process but the entire production network. As benchmarked in an earlier study, the threat of cyberattacks puts the top 1,000 companies in ASEAN at risk of losing \$750 billion or more in market capitalization.<sup>8</sup> Furthermore, the increase of cyber linkages in the production value chains across countries is escalating cybersecurity challenges.

Key security challenges in the manufacturing environment are related to antiquated systems, insecure designs, inadequate control processes, lack of availability of IT–OT security skills, and new technologies that can be compromised, such as IoT devices that lack cybersecurity software.

The entire production value chain and network must be secured against threats, with the help of firewalls, intrusion detection systems, intrusion prevention systems, and endpoint protection. In addition, it must continuously monitor itself to identify and isolate potential breaches.

Cybersecurity is a game of scale: the higher the number of users, the greater the exposure to threats and the more effective the responses.

Two considerations are vital for manufacturers:

- **Planning and operational management.** Ability to support a range protocols while having breadth of coverage, threat detection intelligence and capability in isolating and managing threats are important considerations, particularly when IT and OT are involved. Multi-layer security that provides complete real-time view of all OT networking assets and protects all access points, predictive threat detection that adapts with machine-learning, and fast response times to isolate and manage system breaches need to be carefully integrated.
- **Partner selection.** When selecting a partner, coverage and scale are the main factors. Integrated E2E solutions provide greater depth and coverage, while simplifying vendor management. However, depending on the manufacturing setup, they might not always be available. With regards to scale, the more users there are, the more threats a vendor has exposure to, making risk detection more accurate.

For example, Panasonic identified IoT security as the priority to strengthen the foundations of the IT infrastructure in its 300 manufacturing plants around the world. A key consideration was

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<sup>8</sup> For more information, see [Cybersecurity in ASEAN: An Urgent Call to Action](https://www.atkearney.com) at [www.atkearney.com](https://www.atkearney.com).



that there were not enough professionals to deal with the challenges at site level. As such, Panasonic worked with Cisco to centrally design the security policies and applications to support the global operations.

**3. Invest in a universal IoT platform.** By 2020, more than 26 billion devices will be interconnected with 215 trillion stable connections and 63 million new connections every second, according to Gartner.<sup>9</sup> For manufacturers, many of these sensors will be connected disparately across a variety of machines and sites based on individual use cases. A universal IoT platform is required to configure and manage the growing number of end points, particularly during scaling. The IoT platform is becoming an important battleground for many solution providers, with a multitude of offerings equipped with varying value-added functionalities available in the market.

Manufacturers have choice, but they must consider the following to develop a keen understanding of business requirements to select a fit-for-purpose platform:

- Interoperability, scalability, industry-specific applications, and ease of use, are vital to be able to manage across different types of sensors from various sources and locations, including OEM-specific sensors, on a single pane of glass. Consideration for additional functionality, such as data storage and edge computing, depend on overall ambition and road map.
- When selecting a partner for IOT platform, consider the upstream and downstream ecosystem as well as compatibility with existing suppliers and systems. Proven success in similar industries is also important to ensure usability and applications are fit-for-purpose.

**4. Integrate resource and manufacturing planning systems.** Accessing data is one thing, but creating an E2E flow unlocks the potential for automation, decision-making based on cross-organizational factors, and more complex analysis, AI, and machine learning. ERP systems provide a point of commonality across the business, linking OT and IT systems (for example, manufacturing execution systems, quality management systems, and learning management systems) as well as the support functions that sit in the background. While ERP systems are expensive to license and implement (often costing tens of millions of dollars), they also form the organization's information foundation.

Two considerations are vital for manufacturers:

- Functionality, interoperability, and ease of use are the biggest concerns when implementing an ERP system. Feasibility and cost of integration with all of the legacy, or siloed system environment on the factory floor, and ease of use would influence the effort involved in upskilling workers to interact with the ERP system and ensure its integrity.
- When selecting a partner, consider solution maturity, market reputation, and alignment of vendor specialization. Although the ERP market is relatively mature and dominated by companies such as SAP and Oracle, a few more-specialized players such as Epicor cater to specific segments, including manufacturing.

## 6. Sustain the transformation momentum

Manufacturers, especially larger ASEAN companies, must take the lead in building their own transformation initiatives instead of relying on government support. Success in 4IR will require investing in developing a clear vision and a digital culture and enabling progress through the right organization structure and processes to drive sustainable change.

<sup>9</sup> "Gartner Keynote: CIOs Will Build the New Civilization Infrastructure," Gartner Symposium/ITxpo, October 2016

**Set up a digital transformation.** Build a well-governed transformation program with an aligned digital strategy which drives commercial objectives.

- **Utilize the North-Star** that is being created to define the end-state vision. Successful companies start by defining a digital vision across the value chain that aligns with their overall corporate and customer strategies and is cascaded down the business lines. This vision steers the development of the target-state architecture, informs the prioritization of digital innovations, and most importantly, creates a common thinking and direction in the organization on digital.
- **Involve the customer (external customers and employees) and partners.** Digital innovations that create maximum impact have genesis in customer needs or the desire to reduce customer pain points. For manufacturing, employees or management are the internal customers who may want to reduce pain points in safety, quality, or other processes. Partners can also play a part to help diagnose and identify applicable solutions to address the customer pain points.
- **Lead by example.** Most organizations today want to adopt digital. However, in complex organizations, various teams are often moving in different directions without a clear path for returns on digital investments. Top management ownership and alignment helps organizations streamline their efforts and inspires employees to embrace a digital and agile mind-set.

**Align the organization and culture.** People are the number one reason transformations fail—the failure to bring employees, customers, and suppliers along on the journey. Four elements need to be addressed:

- **Ensure digital governance (control tower).** In addition to customer innovation and an experimentation mind-set, speed of change is a key driver for digital transformations. Digital governance is often the most important success factor for organizations to change their ways of working and move at digital speed. Existing organizational structures and processes do not allow teams to move at that speed. Imagine applying a traditional procurement request-for-proposals process to selecting the right artificial intelligence partners. A traditional procurement process will slow down and likely lead to the wrong selection of partners. Thus, procurement as a function needs to have a two-speed model to adapt to digital world that is much more agile and flexible. Similarly, digital governance is needed for finance, HR, and IT integration processes. This is, however, not a typical governance that can be managed by a project management office (PMO). Instead of looking backward and reviewing the processes that a PMO does, companies need a setup that can look forward and create new processes to enable such transformations. This is likely to be a control tower which provides direction and clear hurdles. However, do not micromanage progress on a day-to-day basis. This is a powerful concept that most organizations need to embrace to deliver on digital transformations.
- **Build capabilities and skills.** Capability building needs to be thought of in two dimensions: how to upskill employees with digital and how to empower employees with digital tools. A well-established rule of change management is that two-thirds of employees should start doing things differently to sustain the change. This is also true for digital transformations, which need to drive a large-scale upskilling and enablement agenda. Three broad categories of skills are needed to support 4IR implementation: analytics (big data management and data science), technology (cybersecurity), and business (ecosystem management, analytics translation and problem solving). Not everyone requires every skill, so it is important to map the skills and level of competency that each function requires.

- **Embed agile ways of working.** Most technology innovations today are delivered by agile teams. The pace of innovation, emergence of new use cases, and collaboration within ecosystem players imply that projects can no longer be delivered in years but instead need to be considered in weeks (a few months at most). This requires setting up empowered cross-functional teams that have business skills, technical skills, and the mind-set to deliver new products or innovations. One caution for manufacturing companies in adopting agile: these ways are relevant for new products and innovations, changing processes, and business planning but are not relevant for running operations in manufacturing.
- **Redefine success parameters.** Align KPIs to embed digital requirements into organizational expectations and definitions of success. One advanced manufacturer reduced the focus on operational KPIs such as productivity growth and costs for one year, trading them for digital KPIs such as the number of pilots run and the estimated potential future benefit and incentivizing plant leaders to engage in innovation.
- **Create a compelling change narrative.** Articulate the imperative for change, and engage the organization, supported by a communication plan, to maintain direction and momentum (for example, celebrating successes and launching engagement initiatives) and constructively address initial resistance (turf wars and targets). This creates an environment that rewards innovation by celebrating successes and avoiding harsh punishment for failure (see sidebar: Thai Petrochemicals Manufacturer Puts Spotlight on Culture Change).

**Improve on existing processes.** Even with the right people and technology, it is important to formalize changes in processes to ensure consistency, repeatability, and clear accountability.

## ASEAN Petrochemicals Manufacturer Puts Spotlight on Culture Change

Changing people’s mind-sets was an ASEAN petrochemicals manufacturer’s biggest change management priority. The company recognized that getting people on board was the only way to create a sustainable digital transformation. With this in mind, the company adopted a three-pronged approach to managing people and the culture (see figure a).

Figure a  
**Change management requires new mind-sets and sustained enthusiasm**



Source: A.T. Kearney analysis

Processes fall into two main categories that have different objectives and impact horizons:

- **Redefine man-machine processes.** The Fourth Industrial Revolution will change the ways humans and machines interact, alter standard operating procedures, and require retraining of affected workers to ensure the immediate effectiveness of deployed solutions.
- **Instill a continuous improvement mind-set.** The Fourth Industrial Revolution is not a “set it and forget it” activity, but rather an ongoing journey. Frequent progress checks and identification of opportunities to refine, extend, and improve processes will help prevent complacency.

## Implications for Ecosystem Players

Taking a structured and experimental approach to 4IR transformation is not a standalone mission. Companies across the ASEAN manufacturing ecosystem, as along with governments, have vital roles to play in bringing 4IR to life. Governments across ASEAN have sought to invest in building the required workforce capabilities, digital ecosystem, and regulatory environment to promote innovation in manufacturing.<sup>10</sup> While each country has tackled this in a slightly different manner, such interventions largely remain at the broader national level, with few specific initiatives to target large manufacturers and MNCs. Manufacturers must seek to influence the national 4IR initiatives, particularly those for building manufacturing-specific capabilities and skills and promote innovation in manufacturing through various initiatives such as university tie-ups and automation centers.

As the OT and IT elements of manufacturing converge, supporting actors must also decide what role they want to play and how they want to support manufacturers. This period will not only shape the future of ASEAN’s manufacturers, but also the region’s manufacturing landscape.

Manufacturers no longer need to nor can afford to take a wait and see approach towards 4IR. They will need to act now and start on their 4IR transformation journey. Following are main takeaways to help manufacturers and their partners think through the implications of how they approach 4IR transformation:

**Manufacturers: Stop waiting, and act.** Manufacturers will be at the center of 4IR. And as with previous revolutions, there will be winners, such as Apple and Google in the Third Industrial Revolution, and losers (such as the fallen tech giants Kodak and Nokia). Manufacturers can act now to set themselves up for success:

- Stop waiting for all the facts to emerge, and start uncovering them using an experimental and iterative approach.
- Identify the problems by aligning them with the important value drivers.
- Utilize a “North Star” concept to define the target-state vision to work toward, and guide pilot sprints, but keep an open mind to modify it when necessary. Partner with vendors to build fit-for-purpose solutions. Plan to change processes, mind-sets, and capabilities.

**ICT OEMs: Earn the right to play.** The entry of information and communications technology (ICT) OEMs into the 4IR conversation is potentially tenuous. This could be a result of the

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<sup>10</sup> ASEAN governments recognize that access to the right skills is one of the biggest barriers that manufacturers face. Indonesia has committed to building polytechnic universities to focus on STEM skills; Thailand and Malaysia are putting in place specific training programs to upskill workers. Governments are also seeking to foster a digital ecosystem. Initiatives in building the regulatory environment also vary, ranging from establishing secure data laws (Indonesia and Singapore) to providing tax incentives to invest in IT infrastructure (Vietnam).

perceived stand-alone offering from manufacturing OEMs and the misconception that architectural elements are an afterthought or merely an implementation consideration. Several moves can help ICT OEMs succeed:

- Educate the market about the right to play in 4IR, particularly the more sophisticated manufacturers pursuing best-of-breed solutions. ICT OEMs should have a seat at the table in designing the long-term architecture blueprint to build a reliable, secure foundation that is compatible with existing infrastructures.
- Provide value to a range of manufacturers with fit-for-purpose offerings to suit a range of requirements and budgets for plantwide connectivity, IoT platforms, and cybersecurity, which are among the major decision points for manufacturers.
- Partner with OT players to ensure cohesive and interoperable solutions. However, be clear on the future targeted operating model before integrating tightly.



OT OEMs perhaps enjoy an advantageous position in the ecosystem.

**OT software players: Fortify value propositions.** As one of the higher risk categories, manufacturing platforms and application providers such as software-based manufacturing companies need to fortify their value propositions and begin to either establish their place in the manufacturing ecosystem or expand and integrate their solution portfolios:

- Focus on interoperability, which will be a major consideration when manufacturers evaluate solutions. Given 4IR's focus on the flow of information, the ability to integrate with other applications and infrastructure, and to create purpose-built, scalable solutions will be crucial.
- Partner with ERP, supply chain management, and IoT management companies as well as manufacturing OEMs to solidify market position by leveraging these major decision points for manufacturers.

**Enterprise software players: Focus on flexibility** As perhaps the most dynamic part of the ecosystem, enterprise platforms and application providers need to focus on providing flexibility and future-proofing their fragmented and varied solutions to work in any environment:

- Provide fit-for-purpose functionality in a form that is easy to integrate, secure, and easy to use.
- Understand where the OT market is moving, isolate major touchpoints, and use these to establish strong partnerships with OT providers or to extend into the OT space.
- Prioritize open-source solutions over proprietary ones, particularly for smaller firms. Not only does this provide peace of mind to customers, but it also forces the application provider to continuously innovate and improve.

**OT OEMs: Seize expansion opportunities.** OT OEMs perhaps enjoy an advantageous position in the ecosystem. Given their close alliance and extensive history in the manufacturing space, they stand to protect their positions and seize the opportunity to expand into higher value-added services. OEMs can maximize this opportunity:

- Provide plug-and-play solutions that are non-intrusive and reliable. Users have low tolerance for failures and often stick with what works.
- Strengthen and broaden existing capabilities and offerings via partnerships and acquisitions.
- Use existing knowledge and expertise to shift awareness from hardware, and start moving into the services space—beginning with project management and installation, followed by solution development, and target-state architecture blueprints.

Players across the ASEAN manufacturing ecosystem, including governments, need to adapt and solidify their role in accelerating 4IR. Establishing strong partnerships is important not only to manufacturers but also to ecosystem providers to ensure fit-for-purpose, interoperable solutions. Collaborations between companies and between governments will become more important to help ASEAN manufacturers succeed, for a number of reasons. Firstly, the pooling of resources will help scale up the building of new manufacturing capabilities, while sharing of knowledge will shorten learning cycles. Secondly, an integrated, cross-regional ecosystem will create better visibility across interconnected regional production networks, and connected platforms will foster more co-creation in innovation.

## Conclusion

The Fourth Industrial Revolution is bringing unprecedented changes to manufacturing around the world, putting ASEAN at risk of losing its low-cost competitive advantage as 4IR enables advanced economies to regain a competitive advantage by reducing costs and improving productivity and quality. With \$250 billion to \$275 billion in incremental value at stake by 2028, ASEAN manufacturers cannot afford a wait-and-see approach.

Manufacturers must adopt an experimental and iterative bifocal approach that marries the need to solve immediate problems with a long-term vision and road map for transformation to set themselves up to succeed in the digital era. A new approach of self-discovery starting with a diagnosis of pain points, identification of 4IR use cases, and collaborative sprint-based pilots will enable the speed and flexibility to build confidence and momentum. Coupled with a long-term “North Star” vision to guide the development of strong partnerships, robust infrastructure and organizational enablers are essential to accelerate 4IR adoption in a highly dynamic technological and vendor landscape.

With a clear action plan for advancing into the 4IR age, now is the time for ASEAN manufacturers to confidently seize the opportunities to become lighthouses for digital manufacturing and leapfrog onto the global stage. Collectively, this will not only safeguard the expected doubling of ASEAN’s manufacturing economy to almost \$1.4 trillion, but also add 35 to 40 percent in incremental MVA by 2028.



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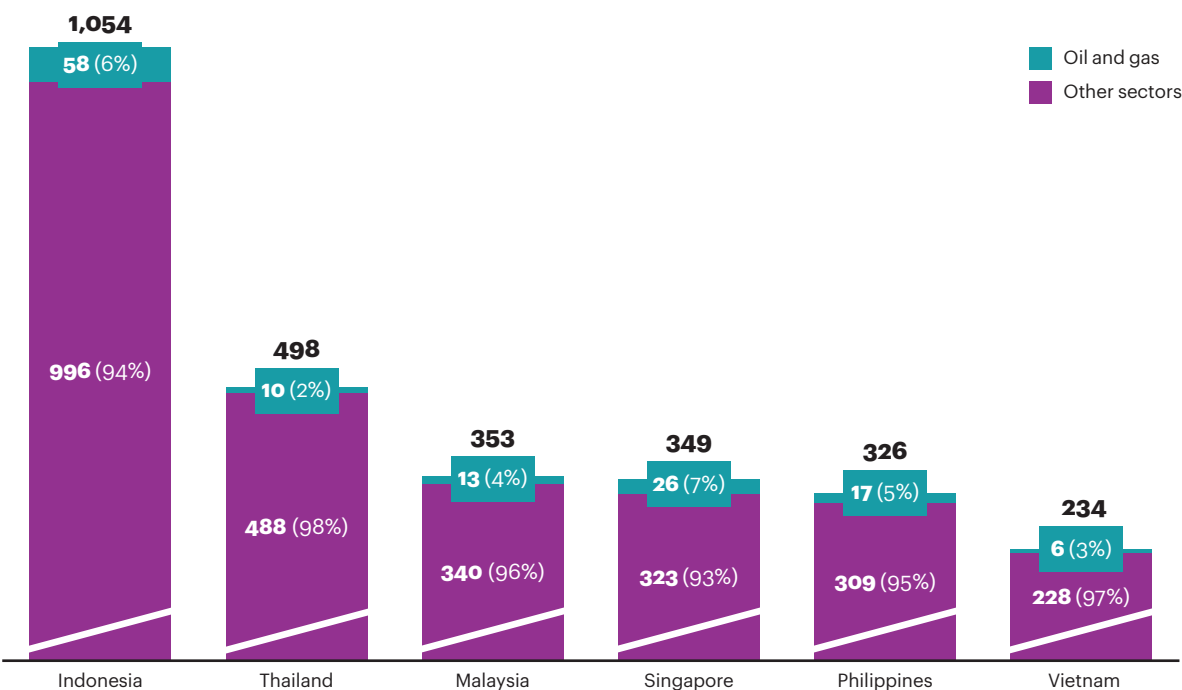
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# Appendix: Oil and Gas Contribution to the GDP of Six Major ASEAN Economies

## Oil and gas sector's GDP contribution

(\$ billion, 2018f)



The oil and gas sector contributes a sizable total value of \$130 billion to the region, translating to 5 percent of the region's GDP or about 20 percent of the manufacturing value add.

Source: A.T. Kearney analysis

# Appendix: Pain Point Prioritization and Solutioning by Manufacturing Archetype

## Commodities

### Description

The commodities archetype is characterized by a focus on producing high volumes of largely standardized products leveraging a machine-intensive model. Products such as chemicals, refined coke, and petroleum products are often undifferentiated in the market, and key deciding factors for customers center around cost, accessibility, and other value-added services.

#### Example industries

- Metal products, such as iron and steel
- Fertilizers
- Petrochemicals and plastics
- Refined coke and petroleum

### Key value drivers

Commodities industries often operate using continuous processes, using expensive machinery to extract and convert raw material inputs into goods for other businesses. High capital costs, limited product differentiation, and often intrusive, dangerous operations see prioritization of asset utilization, safety, and environmental responsibility.

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Asset utilization	<p><b>Suboptimal asset usage.</b> This occurs when assets are run below their maximum throughput capacity. This can happen because of a lack of visibility of real-time asset status and overall equipment effectiveness or continual optimization required as a result of variability in machine wear and raw inputs. Manufacturers complain of the lack of basic visibility.</p> <p>“We have lots of machines. ... While our team focuses on the major pieces of equipment, it would be helpful to know what assets I have and whether they are running or not.” —<b>cement manufacturer</b></p>	<p><b>Asset tracking.</b> Sensors to track location (such as RFID) and status and utilization (such as wireless vibration sensors) of assets for better visibility and management</p>
	<p><b>Machine downtime.</b> ASEAN manufacturers schedule maintenance based on vendor manuals as opposed to asset condition. However, this means working parts are often unnecessarily replaced, shutdowns occur when they aren’t required, and parts may be overlooked as they are off the schedule.</p> <p>“We use the recommended vendor manuals for maintenance, but things still breakdown. ... If we could know two hours before something breaks down, we could more effectively fix it.” —<b>cement manufacturer</b></p>	<p><b>AI-driven optimization.</b> Application of advanced analytics to understand operational constraints and provide recommendations to improve aggregate throughput while minimizing costs</p>
		<p><b>Condition monitoring.</b> IoT-enabled continuous monitoring of assets (such as temperature, friction, and alignment) with AI-automated process adjustments (such as run-to-run controls) to reduce wear and tear, extend lifespan, and drive higher processing efficiency</p>
Safety	<p>Manufacturing workers operate among heavy machinery in remote locations. Most manufacturers globally have a zero-harm policy, in which every incident or near miss is strictly investigated.</p> <p>“Safety is critical to us. One of the first cases we are piloting is a safety observation app, including near-miss reporting and alerts.” —<b>petrochemicals player</b></p>	<p><b>Connected workers.</b> A combination of pervasive Wi-Fi, mobile sensors, and mobile devices (such as phones and tablets) to locate workers and transfer critical information and data in real time</p>
		<p><b>Predictive analytics.</b> Use of AI to identify potential hazards and provide a course of action to prevent the risk</p>
Environmental responsibility	<p>Commodities players not only run operations with high impact on the market, but also are among the largest consumers of energy, required to keep continuous processes running, and apply high temperature processes.</p>	<p><b>Pollution monitoring.</b> Use of sensors combined with analytics to track emissions (such as heat and carbon dioxide levels) and alert workers to act</p>

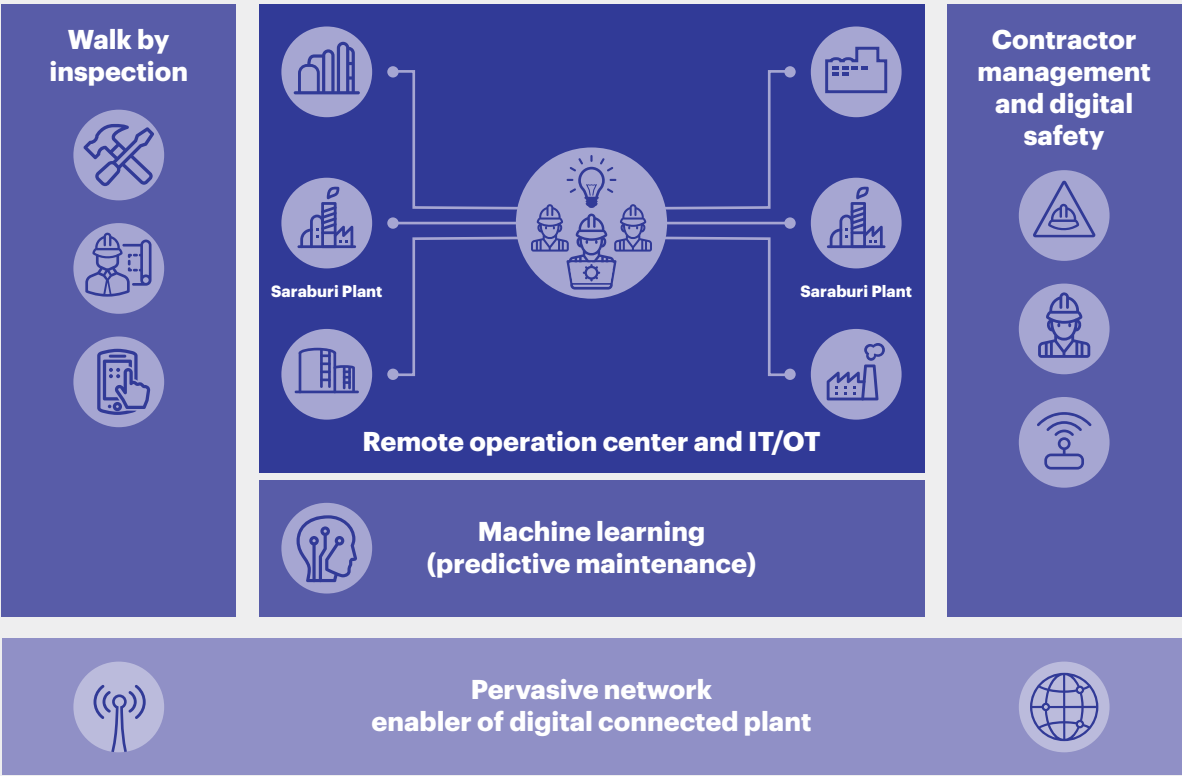
Case Study: Siam City Cement

Siam City Cement, a Thai cement manufacturer, is aiming to become the digital leader in the cement industry. Part of a competitive industry in ASEAN, the company is seeking to gain a competitive advantage by improving efficiency and

reducing costs through its digital connected plant (see figure b). Thus far, the deployment of pervasive Wi-Fi and plantwide connectivity in Plant 3 in the Saraburi province has enabled the ability to track employees, contractors, and assets in real

time to improve both productivity and safety. Initial results suggest a 2 percent improvement in annual overall equipment effectiveness and a 10 percent decrease in maintenance costs.

Figure b  
Thailand’s Siam City Cement is embracing digital



Note: IT/OT is information technology and operational technology.  
Sources: Fujitsu, Global Cement; A.T. Kearney analysis

# Specialized

## Description

The commodities archetype is characterized by a focus on producing complex, often bespoke outputs, leveraging complex machinery and processes. Products such as vehicles, industrial machinery, enterprise-grade electronics, and high-value pharmaceuticals are differentiated based on functionality, quality, and time to market.

### Example industries

- Automotive
- Specialized electronics
- Industrials
- Pharmaceuticals

## Key value drivers

Specialized industries are more likely to be discrete manufacturers, assembling many components and applying proprietary processing techniques to deliver leading-edge products. As a result, most specialized manufacturers emphasize the importance of time to market, quality, asset utilization, and planning effectiveness.

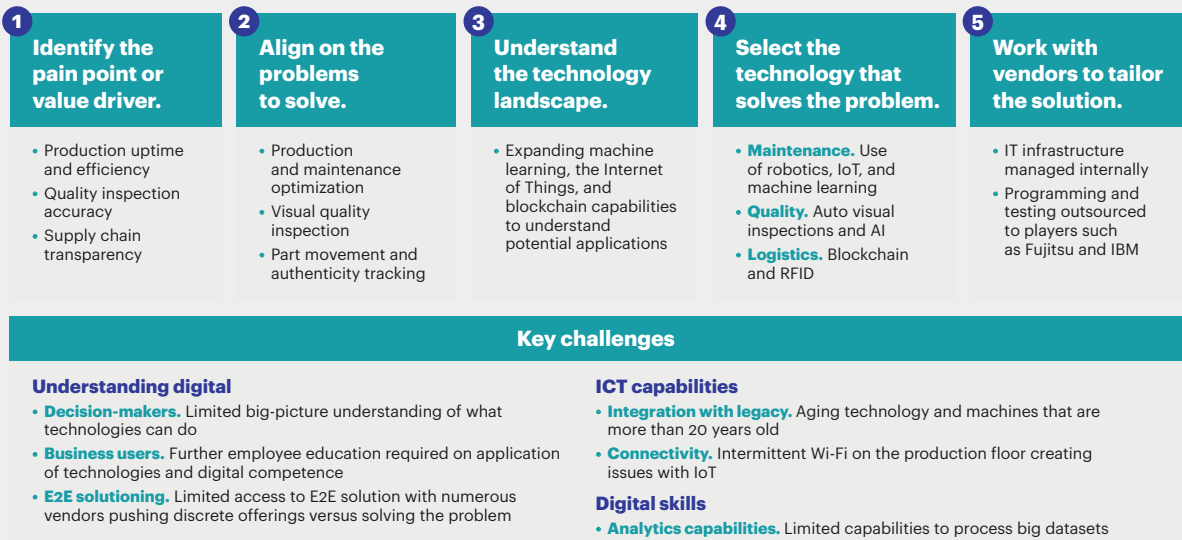
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Time to market	<p>Customers of specialized products value innovation, such as having the latest phone, car, or leading-edge medication. Therefore, the time to move from R&amp;D to mass production is crucial.</p> <p>“New lines come out every six to 12 months as new chips, or other components get released. This means new processes and tooling.” —<b>electrical industry SME</b></p>	<p><b>Rapid prototyping.</b> Use of 3D printing to prototype geometrically complex components (such as a car chassis) reducing cycle time from months to days, and minimizing tools and machine costs</p>
		<p><b>Generative design.</b> AI-driven generation of design combination options that meet set parameters (for example, strength and materials) to rapidly solve engineering challenges and minimize waste</p>
		<p><b>Cognitive robotics.</b> Robotic arms that can feel the difference between picking up different products (a cap versus a pump or a bottle), enabling faster and potentially even automated changeovers</p>
Quality	<p>Specialized goods are usually sold at a premium and are essential to the customers that purchase them. Customer expectations are high, and in some cases, such as pharmaceuticals, automotive and machinery, quality is crucial in ensuring user safety.</p> <p>“Our products aren’t your usual consumer-grade products. Each layer is complex. For example, incorrect temperatures when setting one layer means the whole product must be scrapped.” —<b>cloud and computing contract manufacturer</b></p>	<p><b>Destructive testing.</b> Use of 3D printing to conduct destructive testing at low cost before mass production (such as vehicle bonnets or tread durability)</p>
		<p><b>Automated quality control.</b> Combination of 3D scanning, optical sensors, sampling probes, and machine-learning algorithms to enable high sensitivity quality control (such as active ingredient concentration in medications and microscopic fault detection)</p>
Asset utilization	<p>Machinery uptime and correct tooling is crucial in realizing expected returns. Unlike the commodities industry, downtime in specialized industries drives a depreciation in output value since the previous year’s products can’t be sold the following year.</p>	<p><b>Asset tracking.</b> Use of sensors, RFID and GPS devices to monitor asset location, status, and utilization for better visibility and management (such as yellow goods and vehicles)</p>
		<p><b>Condition monitoring.</b> IoT-enabled continuous monitoring of assets (temperature, friction, alignment) with AI automated process adjustments (such as run-to-run controls) to reduce wear and tear, extend lifespan, and drive higher processing efficiency</p>
		<p><b>Predictive maintenance.</b> AI and machine-learning algorithms to analyze historical and real-time operating conditions to predict time-to-failure of various components (such as gearboxes and motors), schedule an optimal maintenance window, and auto-order spare parts to minimize downtime</p>

Planning effectiveness	Products such as vehicles, enterprise-grade electronics, and heavy machinery are often comprised of hundreds if not thousands of SKUs. The logistics to source and move parts can take months to arrange from conception through to scale.  “We have over 28,000 SKUs and 600 different suppliers split across four outsourced operations in the US, Europe, and Asia. It is a beast of a supply chain.” — <b>IT OEM</b>	<b>Inventory optimization.</b> Use of AI and big data to forecast likely demand and calculate required inventory levels of raw materials to meet optimal production schedule
		<b>Tracking.</b> Use of technologies such as blockchain to efficiently trace location of raw materials and improve overall coordination

Case Study: Indonesian Automotive Player

Figure c  
Automaker aims to improve operational efficiency by 30 percent by 2021



Notes: IoT is the Internet of Things; AI is artificial intelligence; RFID is radio-frequency identification; ICT is information and communications technology; E2E is enterprise to enterprise.  
Sources: A.T. Kearney analysis

# Mass market

## Description

The mass market archetype is characterized by a focus on producing large volumes of rapidly changing SKUs, with a high dependency on human labor. Buyers are typically the consumer market, where considerations vary from cost to innovation, quality, and taste to accessibility and convenience.

### Example industries

- Food and beverage
- Tobacco
- Consumer goods (such as apparel)

## Key value drivers

Mass market industries use a combination of continuous and discrete processing. What unites them is the high standards to which the market and regulatory bodies hold manufacturers, high reliance on human labor, and short product shelf life. As a result, mass market players especially value quality, traceability, labor productivity, and planning effectiveness.

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Quality	Products for consumption by the general population, particularly food and beverages, are held at high standards with regulations that define conditions that must be met to sell products. Delays in identifying quality issues can be expensive to remediate and have an enduring detrimental impact to a manufacturer's reputation.	<b>Automated quality control.</b> Visual and 3D scanning, sampling probes combined with machine-learning algorithms for high sensitivity quality control (such as microbial contamination in food, packaging accuracy, and specification adherence)
		<b>Condition monitoring.</b> Machine-to-machine sensors monitoring conditions across the production line (such as tank sensors for temperature and pH levels in beer brewing) to automatically make adjustments (such as reducing heat) or send alerts for remote control; also supports regulatory compliance and reporting
		<b>Personalization.</b> Smart sensor technology (for example, to detect size of packaging) coupled with adaptive automation systems and AI generative designs to enable manufacturing flexibility and unique designs to produce customized products or packaging or even single unit batch products
Traceability	Traceability from farm to shelf has become increasingly important to ensure product integrity, not only from a sustainability perspective, but also to minimize risk of cross-product contamination and ensure allergies are noted.  "People want to know that when they are paying for organic products, they are getting organic products." — <b>grocery retail chain (SME)</b>	<b>Source to shelf.</b> Technologies such as blockchain or RFID used to track movement of components and raw materials from source to shelf, ensuring integrity of ingredients (such as organic and allergies) while identifying end users in case of recalls
Labor productivity	Mass market manufacturers still rely largely on manual labor to process and assemble products. With the relatively low cost of labor across ASEAN, productivity initiatives focus on improving yield, improving quality, and enabling better decision-making.  "We are producing 50 percent more output without increasing the number of people we have." — <b>chemicals manufacturer</b>	<b>Real-time assistance.</b> Augmented reality headsets providing real-time information to workers, improving decision making, and minimizing errors (such as furniture assembly instructions)
		<b>Advanced robotics.</b> Combination of robot manipulators and vision sensors to accurately replicate complex activities (such as rib cutting in beef manufacturing, filleting fish, and soldering of electronic parts)
		<b>Automated pick and place.</b> Dexterous robots and grippers used to transport the most delicate items around the factory floor (such as fruits and vegetables)
Planning effectiveness	Mass market products often have limited shelf life, either because they are perishable or because they are made obsolete through rapid development cycles. Being able to accurately forecast demand and aligning complex supply chains and distribution networks give manufacturers a competitive edge.  "It takes us almost a year to design (our products), and the season lasts for a year, meaning we need to be designing a year ahead of our competition." — <b>apparel manufacturer</b>	<b>Optimized sales and operations planning.</b> AI and big data used to forecast likely future demand based on observed trends and changing conditions (such as seasonality, upcoming major events) and defining an optimal production schedule



# Intermediates

## Description

The intermediates archetype is characterized by largely standardized outputs but enduring reliance on manual labor. Customers are typically other businesses that value products based on their cost, accessibility, and compatibility with internal processes and components.

### Example industries

- Textiles
- Auto parts
- Basic electricals (such as memory)

## Key value drivers

Intermediates are usually discrete manufacturers that use workers to assemble products or perform stop gaps between basic machinery. As a result, safety and labor productivity are the main value drivers. Furthermore, because outputs are usually for either mass market or specialized manufacturers, there is a flow through pressure for quick time to market.

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Time to market	Products such as textiles, auto parts, memory, and batteries are sold to mass market and specialized manufacturers for further processing and assembly. With the market pressure for customers to collapse time to market, suppliers such as the intermediate manufacturers are expected to reduce cycle time.  “One of the most basic of parts can put a \$5,000 product into jeopardy, as it has a 52-week lead time.” — <b>contract manufacturer</b>	<b>Trend identification.</b> Machine-learning algorithms, including natural language processing to collect and process unstructured data (such as social media accounts for Pinterest and Instagram) to identify fashion trends (fabrics and colors) to incorporate into R&D
		<b>Rapid prototyping.</b> 3D printing enabling a seven to eight times reduction in time to prototype often at less than 1 percent of historical costs, enabling faster, more accurate design (such as auto parts compatibility and durability and safety testing)
Safety	Workers in intermediate industries are often expected to use machinery to complete tasks (such as pressing, stamping, and sewing) or to pass work-in-progress products between machines. Unlike with commodities manufacturers, workers operate in proximity with heavy machinery daily.	<b>Hazard prediction.</b> AI-driven algorithms that take a combination of historical incidents (such as stoppages and injuries) and real-time conditions (such as asset location, employee location, and employee skills) to identify and alert operators to potential hazards before they occur
		<b>Worker safety.</b> Connected wearables to track worker location and ensure they have the right skills for each zone (for example, hazard permits for hazardous zones and yellow good licenses when operating forklifts), enabling real-time communication and assistance and automated emergency notifications
		<b>Augmented reality training.</b> Simulations for immersive off-site training for faster time-to-competency and to better equip workers for dangerous situations
Labor productivity	Similar to mass market manufacturers, the cost of intermediates labor is low. However, an individual laborer’s drive variability into the process creates concerns around product quality as well as decision making.  “We have a 50 percent attrition rate in factory workers every year. With robotics, we only have to teach the machine once, and they continue to operate.” — <b>electricals manufacturer</b>	<b>Real-time assistance.</b> Augmented reality headsets providing real-time information to workers, improving decision-making and minimizing errors (such as electronic placement into cases)
		<b>Smart factories.</b> More than 70 percent of automation of all factory floor processes, E2E integration of all standardized processes driving higher throughput and lower error rates (for example, picking of components and placement through to soldering and packing)



## About A.T. Kearney

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