NEURAL MANUFACTURING
The next step in the evolution of location-independent agile manufacturing
PURPOSE-DRIVEN, RESILIENT & ADAPTABLE

with Business 4.0™

- Embrace Risk
- Mass Personalize
- Cloud
- Intelligent
- Leverage Ecosystems
- Create Exponential Value
- Resilient
- Automated
- Agile

Purpose-Driven Business 4.0™
Starting off with the principles of mass manufacturing introduced by the automobile assembly line almost a 100 years ago, the manufacturing industry has transformed itself by globalizing supply chains, adopting lean, leveraging digitalization not just for enterprise processes but products and customer engagement as well, and now starting on the journey of de-carbonization. But 2020 will be a watershed year for the industry. The global manufacturing Purchasing Managers’ Index (PMI) from IHS Markit has slumped from 47.3 in March to 39.7 in April, its lowest since the height of the global financial crisis in March 2009. The automotive industry reported over 90% plant shutdowns and it will get back to 2019 sales levels only in 2021, according to several forecasts. Aircraft manufacturers and their suppliers stare at a bleak future as airlines have put their orders on hold. Stalled infrastructure projects imply that the industrial machinery business will take a long time to rebound as also the associated construction, housing, and other segments. Only selective chemical industries supplying to pharmaceuticals, hygiene and personal protection industry, and agricultural business provide a silver lining.

The manufacturing industry stares at a very long recovery cycle ahead, pushing it to adopt new paradigms of safety and distancing inside plants and warehouses. We expect that the COVID-19 pandemic will further drive the manufacturing enterprise to build adaptive supply chains catering to the ‘business from anywhere’ models operating within purpose-driven ecosystems. Firms will transform themselves into asset-light companies, with localized operations, and a strong customer services focus. Digital technologies will drive these initiatives, making for more resilient, innovative, and intelligent manufacturers.
The COVID-19 change imperative

The manufacturing industry is unique in its absorption of digital – from products with software-enabled features to harnessing the abundance of data from connected smart products and assets, enterprise operations and customer engagement. This makes the manufacturing sector a very large consumer of digital capabilities and the high digital quotient provides a lever to transform business operations.

Waves of change

Figure 1 presents the evolution of the manufacturing industry through various defining moments or ‘waves’, as identified by TCS in past research. Each wave complements the next one by bringing in better efficiency, innovation, globalization, and opportunities. Intriguingly, each wave was triggered due to customer demand or previous experience. But accepting those drastic changes, adhering to the risks and compliances that come with the change, and riding the disruptions never came easy, just like the Coronavirus pandemic.

- **Wave 1**: Reduced costs and created new price points for buyers to build economies of scale
- **Wave 2**: Tiered supply chains coupled with lean manufacturing
- **Wave 3**: Shifts in sources of supply and demand due to globalization
- **Wave 4**: Emergence of global brands due to M&As among manufacturers and suppliers
- **Wave 5**: Disruption due to digital technologies, smart connected products, assets, and operations
- **Wave 6**: Digital technology, data, and ecosystems to power the future manufacturing enterprise

Figure 1: The evolution of the manufacturing enterprise
Manufacturing enterprises have witnessed an exciting period of change in the last decade. They have embraced a more customer-centric B2B2C model, against the traditional business-to-business model. This in turn has made them digitally savvy, both within the product and the enterprise.

Manufacturing has led many other industries in digital transformation investments. The discrete and process manufacturing industries together spent an estimated $340 billion on technologies and services that enable digital transformation1.

However, the change in the socio-economic environment brought about by the COVID-19 pandemic brings to the fore crucial decisions about how to manage these strategic investments with long gestation periods and innovation cycles. While the change in manufacturing has been visible but very incremental in the last decade, it is likely to accelerate very fast, potentially one wave every quarter, given the current economic climate. The transformation is being led by the convergence of social (medical), economic, and technological forces. Applying the principles of Industry 4.0 will help manufacturing enterprises restore their operations in the shortest possible time. But this transformation raises some challenging questions – Is there enough capital to set up a future-ready architecture? How fast can it be created? Return on investment is no longer core to this transformation.

Manufacturing’s renewed agility

The speed with which global business has been disrupted between January and March 2020 is certain to reset the assumptions that define the extended enterprise business and operating models. As companies seek to reset their long-term goals, the business models seen today will not remain the same. Combinatorial trends encompassing data analytics, machine learning, cognitive computing, agile methodologies, omnipresent connectivity, artificial intelligence, and cloud computing, will likely bring about paradigm shifts, both in the operating models as well as strategies. A new set of leading companies will emerge; leading players of today will potentially engage in entirely different areas of business; others may shrink in size but will focus on value-added businesses.

1IDC; Businesses Will Spend Nearly $1.2 Trillion on Digital Transformation This Year as They Seek an Edge in the Digital Economy; April 24, 2019; https://www.idc.com/getdoc.jsp?containerId=prUS45027419
This resilience is best defined by the concept of the ‘agile manufacturing enterprise’. While agility in manufacturing is not new, in the post COVID-19 era, it will evolve with the following distinct characteristics:

- **Frictionless value chain**: In such a model, research, design, build, manufacture, sales, and service can be conducted anywhere. The model requires companies to develop networked businesses beyond one-to-one collaborative engineering, contract manufacturing, or distribution rights.

- **Resilient supply chains**: Supply chains will become more cognitive and automated (machine first), sensing risk on the supply side as well as shifts in demand patterns.

- **Adaptability**: The product mix will evolve rapidly in response to market stimulus.

- **Purpose-driven business agendas**: A blurring of boundaries between industries, largely around customer-centric constructs, will push companies to build partner ecosystems that satisfy the demand for ‘frictionless experience’ by end customers.

- **Emergence of B2B2C business models**: Manufacturers seek to get closer to the end customer and own the experience for life in order to capture value.

  Technology will play a key role in defining the business, customer experiences, and product or service behaviors of the agile manufacturing enterprise. This is what TCS terms as neural manufacturing - an intensely networked set of partners aligned to a common purpose, where the value chains are responsive, adaptive, and personalized, with intelligence built on the ‘edge’ of the networks.
To achieve the new-found agility described above, manufacturing businesses can reinvent themselves as they tweak their operating models to emerge from the acute economic distress. However, the rate of change will accelerate from decades to unfolding within a quarter.

Research by TCS, as captured under the Business 4.0™ thought leadership framework, shows that companies with a strong foundation of integrated data-based insights, visibility into both the supply and demand sides of the value chain, and deep understanding of customers will help them sustain through such a period of crisis. Not only will the firms need to demonstrate resilience to come out of the crisis, but they will also need to adapt their business and operating models for the future and initiate multiple transformation interventions.
Manufacturing firms will have to undertake a three-step journey (see Figure 2) to digitally transform themselves in the post-COVID-19 world, and this process has been developed based on TCS’ interactions with a number of industry players across segments.

**Industry Response**

**Business Phase**

**Pause and Restart Phase**

- Resilience:
  - Secure ‘liquidity’ to keep business running
  - Retain existing customers
  - Postpone capex and non-essential projects
  - Systemic avoidance of cost obligations
  - Ensure better workforce insights and planning optimization

**Adaptability:**

- Secure safe ‘production’ operations
- De-risk and rebuild the supply chain; enhance visibility
- Rapid acceleration in the B2B2C model
- Relook at future-ready technology architecture
- Re-purpose factory and supply chain for re-factored manufacturing demand

**Transform:**

- Revitalize strategic investments in ‘new age’ business plans
- Un-bundle loss-leader investments
- Reimagine value chain in line with business models
- Intensive Industry 4.0 adoption
- M&A/JV/alliances for cost efficient strategic growth

**Recover**

- < 1 Year

**Future Proofing**

- 6 months to 3 years
- Ongoing

*Figure 2: The manufacturing industry’s response to COVID-19*
Resilience through strategic cost management:
As with other industries, the COVID-19 pandemic has also had an adverse impact on the manufacturing industry. Consider these statistics: According to global management consulting firm Oliver Wyman, 60-90% of manufacturing firms will incur significant losses due to the pandemic2. Two surveys by Gartner reveal that more than one fourth of companies are bracing for a revenue contraction of more than 30% in 20203 and more than 60% of chief financial officers plan to cut their spend in the selling, general, and administrative division this year4.

Despite unfavorable forecasts, manufacturing firms are well-equipped to handle such economic disruptions. This is because cost optimization has been a dominant theme of competitive advantage for manufacturing enterprises for a long period of time and will continue even in the post COVID-19 era. This trend will be further accelerated by establishing global economies of scale, lean thinking, and increasing levels of automation, among others.

Adaptability through new services, processes, and technologies:
Firms that started early on their digital journey will ride out of the crisis faster. Adopting new channels for direct customer outreach such as e-commerce and digital interactive marketing will be key to increasing customer footfalls. The ability to configure customized or personalized products, diversify the product portfolio to...

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3Gartner; Gartner Survey Shows 51% of CFOs Are Preparing for Up to 30% Decline in Revenue This Year Due to COVID-19; April 16, 2020; https://www.gartner.com/en/newsroom/press-releases/2020-04-16-gartner-survey-shows-51-percent-of-cfos-are-preparing-for-up-to-30-percent-in-revenue-this-year-due-to-covid19
cover services, and partner with other providers for complimentary services will help firms manage the impact of COVID-19.

A strong technology backbone that includes planning for automation and cybersecurity will help firms in supply chain and manufacturing operations cope with the aftereffects of the pandemic.

This crisis has taught enterprises that in order to avoid becoming obsolete, they must establish strong information exchange mechanisms for cognitive collaboration across the value chain and ecosystem.

**Purpose-driven transformation:**
The COVID-19 pandemic will restructure and redefine the roles and responsibilities of future manufacturing enterprises in whatever form – be it connected and autonomous systems, predictive and prescriptive diagnostics, products and assets-as-a-service – for long-term gains. Steps 1 and 2 mentioned above would have financially stretched several industry players, pushing companies to relook at their core. This will give rise to alliances, joint ventures, and mergers and acquisitions. Firms with a head start in the game are establishing the next entry barrier for their competitors.

As demonstrated in TCS’ Business 4.0 research, manufacturing firms that are focused on personalizing products, have established platforms to leverage ecosystems, and harness data to build insight-driven enterprises will stand out from the rest.
The future manufacturing industry will see greater partnership between various players in the ecosystem. Some big business and technology breakthroughs are likely to come from startups or alliances between various ecosystem partners. Such partnerships will be a key point of inflexion in the industry, as firms make choices to invest in digital technologies for product, enterprise operations, or customer management.

Further, technologies such as artificial intelligence, blockchain, and additive manufacturing will move beyond piloting and gain wider acceptance in the future manufacturing enterprise and in the new value chain construct. Companies will have to adopt new skills and capabilities to create a technology-savvy agile workforce to operate in a changed business environment.

Figure 3 sums up the main drivers of the future manufacturing enterprise.

**Figure 3:** The ecosystem of the future manufacturing enterprise
Another aspect of the future manufacturing enterprise is how the entire ecosystem and value chain will regain its equilibrium once the initial turbulence caused by the COVID-19 crisis settles down. In its wake, a new multi-layered system dynamic, or manufacturing world order, will arise. It is highly unlikely that the form and shape of the operating model or value chain will be the same as before. Based on early research on business and operating models and their interplay with the industry value chain, we believe that the new manufacturing world order will have three distinct layers:
The new manufacturing order is predicated on deconstructing the traditional value chain built around cost additions from the left (raw material) to the right (finished product) to a modern 21st century value chain that has the end customer at the center. Direct product and service providers around them (true value addition) and the rest of the tiered structure will serve as enablers of this new value chain. This new order can be referred to as the resilient manufacturing enterprise with a connected, cognitive, and collaborative value chain design, leading to adaptive and sustainable business models.

The fundamentals of how companies operate will need to transform from being asset-heavy, with centralized operations, and a product focus to asset-light, with localized operations, and a strong customer and services orientation. Companies that leverage the ecosystem and form strong collaboration networks are likely to be more successful than the rest. The survival and success of many large manufacturing firms will depend on identifying, funding, and nurturing the opportunities which will accelerate this next wave.

**Market Leaders**

Firms that have continued investing into digital technologies for product, customer, and partner ecosystem platforms.

These firms will shape the agenda as they have retained a large part of their capital expenditure in the pre-COVID-19 phase.

The true agile, intelligent, and insight-driven manufacturing enterprises.

**Complementary Partners**

Firms that are niche and innovative and will complement market leader firms in customer, market, and revenue expansion.

Predominantly use digital technologies in their enterprise operations.

Characterized by market aggregation, service innovation, and collaborative networks.

**Enablers**

Firms which will support the market leaders and complementary partners with reach, economies of scale, and scope.

Characterized by cost leadership, flexibility of capacity, scalability, and localization.

These companies will deploy the operations of larger firms in local markets and de-risk the supply chain constructs.

**Figure 4:** The new manufacturing order
A future built on reimagination

Any impact the manufacturing sector faces occurs on both the supply and demand side. In the last three years, the industry has invested billions in product engineering for autonomous and electric cars, predictive and prescriptive diagnostics of assets, customer experience platforms, de-carbonization, and sustainability. Given the liquidity crunch, capital expenditure in these areas will be reconsidered, as enterprises seek to become cost competitors (resilience), which will set a new baseline. As the industry regains its footing over the next two to three quarters, companies will need to de-risk their operations (adaptability), rejig their product portfolio, and increase the levels of collaboration, both between competing firms as well as ecosystem partners to spread the costs out.

Manufacturing has a large downstream effect on other industries. A skilled manufacturing job on average generates many more jobs in services businesses. This will also play an important role in the socio-economic revival across countries.

This new economic model will potentially evolve around new customer-centric services which are built on the reimagination of the traditional value chain and blurring of traditional boundaries between industries (purpose-driven).
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