21st century neural value chains - Heralding the future of manufacturing

Reimagining the operating and business models of enterprises
Abstract

The manufacturing industry has been transforming over the decades through the intensive adoption of automation technologies and philosophies such as Lean. This transformation has further been fueled by large-scale investments into digitalization of enterprise operations, processes, and products. The pandemic has only accelerated these changes. Manufacturers are, thus, rethinking their operating models, and in turn, their value chains, which have for long served as the foundation of their business models and value realization.

Technology adoption, seen through the prism of digital capabilities, will help manufacturers reshape their businesses, customer experiences, products, and services. At the same time, several other factors will determine the success of the 21st century value chain. These include embracing enterprise agility at scale; restructuring organizational roles in line with ecosystem-centric business and operating models; enhancing workforce skill sets; and evolving on-demand commercial and financial models to work with partners, customers, and even competitors.

Manufacturing enterprises should start taking notes from the biological systems of many evolved species to demonstrate adaptability and resilience. Biomimicry of the human neural system can lead to creative interventions using artificial intelligence (AI). Our first paper in this series, titled Neural Manufacturing™, analyzes how manufacturers can design 21st century, digital-first business models, with value chains that are responsive, adaptive, and personalized, and drive exponential growth through purpose-driven ecosystems.

To develop a robust 21st century neural value chain, investing in digital capabilities and an information fabric will help enterprises better connect and collaborate with their ecosystem partners, thereby helping them keep pace with evolving market demands.

Transformation in manufacturing

Manufacturing enterprises that have invested in digital capabilities have established a strong foundation to compete in the future, as demonstrated in recent times. We believe the industry has evolved over distinct phases, each phase more technology intensive than the earlier and arriving at a more accelerated pace (see Figure 1).

This evolution is backed by research, which states that in the future, manufacturing enterprises will emerge stronger by leveraging the power of convergence created by all the waves of digital technologies peaking together. High software usage, increased focus on sustainability and circularity in businesses, usage-based ownership of offerings, personalization of services and products, and widespread adoption of cognitive technologies are paving the way for the next wave of transformation in manufacturing. Achieving economies of scale through aggregation of demand across products and geographic regions, by leveraging platform models, has further helped enterprises strengthen their market position.

Manufacturers have been disrupted by new-age technology-driven business challengers, and COVID-19 has impacted the industry further, thus transforming the conventional value chain structure.

The need is to cater to-

- The demands arising from the emergence of ecosystem-centric businesses
- The shift towards asset-light models (as-a-service, on-demand, and pay-per-use)
- Agile, design anywhere-build-anywhere-sell anywhere operating models

Such radical changes to business models require manufacturers to re-evaluate how their traditionally linear value chains must transform to be future-ready. We are already witnessing the rise of niche business ecosystems, with an innovative interplay of adjacent industry services, such as personal mobility, nutrition and wellness, and asset availability, among others. This pattern is accelerating in the business-to-business-to-customer (B2B2C) space, where new products, services, and platforms are personalized per customer journeys and consumption patterns. We believe these business models are only going to increase in the near future.

The operating and business models in manufacturing enterprises are undergoing numerous changes. Two strategic levers driving their transformation are as follows (Figure 2):

1. Ecosystem-centric B2B2C business models
2. Connected, cognitive, and collaborative value chains defining the new operating models
To design these new business ecosystems and models, manufacturers can draw inspiration from the human neural system. This will help them develop the ability to make simultaneous decisions on the edge - both in a decentralized and centrally coordinated manner - such as taking targeted action to achieve a task (purpose-driven). TCS defines these capabilities 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 at the edges of the networks.

Such neural capabilities will help enterprises create value chains that are responsive to digital-first business models. Leading manufacturers are proactively investing in building an agile, digital core, which will revitalize not just the existing value chains, but will also enable them to build new ones to deliver frictionless products and services to end customers.

The pursuit of value

Value chain is a concept from business management that was first described and popularized by Michael Porter in his highly referenced book, published in 1985, *Competitive Advantage: Creating and Sustaining Superior Performance*. It defines a value chain as-

- A series of activities for a firm operating in a specific industry
- Products pass through all activities of the chain in order, and at each activity, the product gains some value
- The chain of activities adds more value to products than the sum of the independent activities’ value.

For close to three decades, value chain has been the mainstay model for manufacturing enterprises, helping them define, benchmark, and realize value and competitive advantage by-

- Optimizing operations (systems and processes)
- Eliminating friction between successive steps of the chain through close interlinkages
- Understanding the impact of these processes on long-terms costs and profitability, and identifying sustainable sources
Conventional value chains have been largely linear, and have followed a cost-plus approach, where the value of products and services has been delivered downstream. While this conventional structure served manufacturers well in the past, it is increasingly a challenge to cater to current emerging market and business demands, riding on the conventional value chains.

The emergence of purpose-driven ecosystems

A TCS survey conducted in 2020 on the business impact among global companies\(^2\) found that enterprises that emerged as leaders had invested in omnichannel digital customer experience (CX), AI, business process automation, smart products, cloud, and key ecosystem partnerships. The survey also showed that manufacturing was one of the sectors to score relatively low in terms of investing in digital capabilities and creating key partnerships in digital ecosystems.

With the emergence of ecosystem-centric businesses, the demands from value chains are now more focused on flexibility, agility, and connectedness. We studied this emerging landscape of business ecosystems within the manufacturing sector and inferred that many of these networked ecosystems are focused on creating new products or services, experimenting with future technologies in controlled user environments, or nudging customer behavior and consumption patterns (see Table 1).

Further, a recent article by Gartner explained the different styles of creating ecosystems\(^3\). Our research on the digital investments made in manufacturing has many examples of these different styles. To illustrate, Embraer, an aerospace manufacturer, has created a subsidiary – EmbraerX. This entity orchestrates niche ecosystems by partnering with other firms that work on futuristic technologies such as urban air mobility\(^4\). It has also created an accelerator called Eve, to nurture potential startups and support their development, thus creating new revenue streams for itself\(^5\).

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\(^5\) evVTOL; EmbraerX ‘graduates’ urban air mobility activities as a standalone company: Eve; October 16, 2020; https://evtol.com/news/embraerx-graduates-urban-air-mobility-activities-standalone-companyeve/
Agricultural companies are not too far away from participating in or creating new business models. Archer Daniels Midland Company (ADM) and Cargill Incorporated, which compete in the same food grains processing space, have joined hands to create GrainBridge LLC. Following a ‘coopetition over competition’ approach, GrainBridge offers a software platform to bring different stakeholders together, and advisory services for the grain industry[6].

Both ADM and Cargill are conventional players in the food industry: They have a linear value chain and grow through M&As to acquire new markets. However, through GrainBridge, they have brought their suppliers and customers closer, built transparency in operations, and are providing their customers better decision-making capabilities, thereby increasing the chance of achieving higher profitability.

A performance analysis of manufacturing companies by our research team shows that over the last few years, the market capitalization of companies that have invested in new business models has increased significantly. New leaders are emerging and existing companies are forced to invest or partner towards closing the technological gap.

That said, a key question arises: Will the conventional, linear value chains be appropriate and conducive for businesses to grow exponentially?

Value chains in the 21st century: To be or to transmute?

Value cannot be contained to a specific indicator, as it takes on different meanings based on which perspective is taken. A product-centric view of value places the product at the core, and a company’s strategy and linear value chain are built around it. On the other hand, a customer-centric value chain views the customer as a profitable asset, and all business decisions and the value chain structure are based on maximizing customer lifetime value.

The word value is being redefined across industries. Earlier, it was driven through on-time delivery, inventory-to-sales ratio, order fulfilment time etc., but these may not be the right measures to capture value in the future. The new metrics already in place are lifetime value, advocacy, and new service line contributions with companies pursuing new-age strategies.

Our industry insights and deep understanding of adjacent businesses as well as emerging technologies, have helped us put together a new value chain structure, as depicted in Figure 3, which will be relevant for the 21st century. The value chain transformation is anticipated to be a two-step process:

**Step 1:** Adoption of new capabilities to create a digital spine.

**Step 2:** Establishing a neural fabric to cater to purpose-driven ecosystem models with multimodal value chains.

**Step 1: Creating the digital spine**

The manufacturing enterprise of the future will be powered by technology enablers, which act as an enterprise’s digital spine, helping it participate in multiple, new value chains such as those for design, materials, logistics, customer experience, and circularity. The digital spine will rely on cloud hyperscalers, AI at scale, digital thread, digital twins, platforms, edge computing, low-latency infrastructure, and more such enablers. While the existing value chains will remain important for business as usual, the new value chains will come together as niche ecosystems through which the various needs of the enterprise and customer will be met. While improving its traditional value chain capabilities such as research and innovate, source and produce, distribute and sell, marketing, and product in use, the enterprise will also develop new specialized capabilities that can be provided to other participants in these ecosystems in exchange for different forms of value (see Figure 3).

Figure 3: New capabilities and business ecosystems for manufacturers in the 21st century
Step 2: Establishing the multimodal value chains

For the new operating and business models, manufacturers need to choose between designing multimodal value chains with the superlative capabilities of cognition, collaboration, and connectedness, and working on transmuted ones. While establishing a strong digital spine is the foundation, using this spine effectively through a seamless neural fabric should be the next focus area for manufacturers. This fabric ensures that there is a smooth exchange of intelligence through the different systems, processes, and entities within and outside the enterprise. **Multimodal value chains utilize the cognitive power from the neural fabric.**

These multimodal value chains should be designed considering the future manufacturing enterprise’s business strategy for gaining competitive advantage and growth, be it in customer centricity, products and services differentiation, or cost leadership. As a next step, manufacturing enterprises should focus on how to bring forth these capabilities and align them meticulously with their business strategies. We see the emergence of two constructs of value chains to serve the above-mentioned business strategies:

- **Multiple value chains converging around the customer**, with the extended manufacturing enterprise playing the part of an orchestrator of customer value – the new avatar of the erstwhile customer-centric value chain. This model, illustrated in Figure 4, has a significant upside from accruing revenues, as it meets all the needs of the customer and secures enhanced lifetime value, increases the net promoter score (NPS), and hence, ensures competitive advantage.

**Figure 4: Customer-centric value chain - The manufacturing enterprise as an orchestrator of value**

- **Manufacturers can use their new value chain capabilities to participate in multiple ecosystems and serve different customer segments**, as illustrated in Figure 5. This is closer to the diversification strategy of yesteryears. Here, the manufacturer can still choose between orchestrating the ecosystem as a new line of business and just participating as a player in the ecosystem value chain orchestrated by some other player. Through the new capabilities available in the 21st century value chain, a manufacturing enterprise can participate in multiple new ecosystems with diversified services and offerings.
To meet these demands, value chains need to be designed to exhibit characteristics such as being data-driven and intelligent, promoting networked and flexible collaboration with supply chain partners, providing multi-tier visibility for planning and operations, enabling intelligence for autonomous decision making, and reducing carbon footprint of operations. The conventional linear structure does not lend itself to the networked, data-driven, and agile-focused needs of the enterprise. A quick comparison between the characteristics of traditional and 21st century neural value chain is shared in Table 2.

Figure 5: The manufacturing enterprise participating in multiple value chains through different services
A peek into the 21\textsuperscript{st} century manufacturing enterprise

With the 21\textsuperscript{st} century neural value chain, a manufacturing enterprise can orchestrate niche ecosystems to serve multiple purposes such as tapping into emerging business opportunities, accessing new markets, and running controlled experiments for futuristic products. On the people front, the value chain also empowers firms to leverage a skilled workforce on demand, gather direct customer feedback or co-create personalized services, exchange value from their partners to attain group sustainability goals, and many more. Siloed value chain functions may not exist within a manufacturing organization. Its core focus would change from producing a product to managing specific ecosystems that deliver holistic customer needs. The ramifications on organizational design will be far reaching.

The most significant change that we see is the shift away from hard-wired capabilities towards an orchestrated capability model. Enterprises will have an array of digitally enabled capabilities to choose from, configure, or orchestrate to create new operating models for ecosystems. The dynamics of the new market demand the creation of an agile, scalable enterprise. Laying a strong foundation to build the 21\textsuperscript{st} century value chain lies in investing in digital platforms that allow for smooth participation in ecosystems. Investing in an expansive information fabric will also help ecosystem players connect and collaborate. Ensuring that the capabilities of autonomous decision making, connectedness, and collaborative exchange of intelligence are available through these value chains, will be the significant area of focus for the future manufacturing enterprise. Being neural in thinking and operations is the way ahead for manufacturers.

Table 2: Characteristics of traditional and 21\textsuperscript{st} century neural value chains
About the authors

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Sreenivasa Chakravarti is Vice President and Head of the Manufacturing Business Practice at TCS. He has 28 years of cross-functional experience, cutting across consulting and advisory services, IT and manufacturing industry functions. He works on issues of significance to the manufacturing enterprise, addressing the challenges and opportunities arising out of digital transformation especially –
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He has authored several thought leadership papers on topics such as Neural Manufacturing, intelligent and insight-driven enterprises, and automotive retail.

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Priya Varadan is a Managing Consultant and Brand Architect for Manufacturing at TCS. She has over 19 years of work experience straddling different functions such as research and development, pre-sales, innovation evangelism, and marketing. In her present role, she is focused on Neural Manufacturing, TCS’ thought leadership framework and its future impact on manufacturing industry segments. She holds a management degree from the Indian School of Business, Hyderabad, India.
Awards and accolades

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