# A TURNKEY SOLUTION TO UNLOCK THE POWER FUTURE OF MANUFACTURING

**Deneb Automotive Group - A 2035 leading global manufacturing enterprise**

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**Statement of Purpose:**
My goal in this essay is to outline the features of a successful high-tech global design and manufacturing firm called Deneb Automotive Group in 2035. Deneb Automotive Group is a worldwide automotive manufacturing company based in South Carolina. It creates, manufactures, and sells passenger and commercial vehicles, engines, and turbomachinery, as well as finance and fleet management services. The essay discusses the company's operating model, operational difficulties in maintaining the operations, and research gaps. Finally, it suggests the technologies that will be required to help the company's workforce stay globally competitive and not let the company be stuck in the pilot-purgatory phase.

**Design and Manufacturing Process in 2035:**
To seize the opportunities in 2035 and address the forthcoming difficulties, our company, Deneb Automotive Group, which is a leading high-tech global design and manufacturing organization, has evolved to exceed customer expectations in terms of product design, quality, and service. The company is more agile and adaptive than ever before. From technologies to business models used in design and manufacturing, from research to employee training, from developing products based on individual customization to social behavior, significant changes have occurred in many domains, including disruptive ones in the years preceding 2035. The value chain's organization and the geographical placement of manufacturing activity are two of the most noticeable developments. The convergence of technologies such as 3D printing customization and the circular economy has accelerated the transformation of future production to a consumer-centric web. The new goal is to provide the necessary products and services to consumers while optimizing the use of resources, such as materials and energy, to create a balanced and sustainable ecosystem. In addition to this, consumers have also been empowered to consume unorthodox and novel items thanks to the rapid development and adoption of Artificial Intelligence and Virtual Reality-based applications for product and process development, as well as the increasingly lower-cost equipment and services for additive manufacturing. Customers now play an increasingly essential role in value generation, with more involvement in design and manufacturing.

**Our Approach:**
As a consultant, my analysis has shed light on the following features due to which our firm stands as the leading high-tech global design and manufacturing enterprise in the world.

1. **'Nature Inspired Manufacturing':** From the organizational to the technological levels, nature has long provided the industry with inspiration and information. However, since 2025, this synergy

has grown even stronger, owing to significant advancements in the fields of biological sciences and biotechnology. In the year 2035, our design and manufacturing company has solved the problem of combining different actors and activities of effective recycling and reuse processes to become the most efficient firm of its kind.

2. **Artificial Intelligence:** Artificial Intelligence is now being used to help with product creation, operations, decision-making, and consumer interaction. It has become an integral aspect of the design and manufacturing process.

3. **Bionic Manufacturing:** At a large scale, bionic manufacturing has been employed to improve technology and increase key human capabilities. This enhancement has shown to be a winning mix for highly automated and robotized processes that can provide flexibility and responsiveness to changing customer needs.

4. **'Industry 5.0' concepts and technologies:** Industry 5.0 refers to the reintroduction of humanity to manufacturing, particularly as it relates to the usage of our collaborative robots, or cobots. The 'Industry 5.0' settings have resulted in products with a high value add - where the added value is represented by human touch. Workers who will be needed in Industry 5.0 factories in 2035 are those who can add value to the product. Additionally, materials, consumables, intermediate and final products, equipment and processes, quality documentation, and other items have all been merged with the Internet of Things. Sensors and actuators are being used in a variety of applications, such as bio-refineries and energy storage, to demonstrate and fuel a deeper collaboration between different units of industry.

5. **Consistent legislative and policy frameworks:** The availability of technical solutions in response to a global shift in customer preferences based on behavior and environmental awareness has aided the adoption of consistent legislation and policy frameworks across the industry. The existing policy frameworks' flaws have been discovered and addressed to achieve consistency across the board.

6. **Human resource education and lifetime learning:** Allowing employees to adapt to new and rapidly changing technologies and working techniques has become a crucial function of the organization. Innovation and development have occurred at unprecedented rates, necessitating greater collaboration between academia, research institutions, and industry, as well as new and speedier techniques and channels.

Our business features the life cycles of items through improved design, manufacturing service, and making use of remanufacturing. Industrial symbiosis, relating to the optimization of entire manufacturing ecosystems resources, happens to be resulting in minimal consumption of garbage and energy, promoting international competitiveness.

**Research Challenges:**

Naturally, to realize all these characteristics of the leading major high-tech design firm, places a substantial challenge in a lot of domains, like supply chain maintenance, product's high-quality control and safety, and efficient demand and supply planning. The two major research challenges in this space are: Firstly, to provide a consistent framework for evaluating technology, manufacturing business cases, and ecosystem preparedness all at the same time in order to reduce the time it takes for products to reach customers. Note that the accepted metrics of the scalability of non-information technology is critical. Secondly, the invention of design methodologies that can lead to 100% waste-free manufacturing considering a product's whole life cycle. While creating such methodologies, the first obstacle is bridging the knowledge gap between present environmental impacts and technology designed to minimise waste and pollution and the knowledge required to reach future environmental goals. To achieve environmental goals, the second task is to change the manufacturing enterprise's spiritto include cooperation, proactivity, teamwork, and worldwide partnering with governments, universities, allied and competitive manufacturing enterprises, and communities. In addition to this, the balance between high-value-added jobs primarily performed by people and repetitive tasks executed by automated devices contributes to a razor-sharp decline in the number and ordinary skilled human resources.

**Modes of operation - Attaining value at scale and posed issues :**

Currently, the firm is operating in four modes for the development of manufacturing practices. These modes pose challenges in the smooth functioning of design and manufacturing. The four operating modes and the partnerships required to be formed for the company to operate are categorized as follows:

1. **Model 1**: Integration of Global Value Chains
2. **Model 2**: Local Production for Worldwide Markets
3. **Model 3**: Local Production for Local Markets
4. **Model 4**: Vibrant Virtual Value Networks

**Model 1: Integration of Global Value Chains**

This design includes globally integrated legislation and governance and makes use of the application of cutting-edge technologies. In this context, worldwide production, commerce, and investment are increasingly structured into so-called global value chains (GVCs), in which the various phases of the manufacturing process are spread over multiple countries. [1] This is sustained by methods such as synthetic AI, which monitors the chances of client conversions, identifies requirements, and interacts with item design at an advanced level. Companies are motivated to restructure their operations abroad through outsourcing and offshore activities as a result of globalisation.

Identified difficulties for the development of Model 1 tend to be the following:

- Hard administration – governance, control, collaboration – possibly supported by AI-based methods
- Growth of new architectures through the factory towards the sites to allow for vertical and horizontal integration for more flexibility and responsivity
- Optimization of expense and quality – Standardization at the highest amount that is technologically designed for zero failure, with minimization of the utilization of resources

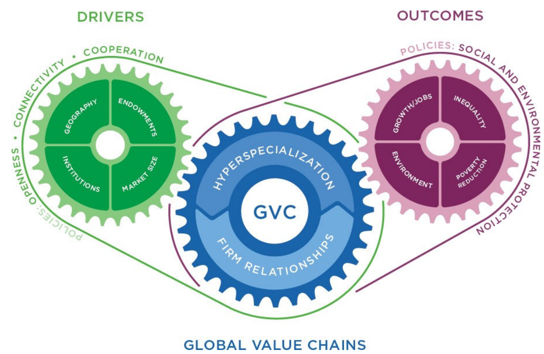



*Figure 1: Constituents of  Global Value Chains [10]*

**Model 2: Local Production for Worldwide Markets**

Like the previous model, this model also targets the international markets in which the regional sites dominate for production and manufacturing including small and medium enterprises. Manufacturing methods are made according to frugal maxims, expense, efforts, and conforming to all relevant laws. Digital platforms hold up the design and development, and operations management for these regional manufacturing communities to become world-leading. These companies are local, extremely dynamic, and flexible. [2]

Identified challenges when it comes to improvement in Model 2 tend to be:

- Regional specialization
- Areas with many protagonists which are leading inappropriate technology areas
    - The versatile structure of small to medium businesses with a high degree of specialization ;
    - Concentrate on intelligence and efficiency;
    - Abilities for consumer-centric system integration;
    - Local technical centers, including service this is certainly electronic (cooperative culture designs);
    - Security and safety components sustained by shared trust in the spot;
    - Regional research and innovation centers
- Generate conditions that tend to host a supportive infrastructure and a legislation framework
- Targeting specialized products

**Model 3: Local Production for Local Markets**

This design has a stronger focus on a model that is regional by encompassing local manufacturing for local clients. As a total outcome associated with the megatrend of urbanization, production is supposed to be progressively understood in urban centers, as towns have become powerful economies in themselves in 2035. [3] The procurement of components is done at an amount that is consistent with the local standards and the construction is principally done near the consumer's location. The mode can dominantly focus on personalization in products such as footwear, clothes, and meals, along with the furniture.

Identified challenges for the enhancement Model 3 tend to be:

- Establishing Carbon neural factories
- Developing flexible and versatile automation
- Creating small, accessible, and affordable designs
- Developing consumer-centric personalization targeted at individuals
- Nurturing a receptive environment

**Model 4: Vibrant Virtual Value Networks**

Along with central management in companies following model 1, there is a need for a system that is completely decentralized. This mode focuses on the emerging platform-based value which is ad-hoc when it comes to the production of a lot of products and solutions. [4]

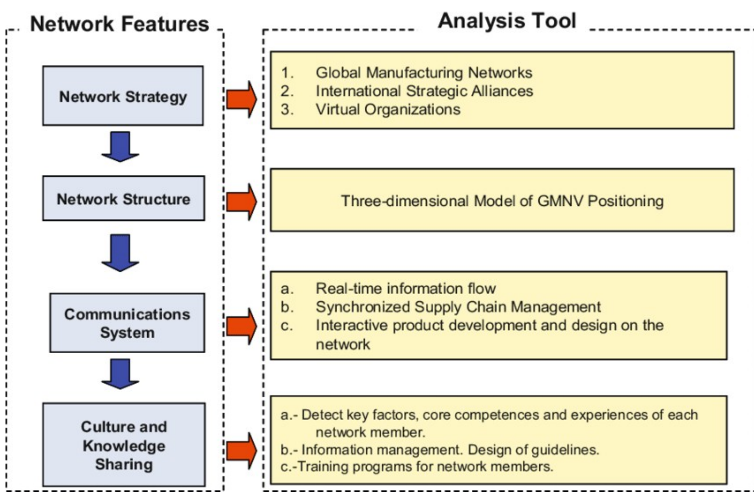



*Figure 2: Evaluation model of global manufacturing virtual networks [11]*

Identified difficulties when it comes to improvement Model 4 tend to be:

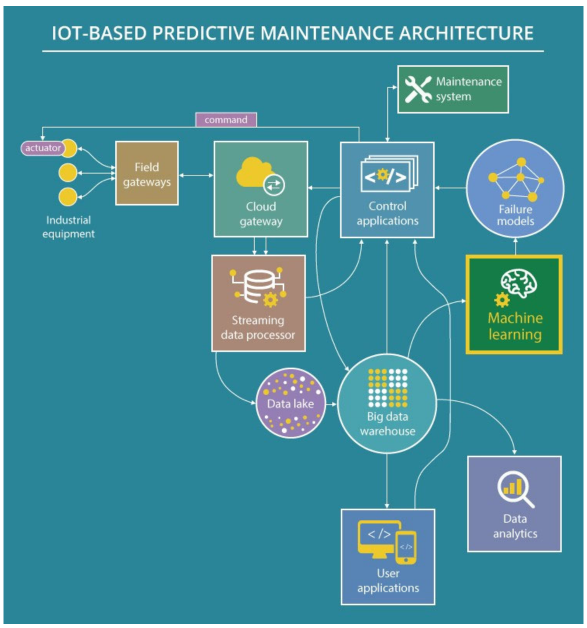
- Interoperability - promoted by logistics and sales platforms for supplies, manufacturing services, and end-market products.
- Developing an adaptive automation throughout a networked community
- Demanding unique and complex items
- Home-based business thinking and aware decision-making
- Ensuring high-security assurance quality

**Solution Use-Cases:**

To solve the above-mentioned issues, the most prominent technology necessary for the company and its employees to stay globally competitive is the implementation and testing of the firm's next-generation AI approach coupled with Robotics and Computer Vision. [5] This advancement can change the way we use materials, stay connected, and the speed of production. The focus of this would be on shrinking the distance between design and production, and from plant to customer. These innovations, if implemented globally at all scales, will change the face of manufacturing rapidly and profoundly. The research has uncovered how using this technology can help the firm solve its three commonly identified problems in the long run:

- **Supply-Chain Predictive Maintenance:** The purpose, as the name implies, is to forecast when a machine or piece of equipment will fail and require maintenance. Unplanned shutdowns and costly supply-chain disruptions can be avoided with a warning system. Machines are becoming increasingly networked in the contemporary Industry 4.0 age. As a result, a single flaw can bring a global value chain to a halt as the firm will adopt Industry 5.0 practices.

*Figure 3: IOT and ML based Predictive Maintenance architecture [12]*




To explain the context, I would like to take the example of Schneider Electric - a multinational industrial automation firm, which is on the verge of making a cutting-edge system that works. In 2019, they joined Microsoft's Azure Machine Learning & IoT Edge service to offer an open-architecture-based predictive analytics solution to their Oil & Gas customers. Given that oil and gas companies operate in some of the world's most distant places, human capital deployment was proving to be costly. As a result, the organization needed to come up with a suitable answer. They were able to reduce in-person visits, reduce downtime by enhancing pump efficiency by 10-20%, and increasing pump lifetime by 3-10 years by partnering with Microsoft and adopting the AI technology. [6]

- **Control of Product Quality:** The goal of Product Quality Control is to use AI to replace and automate manual, repetitive operations like quality-checking. Computer Vision AI systems with extensive training can significantly reduce the cost of quality assurance. As a result, producers can forecast end-product quality, decrease human intervention, and increase production scale quickly.
  For instance, Product Quality Control can be adopted by our firm in the manufacturing site. To maintain consistency across the same automobile models, strict quality standards are implemented on the assembly line. As a result, error-spotting is a time-consuming procedure because personnel are doing repetitive activities. Infrared cameras, on the other hand, using

Automated Image Recognition to check for deviations in real-time were able to attain near-perfect accuracy. This quick, simple solution can also be used to move products, and assist our organization in maintaining the greatest level of production quality. [7]

- **Demand/Supply Planning:** Demand planning is more crucial than ever before, given the enormous magnitude of digital adoption in the preceding year. Maintaining inventory as close to demand as possible is crucial to cashing in on lifeline revenue in a time when people have become completely reliant on gadgets. At this point, manufacturers value agility, resilience, and speed are above everything else. The AI-based demand forecasting technology can be used by our firm, at the planning stage. It can significantly help us with the unmet service levels and demand targets as a result of product promotions. Furthermore, it can assist us with managing and avoiding the large percentage of lost sales due to a lack of cross-functional coordination between the marketing, sales, and finance departments. By adopting AI-based demand forecasting technology across all our plants, we can better anticipate accuracy, variability, and planning by using time-series-based ML models for demand forecasting. It is predicted to reduce the demand planners' workload by 96%, among other benefits. [8]

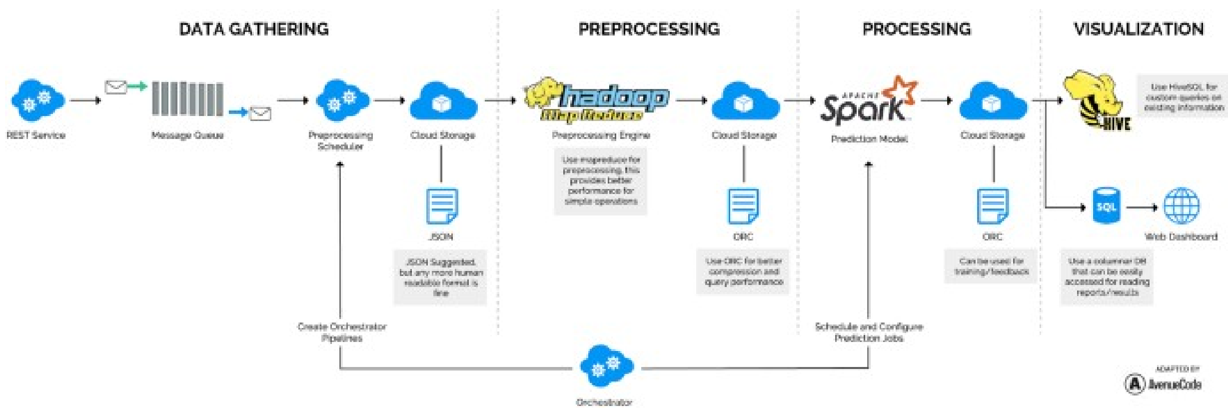



*Figure 4: Big Data pipeline for Supply Chain Predictions and Planning [13]*

Several other actions that are suggested for more effective development of processes in collaborative manufacturing ecosystems are:

- Promote demonstrators and pilot lines as instruments to facilitate data diffusion and fast prototyping. This will shorten the time taken to scale up professionally. Whenever businesses are capable of better assessing the ROI and mitigate the risks which can be financed with new services, technologies, and processes - it becomes far easier for them to determine when and how much to spend.

- Restructure and reinforce the assistance to business and entrepreneurship creation. By making the accessibility to risk capital and loans easier, especially for science-based entrepreneurship, breakthrough technologies can be invented that will serve as the building blocks for production innovations. Collaborative R&D tasks, Innovation Hubs, technical centers, technology parks, and incubators ought to be promoted and supported.

**Conclusion:**

While manufacturers are experimenting with AI and machine learning, Industry 5.0 remains a pipe dream for many organizations. The explanation is simple: far too many businesses are caught in the stage where the idea has progressed to the proof of concept (POC) stage, but instead of reaching clients, it lands in the dreaded PoC grail.[9] I see the successful adoption and utilization of AI in the design and manufacturing industry as a three-step process:

1. Recognize and comprehend the opportunities and threats.
2. Make sure to solve a real-world problem from beginning to end.
3. In the implementation phase, take a scale-driven approach.

I believe that our design and manufacturing enterprise can stay committed to building revolutionary items and services targeting the global markets by following the suggestions. These will also call for collaboration and exchange with stakeholders including academia, companies, and governments, thus accomplishing the goal of overall development.

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