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Cost Reduction Strategies in New Product Design to Minimize Part Costs and Reduce Supply Chain Risks

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ABSTRACT

In today's competitive global market, designing products at reasonable costs is paramount to maintaining profitability. This paper analyzes a set of strategies that minimize new product design costs with minimal risks in the supply chain. The strategies will comprise DFM, material selection, component reduction, automation, and leveraging technology. Additionally, this paper looks at how such approaches might help mitigate risks and achieve resilient supply chains.

Keywords: Cost Reduction, Supply Chain, Global sourcing

INTRODUCTION

It is very important to accomplish cost reduction in product design; every company wants to remain competitive in the rapidly changing market. Engineering, cost management, and supply chain risks are interrelated factors that introduce unique challenges to the product design process for new products.

The designers and manufacturers must determine a method of reducing the production cost without sacrificing functionality, quality, or reliability.

Meanwhile, supply chain risks, like delays, price fluctuations, or material shortages can counteract such efforts. This article explores various strategies to reduce part costs and avoid supply chain risks during the new product design.

KEY COST REDUCTION STRATEGIES

Design for Manufacturing (DFM)

DFM is one of the important methodologies related to the simplification of manufacturing a product by optimizing its design. In return, a company can lower costs with designs that have reduced complexity, standardization of components, and ease of assembly.

Minimizing errors and reducing labor required are some of the significant features of DFM, which further enhance the motive of reducing production costs.

Reducing the number of components and standardizing these components reduces the cost of customized manufacture. Additionally, streamlining designs for automated production can reduce the labor and time costs of production, thus making it more efficient.

Material Selection

Material selection is one of the most significant areas where cost reduction in product design should be considered. The type of material chosen affects production cost, product performance, durability, and ease of manufacture.

Good-quality materials may be more expensive but often reduce future costs, such as lower maintenance or fewer repairs.

Evaluating Material Properties

To manage costs effectively, it's important to look beyond the initial price of materials. Other factors, such as how long the material will last and how easy it is to work with, are also important.

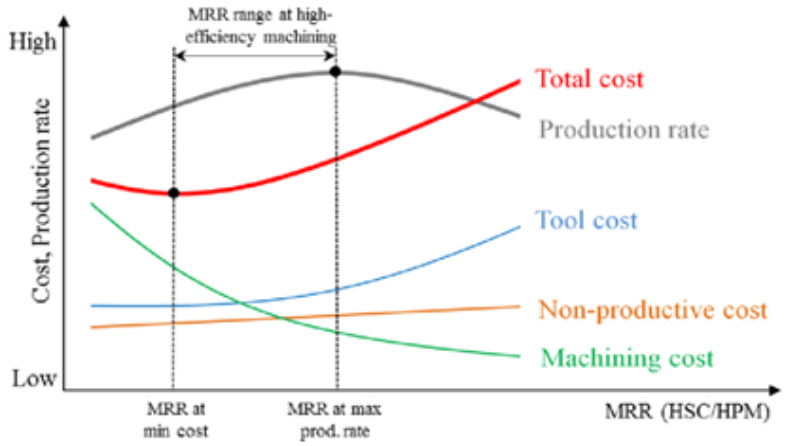
Key properties to consider include:

• **Durability:** Essentially, the material's ability to resist the effects of stress, wear, and environmental conditions. Durable materials may be more expensive, thus saving money in the long run by enabling the building to last longer and reducing replacement and repairs.

• **Weight**: A heavier weight implies that the material is lighter and, because of this, industries such as automotive and aerospace would benefit from better fuel efficiency and lower transportation costs. It may be true that lightweight materials could cost more; hence, their cost-benefit trade-off needs to be considered.
• **Ease of Manufacturing:** Some materials are easier to process, whereby this reduces the production cost by either requiring less labor or energy. The materials that need fewer steps of production tend to save from both time and money perspectives.
• **Energy Consumption**: It is very well comparable that some processing materials require more energy than others, hence increasing the cost. For example, materials such as aluminum and titanium require a lot of energy to melt and shape into the intended form.

Balancing Cost and Performance

There needs to be a balance between the cost of materials and the performance. In other words, one should apply material that would meet the requirements of the product without having to spend extra money on it.



High-end materials like titanium or carbon fiber are excellent in strength and durability; still, they may be overly not needed for many of the applications if a lower-cost alternative could serve the same job equally well.

The substitution of expensive materials with less inexpensive materials that are similar in performance is one of the avenues of cost-cutting. High-performance plastics, like PEEK (Polyether Ether Ketone), can substitute metal in certain pieces that may need that characteristic, especially when weight reduction is an added factor.

Materials of this sort are widely used in industries such as aerospace and automotive.

Substituting with Lightweight Metals

Industries are demanding light metals such as aluminum, magnesium alloy, and advanced alloys. The replacement of steel by aluminum in automobile industries helps to reduce considerable weight.

These lighter vehicles besides being fuel-economical emit less CO2, saving money on a long-term basis, though aluminum is costlier than steel.

Magnesium is even lighter than aluminum; it is more expensive and prone to corrosion. In applications where weight reduction is critical, it can be used with special protective coatings that prevent it from rusting.

Advanced Composites

Advanced composites such as CFRP are required in those applications where a high strength-to-weight ratio is important. These materials, though very expensive, are extremely strong yet light; hence, they are widely used in industries such as aerospace and automotive industries.

While it is still costly to produce, manufacturing technology advances make these materials cheaper for broader applications.

Availability and Supply Chain Risks

Material availability is another determining cost factor. Sometimes, materials are difficult to source, or their prices may skyrocket without prior notice due to circumstances outside one's sphere of influence.

A good example of this is the share of rare earth metals in electronic products, which sometimes surge in price unexpectedly or become unavailable due to political or economic reasons.

Certain mitigation strategies against these risks may include the selection of readily available materials or the use of multiple sources to avoid dependence on one source.

In many instances, locally sourced materials are often cheaper as compared to shipping from other parts and can further minimize the risk of delivery delays.

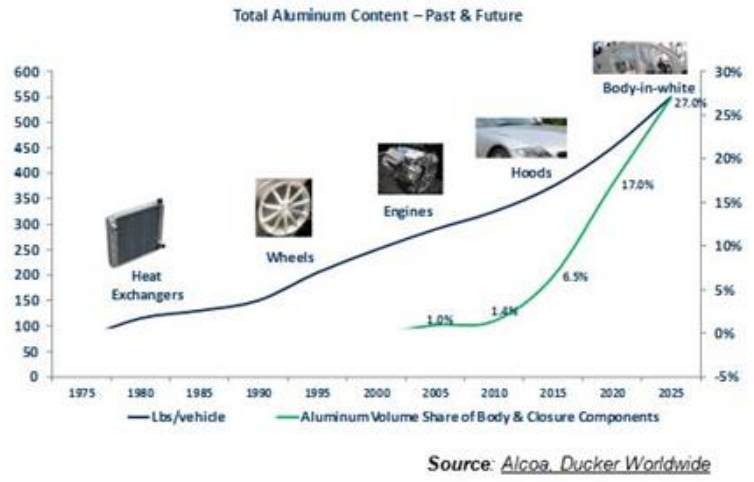
Companies may negotiate long-term contracts with suppliers or maintain inventories of critical materials as a hedge against possible disruptions.

Case Study: Aluminum vs. Steel in Automotive Manufacturing

One of the more common examples of material selection is when automakers began switching from steel to aluminum. Compared to steel, aluminum is much lighter; these advantages ensure fuel efficiency and cut emissions, so significant for automakers needing to synergize with regulatory standards.

For instance, in 2015, when Ford started building aluminum body panels for its F-150 truck, the results shaved the vehicle's weight by approximately 700 pounds.

Although more expensive than steel, the savings on fuel and reduced emissions from using aluminum offset the initial higher costs. Using aluminum also required methods of manufacturing different from what was conventionally employed. For example, riveting instead of welding added to the costs initially but helped in long-term savings.



Source: *Alcoa, Ducker Worldwide*

Component Reduction

Another effective cost-saving technique is component reduction. By reducing the number of parts needed in a design, you reduce both production and assembly costs.

It also reduces the magnitude of possible errors during assembly, hence improving the reliability of the product by making it less complex.

This will also allow for the design of modular systems whereby several functions are integrated into individual parts, simplifying production. The modular components also make maintenance easier, along with reducing inventory costs of spare parts.

One good example of component reduction was when integrated circuits replaced complex arrays of individual components in the electronics industry at a much lower cost.

Automation in Production

Nowadays, automation has become the main driving force that reduces costs in manufacturing processes. Automated systems help lower labor costs, improve efficiency, and reduce human errors.

Most especially in industries such as automobiles and electronics, automatic manufacturing lines enable fast production cycles and higher consistency in the produced quality.

Incorporating robotics could also help enhance the manufacturability of any complicated products. It saves time and reduces waste.

The use of automated inspection systems can find defects in the early stage of the process and thus save unnecessary costs due to defective products.

Industry	Automation Impact	Cost Reduction (%)
Automotive	Automation in the automotive sector focuses on robotic assembly, painting, and welding, improving production speed.	15%
Electronics	In electronics, automated systems perform precise placement of micro-components, reducing errors and boosting efficiency.	20%
Manufacturing	Automated machines handle repetitive tasks in general manufacturing, increasing speed and reducing manual labor.	18%
Food & Beverages	Automation helps in food processing and packaging, ensuring uniform quality and reducing labor costs.	12%

Pharmaceuticals	Automated production lines in pharmaceuticals ensure precision in dosage and reduce the risk of contamination.	22%
Textile	In textile production, automated weaving and cutting systems reduce material waste and increase throughput.	10%
Aerospace	Automation in aerospace manufacturing involves the robotic assembly of aircraft components, improving accuracy and safety.	16%

SUPPLY CHAIN RISK REDUCTION

Supplier Relationships

Building strong relationships with suppliers is the key to mitigating the risks of the supply chain. The rewards could be better pricing, quality control, and increased flexibility when demand fluctuates.

Additionally, having a reliable supplier network reduces the risks associated with delays and shortages, especially at times of high demand or market instability.

To remove further risks, companies are suggested to diversify their pool of suppliers. Companies reliant on a single source of supply are highly prone to cases of disruption should one supplier encounter a problem.

Diversification among many different suppliers, more so over different regions, would buffer them from different risks such as political government instability or natural calamities.

Global Sourcing vs. Local Sourcing

With global sourcing, there is a comparative advantage through reduced labor and material costs, particularly in countries with low costs of labor.

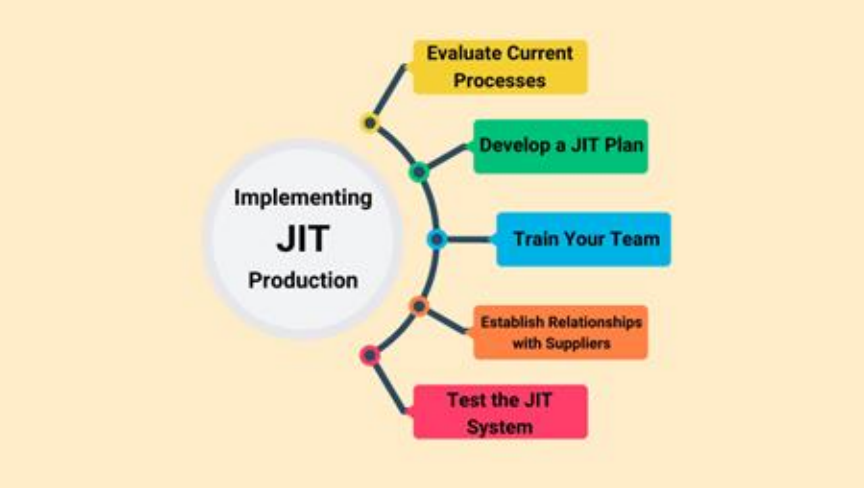
Global sourcing also presents risks: longer lead times, shipping delays, and increased exposure to fluctuating tariffs or political instability.

On the other hand, local sourcing has its own set of advantages, which include, among others, short lead times, better quality control, and even lower shipping costs.

Companies must balance the cost benefits against such risks and losses through operational inefficiencies caused by global sourcing.

Just-in-Time (JIT) Manufacturing

The Just-in-Time manufacturing methodology helps to reduce inventory costs because products are only created when needed. While typically reducing storage costs and waste, JIT does add some risk to the supply chain.



Any disturbance in the supply chain could affect the halting of that link of production which might lead to delays that further cause higher costs.

In the case of JIT, firms have to be in close contact with vendors and logisticians on almost a daily basis for timely and regular deliveries. To make JIT more effective, this can also be achieved by implementing advanced forecasting techniques, such as AI-powered demand forecasting.

COST-EFFECTIVE PRODUCTION TECHNIQUES

Lean Manufacturing

Lean manufacturing is all about waste elimination and process optimization. Lean methodology places great focus on value addition to the process of manufacture, aiming at excluding any step involved in the production that does not add value to the manufactured article.

Cut down on unnecessary movements, surplus inventory, and inefficient workflow to bring down manufacturers' costs substantially.

Additive Manufacturing

Additive manufacturing, popularly known as 3D printing, has revolutionized production in companies through the ability to create complicated parts at a fraction of the cost incurred in traditional manufacturing.

will be even more advantageous in low-volume production or prototyping since there is no need for expensive molds or tooling.

This also reduces inventory costs and decreases lead times because parts can be produced on demand.

However, material costs for AM are still high, and the technology has met with the most success in niche applications.

CONCLUSION

Cost reduction effectively in new product design is combined with strategies that involve simplification of designs, selection of appropriate materials, automation of production, and region good relations with suppliers. This, each company would then be able to minimize part costs and avoid risks in supply chains that may affect their competitive advantage and resiliency in the marketplace.

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