

Cost optimization across the product realization value chain

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Introduction

With global economic factors and competition, manufacturers encounter strategic challenges of right pricing and rising costs. Products are becoming more and more complex with frequent feature enhancements; while target price-points are falling progressively. Moreover, global demand is continuously shifting to rapidly growing emerging markets, where competition is largely based on price. Against this backdrop, companies must continue to create and bring new and highly differentiated products to the market cost-effectively, and within compressed time frames.

To address these challenges; companies try to reduce their product prices and optimize costs. To reduce prices, companies adopt several techniques such as innovative pricing methods (e.g. smaller unit of sale) and optimizing their delivery network. For cost reduction, they build an organizational foundation that promotes a culture of cost containment and productivity improvement. However, both initiatives require careful balancing to avoid any compromise with positioning in the marketplace, and the ability to capitalize on future growth opportunities.

To achieve their strategic goals, companies need to assess their product realization value chain from a total cost optimization perspective. Best-in-class companies adopt several initiatives that focus on opportunities in product engineering, manufacturing engineering and industrial engineering to optimize their product costs.

Need and scope for cost optimization

Need for Cost Optimization

Manufacturing organizations face a strategic dilemma between increasing revenue and decreasing cost to enhance profitability. In this context, cost optimization is often thought to be a purely cost reduction exercise. However, if carefully balanced, cost optimization can help in increasing both profits as well as revenue.

Cost optimization aims at reducing the costs 'built-in' the product; this will ultimately help in increasing the profit margin of the product by lowering the price-points, and expand the footprint of the product in virgin markets as also in existing markets.

Scope – product realization value chain

Most cost optimization initiatives are carried out when products are successfully implemented on the manufacturing product line. Whenever firms undergo a profit-maximization drive, they undertake a cost optimization program focused on post-development functions like production, sales, and other operational overheads. The choice is based on the fact that materials and manufacturing expenses constitute a major part of costs. However, most of the cost structure for the product is locked into place because of the product specifications and decisions made during the development stage. Therefore, it is necessary to focus on cost optimization right from the

beginning of the product development lifecycle, i.e. at the conceptualization stage of a new product. Companies can create significant cost optimization through better understanding and evaluation of cost drivers across the entire product realization value chain.

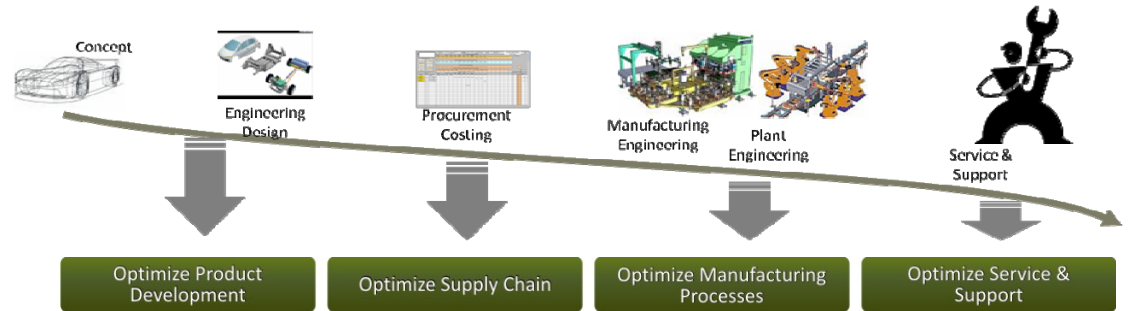


Figure 1: Product-Realization Value Chain

Barriers to effective product cost optimization

Appropriate decision making during the initial stages of product development determine to a large percentage the product cost. However, the supporting information for these decisions (i.e. product knowledge) builds up at a much slower pace. The gap between cost commitment and product knowledge results in missed opportunities for optimization. Organizations try to bridge this gap in various ways, such as cross-functional stage-gate reviews, and early supplier collaboration. However, there are various barriers to reach full cost optimization due to the inherent nature of the product development process.

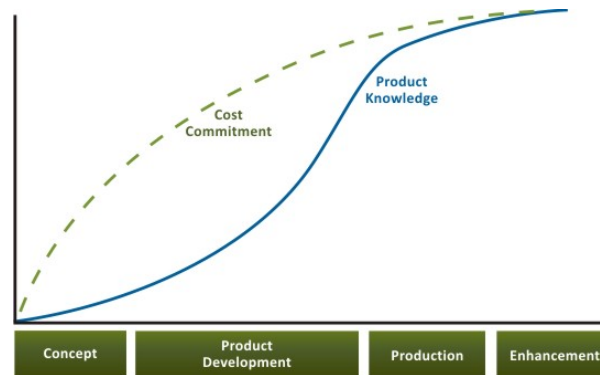


Figure 2: Cost commitment and Evolution of Product Knowledge across product realization value-chain

- **Representation Issues:** Product engineers are trained to work with ‘fuzzy front-end’ requirements, while manufacturing and industrial engineers require complete specifications as inputs. During cross-functional reviews, it becomes difficult to have a shared understanding as specifications are expressed in abstract terms; this leads to ambiguity in understanding the actual cost impact of the product.
- **Capture and Re-use of Knowledge:** Design and manufacturing activities are performed in multidisciplinary teams, and may be operating from distant locations. The increased complexity of the multi-site and multi-cultural organizations hinders the diffusion of knowledge among individual functions. The knowledge of individual functions is not captured in a structured manner and incorporated back into product design, resulting in lost

opportunities for creating products that can be manufactured in the current manufacturing setup at lowest cost.

- **Supplier Communication Gap:** Working with suppliers to optimize product design can significantly reduce the material costs and development time. However, it is not always possible to identify all suppliers at the beginning of the product development stage. In addition, IP protection issues restrict information exchanged between suppliers and the OEMs.
- **Project Management Issues:** Product development includes a series of decisions on shape, size, materials, and manufacturing processes. Each decision requires consideration from various functions; although it may not be possible to validate each decision at all the times neither can decisions be delayed. Correct scheduling/ planning and budgeting of such reviews becomes a project/ program management issue.
- **Need for culture change:** In most organizations, the primary focus is on product performance, quality, aesthetics, or technology, while cost reduction is considered secondary. However, this approach may be useful in some markets and with some products, but ultimately competition will catch up and the product may become obsolete. To successfully ingrain a culture of cost optimization, manufacturing and logistics, organizations should be full partners in initial design concepts so that they can bring manufacturing capability and cost into designer focus.

To achieve complete cost optimization, organizations first need mechanisms of accurate cost assessment. Once costs are assessed, they need to understand the means to achieve cost optimization.

Mechanisms for early product cost estimation

The ability to achieve full cost optimization depends on correct cost evaluation capabilities during the product development stage. Organizations use various techniques such as parametric costing and function/feature based costing, to estimate costs during the early stages of product development. However, accurately evaluating the costs of products, in the detailed design and engineering stage, continues to be a challenge. They need 'On Demand' access to multifaceted skills for correct cost evaluation.

Should costing provides a framework to systematically evaluate costs right from the conceptualization stage to production. It is a cost estimating methodology, whereby one can determine the costs of the part or product, based on the raw materials used, manufacturing costs, and overhead production costs. This can be achieved by analyzing the engineering models to understand the raw material required, defining the manufacturing processes required to deliver the required form features, and calculating the total costs through the use of rate data related to material costs and processing costs.

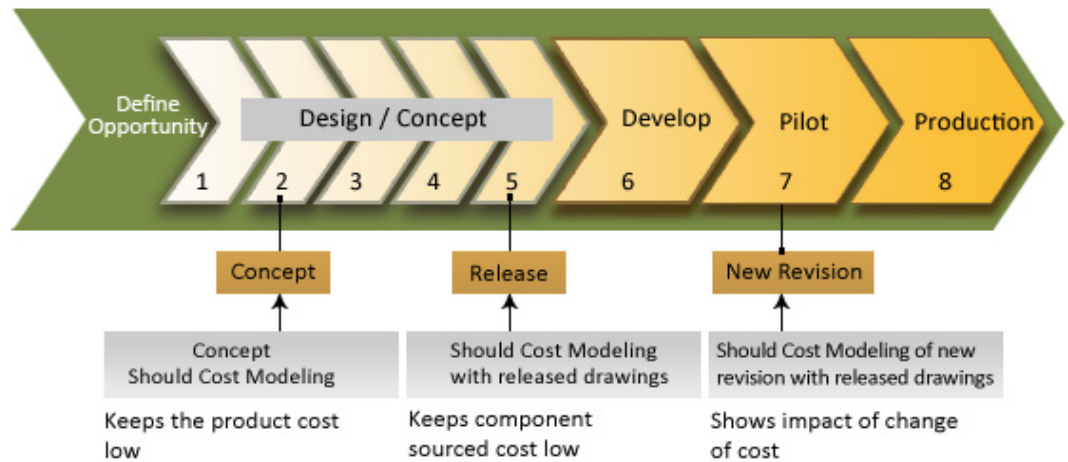


Figure 3: Different types of cost estimations and their impact on product-cost

It is, therefore, very important to have a fairly thorough knowledge of the product, its build up in terms of material, the manufacturing processes that are used, and associated costs in the very early stages of product development. Component costing provides a platform to track cost at every gate, from the conceptualization stage to the launch of the product.

Identifying key elements to product cost optimization

To minimize the total cost of a product, it is important to focus on individual cost elements. Companies need more insight into what drives costs of their products and ensure that optimization is targeted at the right places. Once the costs elements are defined, it becomes easier to take appropriate decisions to channelize suitable actions towards each cost element of the product.

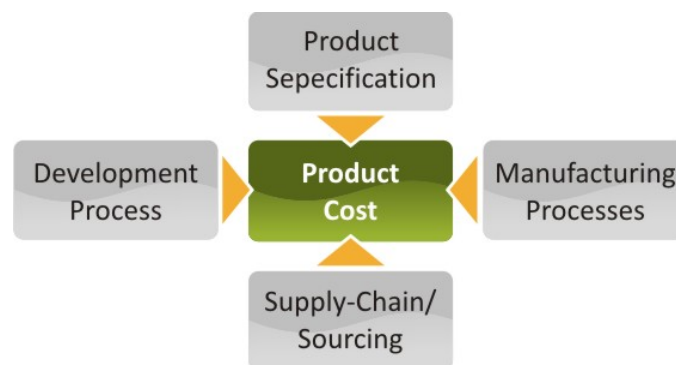


Figure 4: Key Elements to Product Cost Optimization

Optimize product specification

About 75% of the product's cost is committed during the finalization of the product specifications. Therefore, this area requires special focus. There are various ways to optimize product specifications during the design stage.

- **Feature versus Cost Trade-off:** A product offers multiple features, few critical and few not so critical. Trade-offs should be made between product functions and cost for possible cost optimization opportunities. House of quality, value analysis/ value engineering (VAVE) techniques can be used to identify and eliminate features or components that offer lower value compared to its cost.
- **DFX:** Design for excellence (DFX) is a systematic and proactive designing of products through early involvement and functional integration. Proactive checking of design for various downstream requirements (machining, molding, assembly and integration) can help in identifying specifications that can increase cost or reduce quality. DFX analysis for common manufacturing processes such as machining or casting can be done through various tools such as DFMPPro™, while specialized processes like forming & composites need manual checking from functional experts.
- **Simplify and Standardize Product Hierarchy:** Complex product hierarchy with different part specifications can increase the cost of manufacturing and load the inventory. Replacing complex parts with standard parts, reusing parts across different products and achieving less hierarchical product specification can reduce the product cost by leveraging the scale of manufacturing.
- **Reducing material usage:** In some industries, material costs account for upto 70% of total product costs. Re-designing the products to reduce its material usage can significantly influence product costs. Redesigning components to replace the specialized materials with commonly used materials can also help in reducing the material cost. Such initiatives require rigorous analysis and optimization cycles, through complex multi-physics CAE simulation.

Sample Case Study: Optimizing Product Design and Cost to Increase the Product Footprint

A leading manufacturer of specialized lighting equipment was looking for market expansion opportunities. The majority of sale of the lighting product was from commercial markets. Market research data showed that due to its high price-point it was not able to enter the domestic markets. Company wanted to redesign the product to make it relatively affordable for domestic use.

The product was redesigned cost effectively. During product development, certain control features not required for domestic-use were eliminated. The optical, mechanical and electronic sub-systems were redesigned using alternative materials and simplified by reducing the number of components. The existing light source was replaced by LEDs, which significantly lowered the total power consumption. Use of LEDs also made it eligible for reduced taxes in certain geographies.

After redesign, the product's cost was brought down significantly from 400 USD to approx 200 USD. The product was successfully sold in domestic markets at a much lower price.

Optimize manufacturing processes

Manufacturing cost are made-up of elements like raw material cost, tools and equipment cost, tooling cost required for manufacturing, and the cost of human effort. There are various ways to optimize manufacturing costs.

- **Improve material utilization:** Since, raw materials can account for up to 70% of total manufacturing costs, reducing scrap and inventory costs can significantly reduce the total raw material cost. Sourcing the right-sized material stock or adjusting the component placement (i.e. strip-layout) helps in reducing scrap. In a scenario of varying manufacturing mix and variance in shape and quality of input material (e.g. leather), adaptive processes of component placements are used. Utilization can also be increased by switching to near net-shape manufacturing processes.
- **Reduce manufacturing operations:** Low volume manufacturers prefer fabrication operations for flexibility in product variance. This often duplicates the manufacturing operations (e.g. cut and join) and increases cost. Use of programmable manufacturing systems can eliminate duplication, and retain the flexibility of one-piece manufacturing.
- **Flexible equipment/ tooling:** Manufacturing systems (i.e. machinery and tooling) require upfront investment to start production. Moving from special purpose systems to flexible systems reduces the investments required for each product revision. This can be achieved by using programmable or adaptive machines, and design tooling with variability considerations.
- **Increase manufacturing throughput:** To increase manufacturing capacity, companies must be able to capture and reduce idle-time and eliminate bottlenecks in the systems. Techniques such as Single Minute Exchange of Die (SMED) can be used to minimize machine idle-time and maximize utilization. Bottlenecks can be eliminated by appropriate line-balancing techniques. Manufacturing simulation and discrete-event simulation techniques can also be used to maximize throughput by analyzing various what-if scenarios.

Sample Case Study: Product cost optimization for a leading off-highway equipment manufacturer

The step-ladders used in off-highway equipment were manufactured by cutting sheet-metal plates for each step and welding them together to form a step ladder.

A manufacturing process change was instantiated; from fabricated steps to pressed sheet metal steps. By bending the sheet-metal strip, cutting and welding operations were eliminated thus reducing the waste generated from cutting the parts. Sheet metal simulation indicated that a single strip of sheet metal maintained higher strength than the original welded parts. Therefore, plate thickness was reduced to save on material costs.

Due to the change in the manufacturing process, the customer was able to bring down the cost of the stepladder by 75%.

Optimize supply chain

Bought-out items make significant contribution to the total cost of product.

- **Sourcing for material utilization:** OEMs source different components and sub-assemblies from various suppliers. Material utilization can be improved if parts that require similar raw material are manufactured by one supplier. Choosing suppliers based on the component raw material specifications can improve material utilization at the supplier's end, and eventually, bring down component costs.
- **Optimize supply base:** Should costing can help reduce the sourcing costs by identifying a low cost supplier. Should costing analysis provides a basis to seek out the right supplier, by comparing between the actual procurement or manufacturing cost and the cost model, and reconciling the differences.
- **Inventory management:** The cost of in-process inventory goes up with increasing variability (shape, material, color and finish, etc) in sourced components. Supply chain coordination techniques carefully manage the inventory levels. Other techniques such as material flow analysis, what-if analysis, and just-in-time sequencing (JITS), can further optimize the supply chain.
- **Reduce transportation costs:** Transportation of in-process inventory with high volume-to-weight ratio consumes a large percentage of supply-chain costs. Transportation costs can be reduced through various methods such as switching to reusable packaging, redesigning the container or a rack to accommodate more components, or through effective program management that optimizes the overall transportation network.

Optimize product development process

Product development process takes approximately 10% of the organization's revenue. With falling sales volumes per product, the cost contribution of the product development process is substantial. There are several parameters that influence the product cost optimization.

- **Global engineering:** Constraints on availability of appropriate skill-sets is escalating the cost of human efforts. Global engineering can help systematically reduce this cost, by moving non-critical and high volume work to lower-cost countries. Though global engineering increases the communication costs and demands strict adherence to processes, the net cost gain far outweighs these cost escalations.
- **Process optimization:** Product development goes through multiple iterations. Process optimization can be achieved by reducing the number of iteration cycles or the efforts in each cycle. The efforts in the iteration cycles can be reduced by eliminating duplicate or non-value-add tasks through various lean techniques. Iteration cycles can be reduced or shortened with the help of design analytics.
- **Productivity solutions:** Engineering processes involve many repetitive and error prone tasks. Such tasks, if automated, can reduce the engineering hours required for the engineering processes and safeguard against errors (and subsequent rework). Productivity solutions

automate such tasks, one by one, and free up engineers to take up work that is more important.

- **Knowledge based engineering (KBE):** Each product development cycle generates significant knowledge, which mostly remains with the engineers who executed the tasks. Deploying this knowledge in easy-to-use form will reduce the duplication of the learning process, and engineers can quickly move on to newer challenges. Product development tools already support KBE, which can be utilized for this purpose.

Conclusion

Cost optimization plays an important role in a company's profitable growth strategy. It requires focus on full cost structure, culture of optimizing the costs, systems for continuous cost evaluation, and access to various cost optimization techniques.

For manufacturing organizations, cost optimization requires a holistic view on cost across the complete product realization value chain. Through effective cost optimization, companies can create differentiated products, improve their capability for innovation, and consequently take greater strides toward high performance.

References

- Should Costing, Nilesh Kauthekar, Geometric, July 2010
- The Why and How of Design for Manufacturability Review Automation, Rahul Rajadhyaksha, Geometric Limited, June 2009
- Risk Management in Product Engineering, Nikhil Shintre, Geometric Limited, Oct 2008
- Application of Lean in Product and Manufacturing Engineering, Nikhil Shintre, Geometric Limited, January 2010

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About Geometric

Geometric (www.geometricglobal.com) is a specialist in the domain of engineering solutions, services and technologies. Its portfolio of Global Engineering services and Digital Technology solutions for Product Lifecycle Management (PLM) enables companies to formulate, implement, and execute global engineering and manufacturing strategies aimed at achieving greater efficiencies in the product realization lifecycle.

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