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should-cost analysis a key tool for sourcing and product designers

Most companies look for improving product value and increase profit margins focusing on 'cost out' opportunities using Strategic sourcing, Function analysis, Value analysis, Value engineering, TRIZ, Tear down, Benchmarking etc.

Kumar Varadarajan
QuEST Global

Koushal
QuEST Global

contents

Abstract

Most companies look for improving product value and increase profit margins focusing on 'cost out' opportunities using Strategic sourcing, Function analysis, Value analysis, Value engineering, TRIZ, Tear down, Benchmarking etc. These have become vital elements of any discipline to analyse and reduce cost as customers are forced to develop products with stringent cost targets. In the mid 20th century, companies followed traditional cost analysis to estimate the product cost.

Sometimes, this fails to supply the scope and details required to evaluate a supplier's cost proposal credibly. Today, we have significantly progressed in terms of technology, that we have many software to carry out a structured way of cost modeling to estimate the product cost. Also, there are opportunities to identify and optimise the uneconomical and unproductive costs. In this context, Should-cost analysis is an approach that determines what the product or a system ought to cost, assuming applicable economic and physical attributes in line with the requirements. The objective of Should-cost analysis is to provide the sourcing team with acceptable and justifiable information for judicious price negotiation. Apart from this, designers are benefited in cost estimation of the product cost at the early stage of product development to achieve their targeted costs. Should-cost analysis assists the designer to optimise the product and process design that drives the cost. This paper includes the process of Should Cost analysis, its significance, its importance in New Product Development (NPD) and concurrent costing.

Background

Most companies use strategic sourcing to reduce cost of goods sold, reduce spend drivers, improve process performance, identify unproductive services and promote healthy competition to have an edge in their price negotiations. Sourcing is done from low cost countries such as, China, India, Brazil, Russia, Mexico etc. and the objective behind this strategy is to obtain the key cost differences between various geographies and develop strategic sourcing competence. This approach works well provided the business volumes are potentially high. Obviously, there are engineering products and systems that are more complex and purchased in very low volumes. In such scenario, sourcing team has a challenge in getting competitive bids from suppliers as there could be very few to cater to such specific process and engineering services. To make a choice or trade off on the vendor with minimal parameters to assess their estimate would be tough.

In order to get reasonable quotes, the sourcing team is forced to grapple with unique and sole suppliers. In specific businesses like, Oil and Gas, Energy, Aerospace, these categories of spends for unique products and processes could be significant. Most buyers look for a reasonable decrease in outlay to achieve their set targets, but what the product should actually cost is not envisaged. Buyers are usually not familiar with the specific manufacturing processes followed by suppliers and also not aware of the process optimisation done over the period to bring down the product cost. One solution to this problem is a technique known as Should-cost analysis that allows the company to have a better insight in to the cost drivers of their products and provide valuable information to the sourcing team to facilitate judicious price negotiations.

Should-Cost Overview

Should-Cost modeling is the process of determining, what a product must cost based upon the drivers like component's raw material costs, manufacturing costs, process overheads, and an added rational profit percentage. Many a times, the engineering teams do not evaluate the cost of the product themselves and instead, rely on the sourcing for the cost information. The sourcing team negotiates with their suppliers with limited information provided by the designers and without the should-cost models. If the cost model is in place, it would be helpful for the engineering team to evaluate the various design concepts focusing on the target cost during the development phase and also accomplish effective sourcing.

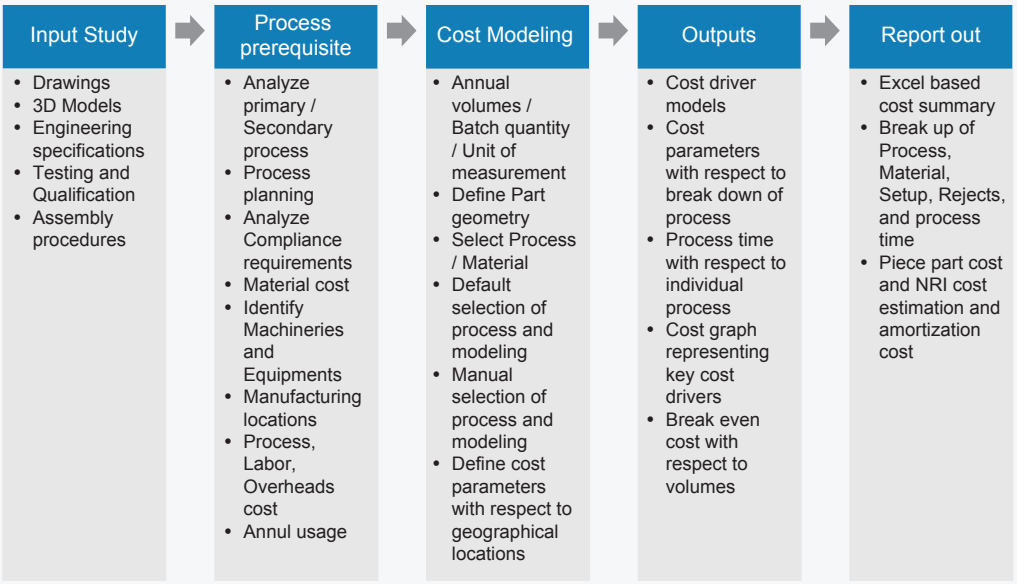
Integration of strategic sourcing along with engineering team in making the cost model will result in an effective should-cost model, which enables the sourcing team to have a better leverage while negotiating with their suppliers.

Should-cost modeling is quite essential for the Supply chain and Engineering team during the new product development stage. Moreover, it also helps to analyse and optimise product cost, to establish and sustain in the market.

Significant changes in demand, lack of resources and inflation have resulted in an increase in the production cost and procurement cost. This has, in turn, led companies to analyse cost accurately and vigilantly evaluate the supplier cost proposals.Should-cost analysis will help in giving the big picture on the overall cost breakup in terms of material cost, process cost, setup, rejects, labor, overheads, packing and transit. From the results, one can identify the potential cost-out opportunities and revisit on minimising the costs.

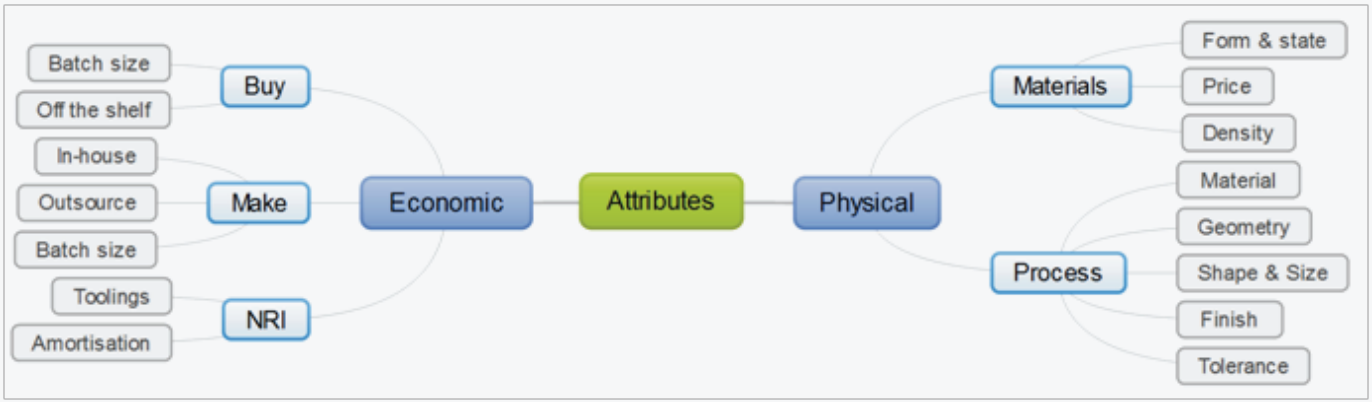
Process of Should-Cost Analysis

Should cost analysis: There are certain prerequisites for Should-cost analysis and based on these available information, one can make an accurate estimation. To start with, one should have a good understanding of the product and the processes required to produce the part or assembly from the raw material stage, adhering to quality and compliance requirements. The level of accuracy depends on the skill and knowledge of the individual who builds the cost model. This activity is quite challenging for a buyer but relatively easier for an engineer as he is the brain behind the product's design. However, engineers may not have the detailed costing knowledge of various secondary processes like heat treatment, plating, welding, which probably are outsourced. This is the area where Should-cost modeling software will help designers/engineers to estimate the complete cost of the product with end to end costing. The chart below depicts the Should-cost approach, which has to be followed to make an accurate estimation of the product cost.



Should-cost analysis works on feature based costing. To well describe a product, it is built based on a number of features, each of which has a particular function to perform. Based on the number of features in the part, the processing time and costs are estimated. Each product or part is characterised by a set of physical attributes: the materials it can be made from, the viable manufacturing process, precision, complexity, size and geometry.

Economic attributes also contribute to the product's cost which is reflected in the cost model. It is essential to have the information on the annual volumes and batch size which in turn, help with "make or buy" decisions based on the bill of materials. These attributes and features are quite essential to build the cost model as shown below. Designer can make a trade-off based on the cost behavior of individual features and optimise the design based on the feature's criticality.

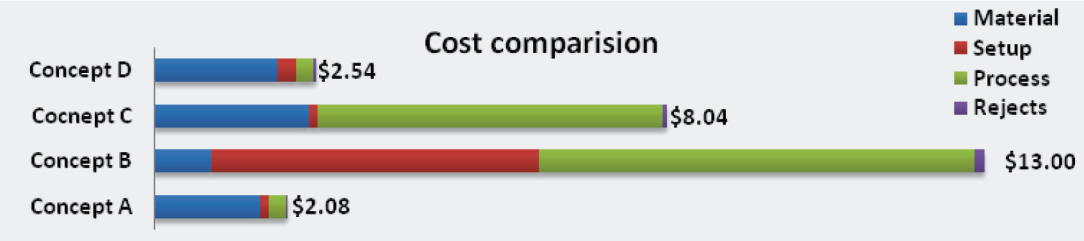


Today, there are a number of cost-modeling tools available for the customers to study and reduce the product cost. Should-costing softwares are mathematical and statistical tools used to analyse the cost behavior of the part or assembly. The software's library, which is built based on cutting-edge technologies, processes, machineries, labor rates according to distinct geographies, setup rates, overheads and time are tagged to the variables related to product and process characteristics. The compilation of the mathematical model in a set algorithm will result in the observation of process variables that significantly contribute in driving the cost of the product. These softwares also enable the user to customise unique materials and process parameters that are not included in the library. The resulting feature based cost model can be used by the end user (buyer, engineer) to infer and measure the amount of uneconomical and inefficient processes followed.

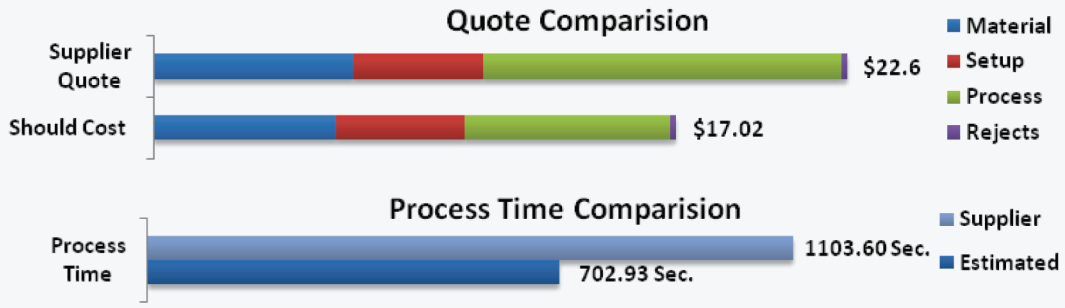
The product designer can probably study the cost behavior of various design iterations. To be more precise, if the user wishes to choose an alternate material or process, the cost model can be duplicated and framed according to their area of interest for design change. The statistical graphs enable the user to compare and analyse the cost behavior for the various iterations in terms of process, material, overheads, and production volumes.

What would it cost to make my Design Concepts?

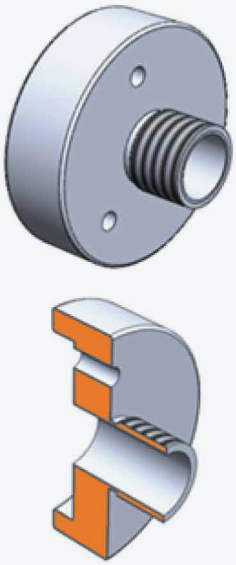
Concept	A	B	C	D
Process	Moulding	Casting	Machining	Sheet metal
Material	PPA	Aluminum	SS 304	SS 304
Annual Volume	1500	1500	1500	1500
Batch Size	200	200	200	200



buyer wishes to study and compare the cost model and manufacturing process plan of the supplier, could infer them and identify the potential tweaks and modify accordingly. Should cost gives a detailed breakdown of cost and time study of the various manufacturing operations carried out that contribute to the part's cost. This will help the sourcing team to make judicious negotiations.



A Simple Cost Model of Machined Part

Machined component	Process Chart	Batch Size	Material	Setup	Process	Rejects	Piece part	Tooling	Total	Operation time per part, s	Tooling
	**304 austenitic stainless steel machined/cut from stock**		**5.96**	**4.17**	**6.71**	**0.19**	**17.02**		**17.02**	**702.93**	
	part										
	Stock process		5.96	0.03	0.01		6.00		6.00	12.93	
	Workpiece		5.96				5.96		5.96		
	Abrasive cutoff			**0.03**	**0.01**		**0.04**		**0.04**	**12.93**	
	Haas SL-10 CNC lathe		25	4.13	6.38	0.06	10.57		10.57	656.89	
	Setup/load/unload			4.13	0.24		4.38		4.38	24.89	
	Rough and finish face				0.34		0.34		0.34	35.00	
	Rough and finish cylindrical turn				0.78		0.78		0.78	80.00	
	Drill single hole				0.81		0.81		0.81	83.00	
	Counterdrill single hole				0.68		0.68		0.68	70.00	
	Counterdrill single hole				0.67		0.67		0.67	69.00	
	Rough cylindrical bore				0.11		0.11		0.11	11.00	
	Rough and finish face				0.34		0.34		0.34	35.00	
	Rough and finish cylindrical turn				0.85		0.85		0.85	88.00	
	Form or groove (perpendicular)				0.11		0.11		0.11	11.00	
	Die thread (Metric, coarse)				0.20		0.20		0.20	21.00	
	Drill multiple holes (live tool)				0.60		0.60		0.60	62.00	
	Rough and finish face				0.36		0.36		0.36	37.00	
	Rough and finish cylindrical bore				**0.29**		**0.29**		**0.29**	**30.00**	
	Hand deburr				**0.14**		**0.14**		**0.14**	**13.90**	
	Inspect visually				**0.07**	**0.06**	**0.13**		**0.13**	**7.40**	
	Measure with vernier caliper				**0.12**	**0.06**	**0.18**		**0.18**	**11.8**	

Significance of Should-Cost Analysis

- Should-cost analysis provides a better insight for the sourcing team to identify the supplier's profit margins and grab the purchasing power from the supplier
- It helps them in identifying the key cost drivers of the product and helps in "make or buy" decisions
- Infer price comparisons of the part, assembly, if outsourced to different geographical locations
- For any strategic sourcing, should-cost analysis would be an ideal tool for making profitable negotiations
- It also aids new product development team to evaluate the product cost in the early stage of development. Engineers will have a better insight of cost implication on the design and revisit on design-to- cost
- Analyse viable alternate material or process to study the cost behavior and make necessary tradeoff
- Identify the apt materials and processes in the early stages and avoid design iterations in the later stage
- Should-cost results will help in understanding the supplier quotient and their strengths

Importance of Should-Cost in NPD

New product development is the key driver of business sustenance. Once a product is launched in to the market, it has its own rivals to kill it. However it will only sustain based on the cost and technological impact that differentiates itself from the rest. In order to establish a targeted cost for the product, cost management is quite essential and has to be initiated from the design stage in the product life cycle to achieve the target cost. Most companies neglect the cost impact in the development of their new products and accept their returns on investment at small margins without knowing the big picture. The lack of awareness brings bigger surprises in the fag-end of development stage resulting in greater cost overrun than the estimated budget. This may lead to various tradeoffs on the design and in turn reduce the product's quality. Such flaws may affect the product's success and lead to a catastrophic loss for the organization as enormous time and cost is spent on the design research and product development.

Target costing emphasizes on cost reduction at early stages in product development and ensures that total costs are minimised for both the producer and the customer. Successful target costing analyses the complete life-cycle cost of the product. Usually, it is observed in new product development that designers usually overdesign for functionality and high product reliability without considering cost implications. This would result in sluggish growth in market. The major drawback is that, the purchasing and manufacturing teams are not involved with the design team to do the feasibility analysis and at the later stage, value analysis is done to bring down the product cost.

In the early stages of product life cycle, the production cost is very high, which are later optimised by finding alternate processes and materials. This process proves a lot more costly and laborious as it involves redesign and validation. However, this does not necessarily eliminate the need for value analysis. Continuous developments in the field of manufacturing and materials drive value analysis of the product after its emergence in the market. This can always bring an opportunity to replace the obsolete and the redundant ones that were used in the original design. It is necessary to promote proactive obsolescence management to Identify and minimise high risk components in active products to ensure the product's sustenance and growth.

Cost management denotes actions driven by the top management to satisfy (meet) customer's requirements on reducing and controlling cost in the early stages of design. Hence Should-Cost analysis is essential for profitable new product development. In this scenario, cost estimation of a product has to be quite accurate to make proper decision during the conceptual stage of product design.

Concurrent Costing-An Integration of Should- Costing and Concurrent Engineering

Concurrent engineering is the strategy that is followed to have an integrated product and process development and it overrides the traditional new product development. It collaborates and facilitates communication amongst various departments within the organisation to ensure an effective and efficient process. This integration brings in the continuous improvement opportunities of engineering and business operation together.

Similarly, concurrent costing in the new product development will result in dramatic and more efficient design. Should Costing allows us to estimate the product cost at the early stage of design phases by making a cost model with the help of available information pertaining to materials and manufacturing techniques. The user can investigate and analyse the cost impact of choosing alternate manufacturing processes or materials, which were not considered previously.

Collaboration of all stake holders in the product development will help to restrict the product cost to target cost by use of should cost analysis and cost models. Stake holders in this context include department representatives within the organisation as well as trusted vendors. With the help of specific information on the costing for various annual volumes, batch sizes, geographies, design changes, material and production methods, the best opportunities can be evaluated and chosen for product development.

Conclusion

This paper describes how should-cost influences the new product development and value management. Cost management is essential for all companies to control and manage costs to provide value to their customers. Should-cost analysis helps the user in cost estimation of the product and to obtain precise information for making necessary trade-offs. It also aids in price negotiations with the suppliers and to foresee supplier process inefficiencies. Should-cost analysis is a holistic approach to cost intervention and benefits us by analyzing each aspect of cost drivers vigilantly.

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Author Profile

Kumar Varadarajan

Kumar Varadarajan specialises in Product and Process design, Cost Management through Value engineering and value analysis. Innovative New Product Development, using 'TRIZ'. Kumar has deployed 10 years in automotive firms in the areas of Design and development, Assembly and function, Testing and Validation. Kumar has been with QuEST for two years till now and he works for GE-ODC to support Mechanical Engineering and VAVE activity across various GE businesses.

Kumar holds a Master degree from Coventry University specializing in “Industrial design”.

Author Profile

Koushal

Koushal was identified and nurtured by QuEST. Hired from campus, and it's been two years of journey with a valuable experience on various phases of design and product development. He specialises in the area of Product design and development. He is passionate towards design research and exploration, concept development, human factors engineering, interaction design, universal design, bionics/ bio-mimicry has been a great motivation for innovation and synectics. Photography and cinematography has been a great part of his understanding the nature's perspective of design to identify the real emotions and human interaction. Koushal holds a Bachelor degree in Mechanical and is pursuing Masters in Industrial design from Coventry University.

About QuEST Global

QuEST Global is a focused global engineering solutions provider with a proven track record of over 17 years serving the product development & production engineering needs of high technology companies. A pioneer in global engineering services, QuEST is a trusted, strategic and long term partner for many Fortune 500 companies in the Aero Engines, Aerospace & Defence, Transportation, Oil & Gas, Power, Healthcare and other high tech industries. The company offers mechanical, electrical, electronics, embedded, engineering software, engineering analytics, manufacturing engineering and supply chain transformative solutions across the complete engineering lifecycle.

QuEST partners with customers to continuously create value through customer-centric culture, continuous improvement mind-set, as well as domain specific engineering capability. Through its local-global model, QuEST provides maximum value engineering interactions locally, along with high quality deliveries at optimal cost from global locations. The company comprises of more than 7,000 passionate engineers of nine different nationalities intent on making a positive impact to the business of world class customers, transforming the way they do engineering.

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