DELIVERING CUSTOMER VALUE THROUGH VALUE ANALYSIS

WILLIAM DUMMER, MIA MASTERS, AND DAN SWENSON

WILLIAM DUMMER is a target- costing expert with extensive experience in the development and application of target costing across multiple industries, including aviation, home appliances, and transportation.

MIA MASTERS is a global product cost manager for the Navistar Corporation, specializing in target-costing processes and value analysis. Mia has more than 10 years of finance experience with a focus on cost reduction and supplier transparency.

DAN SWENSON is an associate professor of accounting at the W. P. Carey School of Business at Arizona State University. He is currently a member of CAM-I's Target Costing group and can be reached at dan.swenson@asu.edu.

Value analysis enables organizations to channel their product development activities to areas that provide the greatest customer value.

Value analysis enables organizations to channel their product development activities to areas that provide the greatest customer value. More specifically, value analysis helps establish an association between spending and a product's functional requirements, as defined by the customer. A value index can then be created to mathematically define the relationship between the cost of a product's systems and the customer value placed on those systems.

Value analysis is also key to the successful deployment of target costing, which is a profit-planning and cost management process organizations use to control costs during the design stage of new product development. Cost targets are derived by deducting required profit margins from market-driven product prices. In practice, once a product's cost target is established, a team works to design a product that satisfies customer requirements at no more than the target cost. Target costing is, however, not just about cost-cutting; more importantly organizations use target costing to increase the product's value to the customer.

As new products are being developed, designers have two very important considerations from a target-costing perspective. Initially, they will strive to reduce the product's cost. But they should also be willing to add to the product's cost if by doing so they incorporate into the design a feature that customers are willing to pay for. In both instances, product designers increase customer value - providing a cost-effective but highly functional design. Therefore, understanding the product functionality desired by the customer, the relative importance of those functions to the customer, and the relative cost of delivering those functions is critical to the process of value analysis.

Product cost breakdown

One of the first steps in the value-analysis process is to break down the product's cost into its major systems. This article will refer to the product development activities associated with a semi-trailer truck as an example. Value analysis is applied to the truck as a whole, and it is also applied to the truck's major systems, such as its cab structure, drivetrain, engine, and so forth. No matter which level of analysis is chosen, the manager should be careful to avoid looking at individual components in isolation. Applying value analysis to individual components, without considering the product as a whole, could lead to missed opportunities. For example, applying value analysis to a wheel's hubcap in isolation implies that the hubcap is a necessary component to the truck's wheel. In fact, the hubcap is not a necessary component and could be eliminated entirely. Exhibit 1 illustrates the semi-trailer truck's major systems and their relative costs.

Exhibit 1:

Exhibit 1.

Product Cost Breakdown (Truck)

Brakes	6.0%
Cab structure	8.0%
Engine	20.0%
Drivetrain	17.0%
Exterior	14.0%
Frame assembly	10.0%
Cab interior	19.0%
Operator controls	4.0%
Suspension	2.0%
	100.0%

Functional requirements ranking

The next step in value analysis is to identify the truck's functional requirements desired by the customer (see Exhibit 2). These requirements must then be ranked in terms of importance. Essentially, the product's functional requirements can be described as customer needs and wants. A product feature, on the other hand, is generally something tangible that provides this functionality. For example, a functional requirement in the truck's cabin might be a low level of noise. There are numerous features, however, that could provide this functionality. One could be insulation around the cabin, another could be an aerodynamic design, and a third could be an engine modification.

Exhibit 2.

Functional Requirements Ranking

A. Haul/Tow load		50.0%
B. Be Cost Efficient to Operate		
B-1 Fuel efficient	15.0%	
B-2 Reliable	9.0%	
B-3 Low maint. cost	8.0%	
Sub-Total		32.0%
C. Be Comfortable to Operate		
C-1 Easy to operate	3.0%	
C-2 Comfort	5.0%	
C-3 Visibility	3.0%	
C-4 Low noise	2.0%	
Sub-Total		13.0%
D. Nice appearance		5.0%
Total		100.0%

While it might seem obvious, the functional requirement ranking scores must be derived from customer input, whether it comes from customer surveys, customer focus groups, or other interactions with the customer. These functional requirements are then ranked by the customer to determine their relative importance. Exhibit 2 lists this truck's functional requirements along with their relative ranking scores in terms of percentages. Higher percentages imply greater importance to the customer. In this example, haul/tow load comes in at 50 percent, which means it is 25 times more important to the customer than low noise, which has a score of 2 percent. The relative importance scores for the functional requirements as a whole will total 100 percent.

Ranking a product's functional requirements by assigning them values is one of the most critical aspects of the value-analysis process. By knowing what customers value in a product and the strength of their preferences, one can provide focus to the product-development process. This enables decision-makers to align development spending with the importance of functional requirements. Put quite simply, if the truck's ability to provide adequate hauling and towing capability provides 50 percent of customer value, then spending on its hauling and towing capability should represent 50 percent of the truck's cost.

Potential pitfalls.

Gathering information about customer requirements is time consuming and expensive. Therefore, companies might be tempted to rely on internal members of the organization to identify and rank customer requirements. This can result in a misallocation of resources. In one example, a truck manufacturer, based on internal rankings, overemphasized the external appearance of a truck. Consequently, the company over-designed the truck's front grille using chrome parts. As a result, customers were unwilling to pay for the added costs. The manufacturer was then forced to lower its selling price, and therefore it was unable to recover the higher cost of the grille. Furthermore, after a municipality purchased the truck, its residents complained that their taxes shouldn't be used to pay for "fancy" garbage trucks. This is in stark contrast to products like a Harley-Davidson motorcycle, where many of its components are readily visible and outward appearance is very important to the customer. By relying on company employees, such as design engineers or sales people, neither the truck company nor Harley-Davidson could properly value the external appearance of its products without asking customers directly.

When customer surveys are conducted, companies must be very careful with regard to how the questions are asked. For example, when a refrigerator company interviewed potential customers about door handles, it asked which door handles customers preferred. Invariably, potential customers picked the ones that were most expensive without considering value or any other options. Instead of focusing on a predefined solution (i.e., door handles), the company should focus on the product's functional requirement, which is to open the refrigerator door. Other possible ways to open the doors include foot pedals, sensors, buttons, or other forms of handleless doors, as well as many handle designs not offered in the interviews. None of these other options will be considered, however, if only predetermined solutions are offered.

Product/functions matrix

Correlations.

Continuing with the value-analysis process, the product's functional requirements must be related to its systems. A system can generally be described as a combination of parts and components that are related to one another for a common purpose. For example, a truck's drivetrain is a major system within the truck that enables it to move forward and backward at different speeds. At a later step in the value-analysis process, each of the product's major systems will be broken down into smaller subsystems. For example, the drivetrain will be subdivided into its transmission, differential, axles, and so on.

The functional requirements of the truck are generally not related to just one specific system. For example, a semi-trailer truck's ability to haul and tow loads is affected by more than just the truck's engine. It is also affected by the truck's drivetrain, suspension, frame assembly, and even its braking system. The strength of the relationship between the truck's hauling and towing capabilities and its other major systems also varies. While hauling and towing capability is strongly affected by the engine, it is moderately affected by the drivetrain, and weakly affected by the suspension, frame assembly, and brakes. It is not affected at all by the cab's interior. The product/functions matrix in Exhibit 3 describes the strength of the relationships (correlations) between the truck's systems and its functional requirements as being strong (S), moderate (M), or weak (W).

Exhibit 3.

Product/Functions Matrix (Correlations)

	Brakes	Cab Structure	Engine	Drive-Train	Exterior	Frame Assembly	Cab Interior	Operator Controls	Suspension
Haul/Tow Load	W		S	M		W			W
Fuel Efficient		W	S	W	W				
Reliable	W		S	M				W	
Low Maint. Cost			M	W		W		W	
Easy to Operate			W					S	
Comfort		W					S		M
Visibility		S			M				
Low Noise	M	W					S		
Nice Appearance					S				

S = Strong correlation; M = Moderate correlation; W = Weak correlation

Relative values.

In this example, a strong correlation is assigned a value of nine, a moderate correlation is assigned a value of three, and a weak correlation is assigned a value of one (see Exhibit 4). Therefore, a strong correlation is three times the magnitude of a moderate correlation, and a moderate correlation is three times the magnitude of a weak correlation. Note that these scores are just starting points. In practice, they will be modified by design engineers to more accurately reflect the relationships between the truck's systems and its functional requirements.

Exhibit 4.

Product/Functions Matrix (Relative Values)

	Brakes	Cab Structure	Engine	Drive-Train	Exterior	Frame Assembly	Cab Interior	Operator Controls	Suspension
Haul/Tow Load	1		9	3		1			1
Fuel Efficient		1	9	1	1				
Reliable	1		9	3				1	
Low Maint. Cost			3	1		1		1	
Easy to Operate			1				9		
Comfort		1					9		3
Visibility	9				3				
Low Noise	3	1					9		
Nice Appearance					9				

Nine point scale: Strong correlation = 9; Moderate correlation = 3; Weak correlation = 1

To the layman, accurately assigning a value to the relationship between a product's functional requirements and its systems might seem like an impossibly complex task. This task, however, is one of the fundamental components of a design engineer's job. Essentially, given a set of functional requirements for a given product, the design engineer's charge is to create a product that satisfies those requirements. Therefore, each of the product's systems is specifically designed to meet one or more of the product's functional requirements, and design engineers are able to quantify those relationships.

Customer value.

To continue the process of value analysis, customer value scores must be assigned to each of the semi-trailer truck's major systems, and this step is illustrated in Exhibit 5. To begin, the truck's functional requirements ranking from Exhibit 2 must be taken into account. For example, customers assign much more importance to the truck's hauling and towing capability (50 percent) than to low noise (2 percent); thus, the systems that provide this capability will be assigned more customer value than systems that reduce noise.

Exhibit 5.

Product/Functions Matrix (Customer Value)

	Brakes	Cab Structure	Engine	Drive-Train	Exterior	Frame Assembly	Cab Interior	Operator Controls	Suspension	Total
Haul/Tow Load	3.3%		30.0%	10.0%		3.3%			3.3%	50.0%
Fuel Efficient		1.3%	11.3%	1.3%	1.3%					15.0%
Reliable	0.6%		5.8%	1.9%				0.6%		9.0%
Low Maint. Cost			4.0%	1.3%		1.3%		1.3%		8.0%
Easy to Operate			0.3%					2.7%		3.0%
Comfort		0.4%					3.5%		1.2%	5.0%
Visibility		2.3%			0.8%					3.0%
Low Noise	0.5%	0.2%					1.4%			2.0%
Nice Appearance					5.0%					5.0%
Customer Value	4.4%	4.0%	51.3%	14.5%	7.0%	4.7%	4.8%	4.7%	4.5%	100.0%

The matrix in Exhibit 5 takes the functional requirements scores from Exhibit 2 and applies them to each of the truck's systems based on the relative value scores from Exhibit 4. Continuing with the example of the truck's hauling and towing capability in Exhibit 5, the customer importance ranking of 50 percent is divided up among the brakes, engine, drivetrain, frame assembly, and suspension. This allocation of customer importance ranking to major systems is repeated for each functional requirement. Each column can then be totaled to calculate a customer value score for each of the truck's systems. Thus, brakes are assigned a customer value score of 4.4 percent, the cab structure a score of 4 percent, the engine a score of 51.3 percent, and so on.

Value index

The next step in value analysis is to create a value index, which is a useful metric to support the entire value-analysis process (see Exhibit 6). The value index is the ratio of a system's ability to deliver customer requirements to the cost of delivering those customer requirements. Mathematically, the value index is created by dividing the customer value assigned to each of the product's systems (Exhibit 5) by the system's cost illustrated in Exhibit 1. Product systems that have a value index below one are targets for cost reduction, whereas systems with a value index above one are candidates for additional investment.

Exhibit 6.

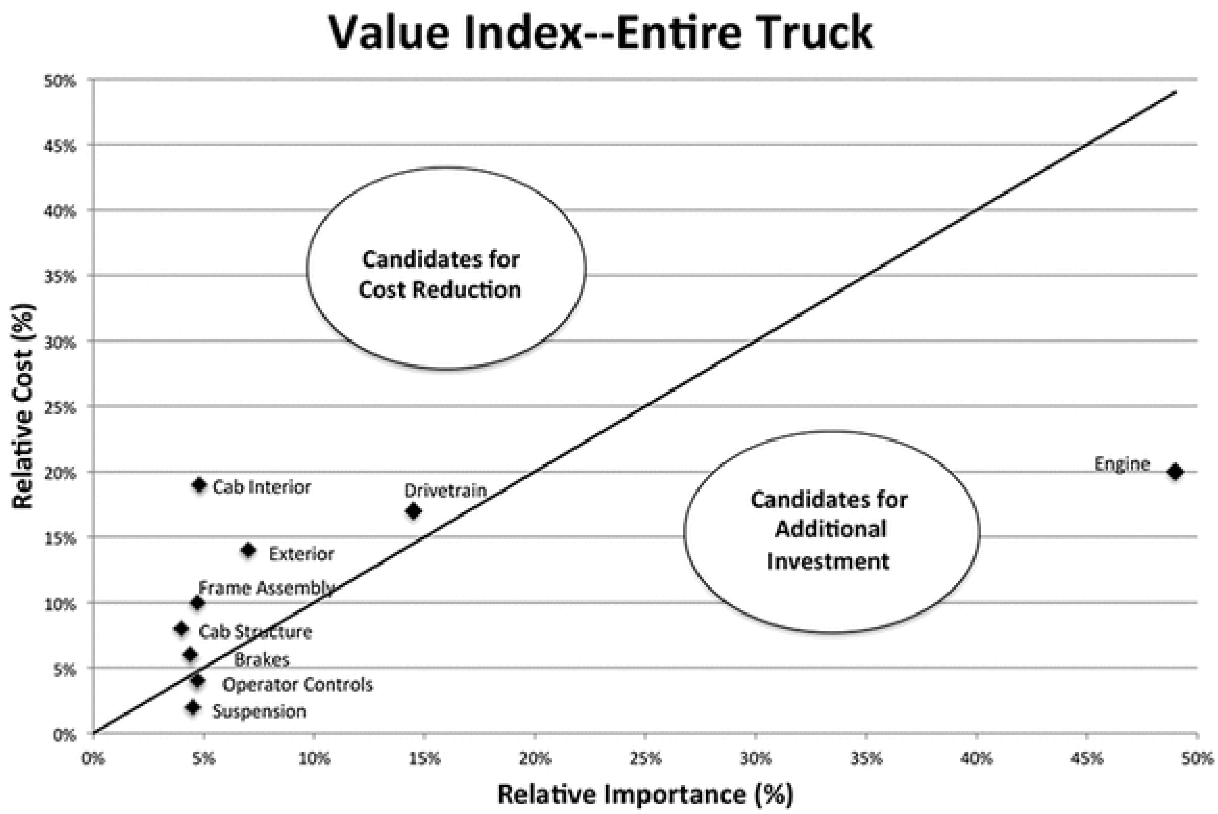
Value Index (Entire Truck)

Truck	Customer Value Scores	Product Costs	Value Index
Brakes	4.4%	6.0%	0.73
Cab structure	4.0%	8.0%	0.50
Engine	51.3%	20.0%	2.57
Drivetrain	14.5%	17.0%	0.85
Exterior	7.0%	14.0%	0.50
Frame assembly	4.7%	10.0%	0.47
Cab Interior	4.8%	19.0%	0.25
Operator controls	4.7%	4.0%	1.18
Suspension	4.5%	2.0%	2.25
Totals	100.0%	100.0%	

In the semi-trailer truck example, the value index for the cab interior is 0.25, which means its customer value score is considerably below its cost. Therefore, it is a good candidate for cost reduction. Conversely, at 2.57, the customer value score for the truck's engine is much higher than its cost. Thus, the manufacturer may actually choose to enhance or upgrade the truck's engine to better satisfy customer requirements. A perfectly aligned matrix would have a value index of one for each relationship. Exhibit 7 provides a graphical illustration of the major systems that are candidates for cost reduction, and those that are candidates for additional investment.

Exhibit 7.

Value Index (Entire Truck)



Applying the value index.

As discussed above, the cab interior is a good area to focus cost reduction efforts for the semi-trailer truck. The cab interior, however, must now be broken down into its subsystems, which are as follows:

- interior trim (front);
- interior trim (rear);
- seats;
- instrument panel; and
- interior lighting.

The functional requirements for the cab interior, as desired by the customer, must also be defined. In this case they are defined as follows:

- reachability of controls, pedals;
- ability to control light in cab;

- connectivity, entertainment, and information access;
- ease of entering and exiting the driver's seat;
- driver's seat comfort;
- roominess;
- visibility; and
- interior appearance.

Once we prepare the product/functional requirements matrices, similar to the exercise for the truck as a whole, we can then develop a value index for the cab interior's subsystems (Exhibit 8) and a graph to illustrate the candidates for both cost reduction and additional investment (Exhibit 9).

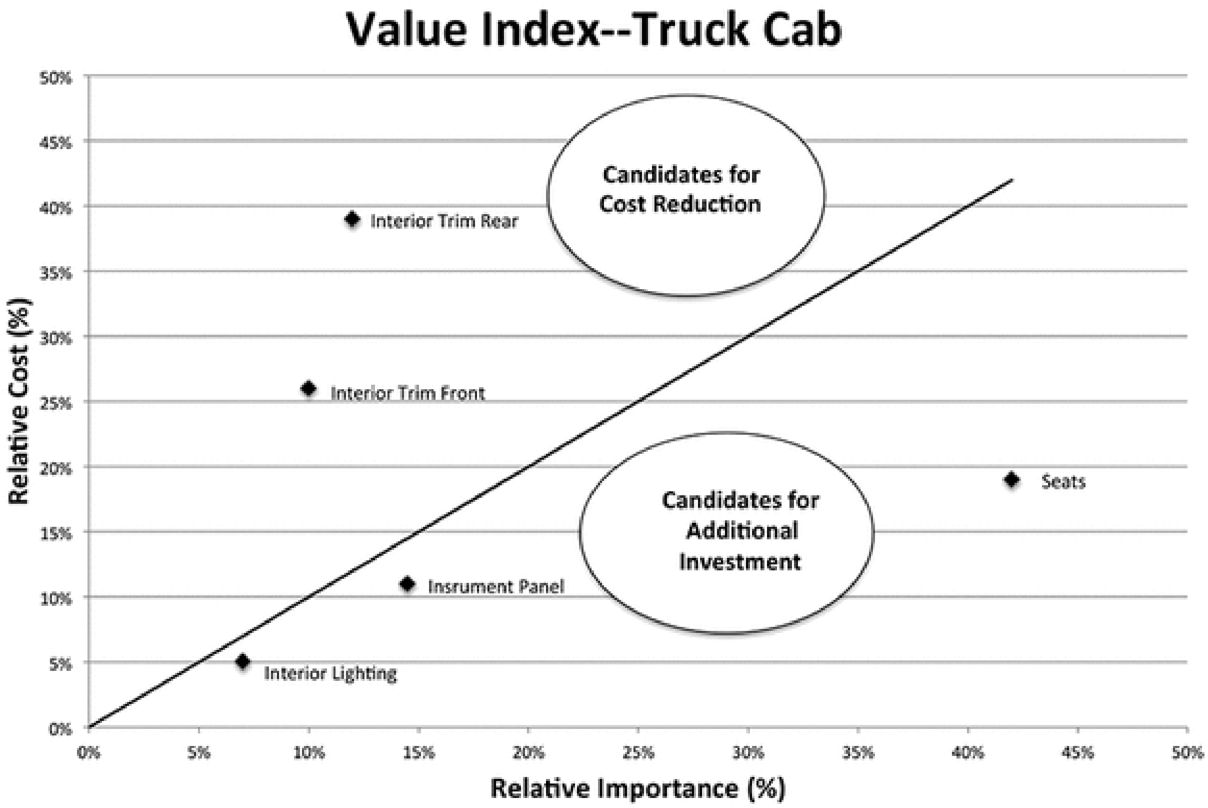
Exhibit 8.

Value Index (Cab Interior)

Cab Interior	Customer Value Scores	Product Costs	Value Index
Interior Trim—Front	10.0%	26.0%	0.38
Interior Trim—Rear	12.0%	39.0%	0.31
Seats	42.0%	19.0%	2.21
Instrument Panel	14.5%	11.0%	1.32
Interior Lighting	7.0%	5.0%	1.40
Totals	100.0%	100.0%	

Exhibit 9.

Value Index (Truck Cab)



As evidenced in Exhibit 9, the interior trim for both the front and rear of the cab are prime candidates for cost reduction. Without value analysis, companies might attempt an across-the-board cost reduction without adequately considering customer value. For example, the cab interior's seats, with a value index of 2.21, provide a relatively high ratio of value to cost (see Exhibit 8). Therefore, the seats are not a good candidate for cost reduction. In fact, relative to their cost, the seats are highly valued and should be considered for additional investment.

Conversely, interior trim for both the front and rear cab have relatively low value to cost ratios (.38 and .31, respectively). Consequently, they are both good candidates for cost reduction. Interior trim is highly correlated with the functional requirement interior appearance, and the original truck designers may have overemphasized the importance of the truck's appearance relative to the comfort and functionality of its seats.

The engineer's goal is to design a product for which each of the product's systems has a value index that is close to one, meaning the system's customer value and cost are in alignment. When this occurs, each of the product's systems will be plotted near the 45 degree line on the graph seen in Exhibits 7 and 9.

When applying the value index, one must be careful to avoid evaluating components in isolation; instead, product systems that have a common purpose should be analyzed. If we simply try to reduce the cost of components, we are assuming that each component is vital to the product and can't be eliminated. For example, a manufacturer of over-the-range microwave ovens had a significant cost problem. Costs were over target by more than 20 percent. As a rule of thumb, when costs are within 5 percent of target, the savings might be achieved by changing the manufacturing process. Greater than 5 percent but less than 10 percent generally requires a change in architecture. Savings of more than 10 percent require a major redesign.

In the microwave example, simply reducing the cost of each component would not produce the desired savings. Therefore, it was necessary to evaluate the product as a whole. For over-the-range microwave ovens, one of the functional requirements is to be able to secure the microwave to kitchen cabinets. This was currently being accomplished by bolting the microwave's chassis to the cabinets. (The chassis is a metal wrap around the microwave that is attached to the cabinets.) After evaluating the microwave's functional requirements ranking, as defined by the customer, the value of this requirement was substantially below its cost. Therefore, the microwave chassis was part of the system that became a focal point for cost reduction efforts.

By focusing on the functional requirement (attachment to cabinets) the engineers found a design solution that eliminated the chassis entirely. Instead, they were able to develop fasteners that secured the microwave directly to the cabinets. This new design helped reduce costs by 20 percent.

Summary

Essentially, value analysis helps organizations prioritize and focus their improvement efforts during the product design cycle. It begins with the customer. The customer must place a value on each of the product's functional requirements to signal where improvements are needed. A graphical representation of the value index provides a highly visual and very informative representation of which product systems are most out of alignment. Even though the organization might be tempted to focus only on cost-cutting, in some cases it is equally, or even more important, to enhance certain product functions that are particularly important to the customer. In the end, each of the product's systems should be in alignment, with their cost equal to their customer value. [1]

1 The CAM-I Target Costing Best Practices interest group members include technical experts from the U.S. Air Force, Boeing, Navistar, Targeted Financial Solutions, and VION. 2014 CAM-I publications from the Target Costing Best Practices group included an article on "Addressing Commodity Price Volatility in Product Development Through a Mature Target Costing Process"; contributors to this article include Elaine Jones (Targeted Financial Solutions, LLC), Matthew A. Anderson (The Boeing Company), Alan Laverson (U.S. Air Force), and Pablo Gomez (VION).