Value from engineering

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Value engineering – or as we prefer to call it, high value engineering – is an important tool that in conjunction with value analysis can be used to optimise component costs, while potentially enhancing the functionality, operating life and performance of each part.

The idea of value engineering as a manufacturing methodology has been around for many years (see side panel) and has been instrumental in helping a great many businesses solve a host of different production, process and operational challenges.

In essence, the goal of value engineering is to reduce cost without reducing function. This straightforward objective is, however, often complex and time consuming in application, especially where multiple components or production operations are involved. In some instances, this can lead to a loss of focus, with the process becoming centred around the need to cut costs regardless of other factors – too often, the need to control cost is mistaken for a need to cut cost – with the end result breaking the golden rule of value engineering: do not reduce the function.

Almost all engineered products and components are designed to a budget. It's not unusual, however, for a particular component to be over-engineered or overpriced, but for this factor to be overlooked if the overall system cost comes in on, or under, budget. Systematic analysis of function and cost, using value engineering, can flag this up by asking, what else will replicate or improve the function of the product, service, or process but at lower cost?

The first approach to the problem is to analyse a product – be it a bearing, clutch assembly or gearbox – using a cost/function matrix. This links the relative worth of these two elements,

What is value engineering?

Although the idea of value engineering was born in the late 1940s, it was not until 1961, with the publication of 'Techniques of Value Analysis Engineering' by Lawrence Miles, an engineer at General Electric, that the methodology began to be widely accepted. Today, value engineering is used in a wide range of industries and for analysing and enhancing many different engineering, process and construction challenges.

The value engineering methodology defines value as the ratio of function to cost. Value can be improved either by enhancing functionality or reducing cost. However, cost reduction in itself is not the goal of the value engineering process, especially if cost can only be driven down by reducing functionality. Unnecessary cost was defined by Miles as something that adds nothing to a product, in terms of quality, functionality or appearance.

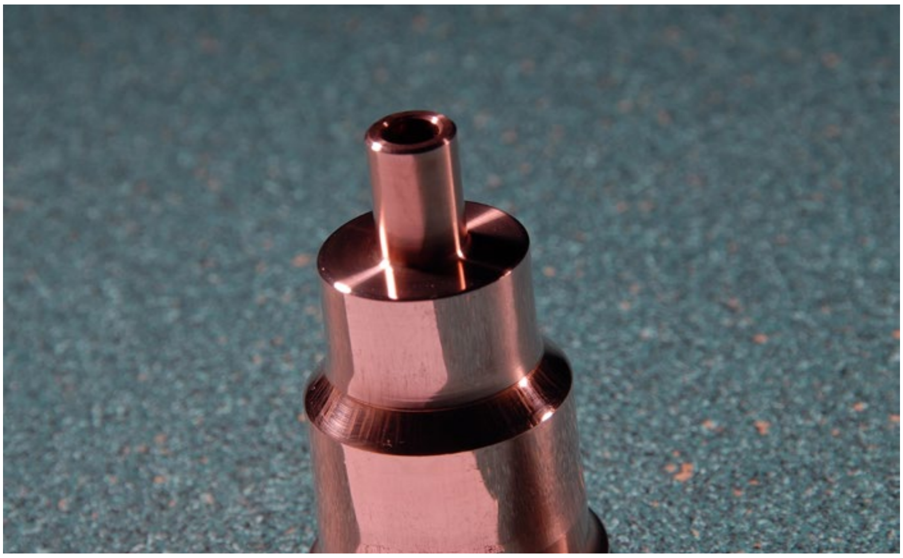
Function is a description of what something does and is normally expressed as a short – often just two words – phrase; e.g. the function of a pen is to make marks. For many engineering processes, although arriving at a simple definition can be a complicated process it does enable the individual aspects of a process or procedure to be isolated and analysed – so called, function analysis.

Function analysis is key to the value engineering methodology, being used in conjunction with a structured how/why questioning technique to identify and explore the options for removing cost and/or enhancing function from a component, system or process operation.

and identifies, in Lawrence Miles' words (see side panel), unnecessary cost – or, at least, parts whose function do not justify their cost.

A simple example is automotive wiring harnesses. By reviewing the circuit design, it can often be possible to minimise the number of connectors, by creating common connection points, replacing customised connectors with generic alternatives, and improving harness routing or combining harnesses to minimise wire usage. The results are likely to be a fall in costs, without affecting functionality, plus the longer term benefit to the final customer of easier installation and maintenance; indeed, in the example quoted it may even be possible to improve energy efficiency and overall reliability.

Similarly, in a production operation, if the objective is to increase profitable capacity, then you need to consider if the most effective solution is simply to increase capacity in the most efficient manner, or if profitable capacity can be improved by eliminating inefficiencies in existing production systems.

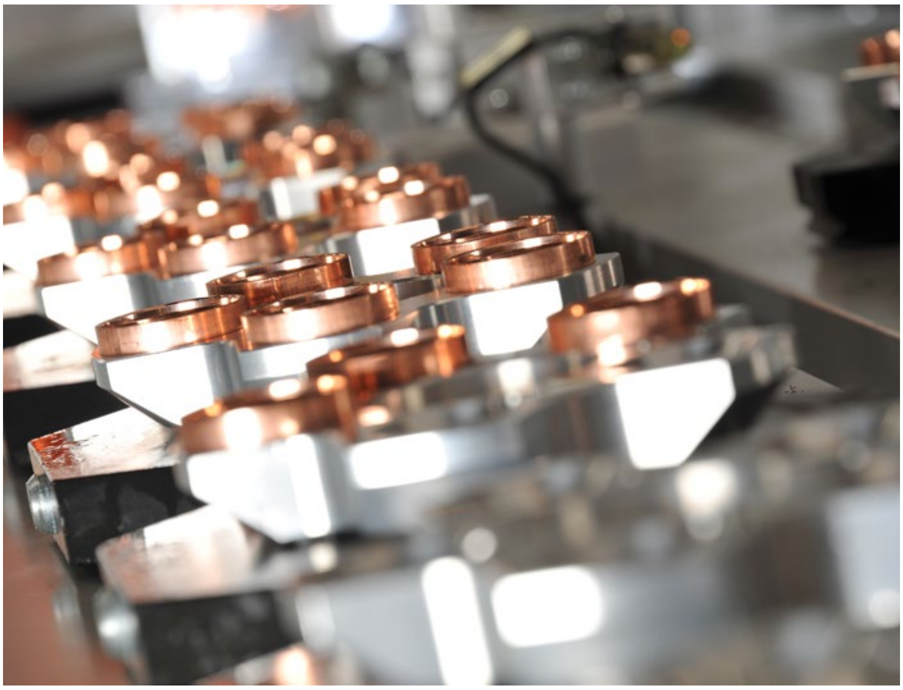


This might, for example, involve the modification of production equipment to reduce energy consumption, making a reduction in the number of process steps, or the introduction of recycled materials.

Hidden benefits

Value engineering can take many forms and involve a reassessment of product or part design and engineering, and the manufacturing process itself.

For example, we have worked closely with a number of automotive tier one and two suppliers to help them re-engineer components. These have included diesel injector valve sleeves, which traditionally had been produced using conventional CNC milling processes. The production volumes were high, so even a minimal saving on each part, in terms of materials, production stages or production time, would represent a significant gain for our customer.



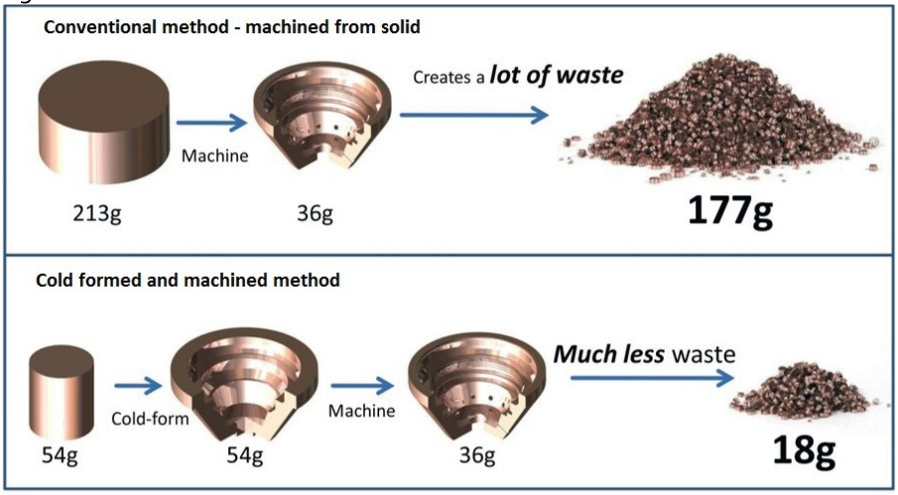
Our approach was not to redesign the component – this would have been disproportionately costly and possibly affected the performance of the valve sleeve and thus the engine itself.

Instead, we considered alternate methods of producing the same part, without affecting its functionality and quality, or impacting lead times.

In conjunction with our customer, we carefully considered the options, including a review of the existing machining process, to see if increased levels of automation or other changes to the machining operation would help to reduce cost without impacting on functionality. We were able to identify a number of areas where incremental change was possible.

Overview of Cold Forming and CNC Machining - Application Plasma Cutting Shield

Fig.1



However, we also realised that, by switching the way in which the component was produced, from machining the part from a solid block of Copper to precision cold forming it from a much smaller Copper blank, it would be possible to introduce a step change that had a major impact on the long term success of the contract.

Precision cold forming is a tried and proven process, so there was no element of risk involved at this level. We also knew from previous experience that the cold forming process could enhance the mechanical properties of components in unexpected ways, which proved to be the case with this project.

Not only were we able to make considerable reductions in the volume of scrap produced – in the order of 70% – we were also able to significantly cut the time required for the production of each valve sleeve. In addition, the mechanical extrusion that is inherent in cold forming process, leaves an extremely smooth, highly polished inner surface on each sleeve, thereby eliminating the need for further rework and creating a finish that improves component functionality.

This is enhanced still further as extrusion of the metal, at a molecular level, takes places along the grain boundaries, thereby maintaining the mechanical properties of the material; by comparison, machining generally cuts across theses boundaries, which can affect mechanical strength.

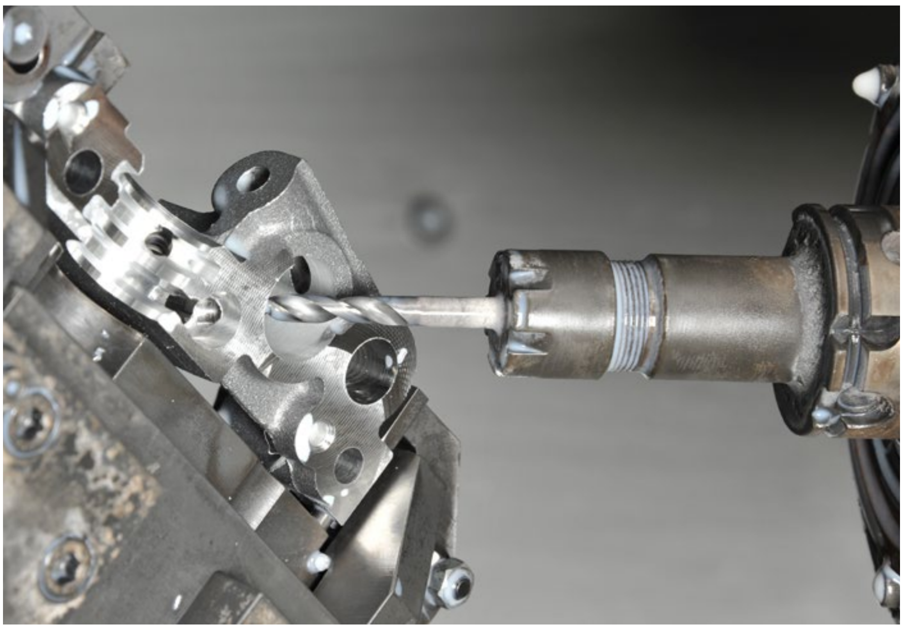
A similar example can be found in the manufacture of nozzles for plasma and laser welding. These had traditionally been cut and machined from solid bar.

This was a relatively expensive and time consuming process, which as can be seen from Fig 1 generated considerable volumes of waste.
In conjunction with our customer, we reviewed the existing method of production and assessed the options for reducing waste and cost without affecting the overall performance or design of the nozzles. Cold forming again provided the most appropriate alternative, reducing waste metal from 177g/part to just 18g. Although each part still requires a final machining operation the cost, speed of production and finished quality is far superior to that of machining alone.

A different approach

Value engineering is not always about the cost and functionality of a component or product. It can also involve the method and means by which parts and assemblies are produced.

In general terms, suppliers of capital equipment, production lines and large systems are specialists in the design, construction, sales and support of the overall machine or system. They rarely have the detailed knowledge or



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resources to develop and engineer every part used; as a result, outsourcing standard components, such as bearings, shafts, seals and so on, is common practice.

Less common is the outsourcing of specialised sub-systems and assemblies. Although these can be produced in-house, the process often involves considerable cost, in terms of production by skilled engineers who could be better employed elsewhere in the business, plus assembly time, testing, quality control, dedicated production space, and the associated stockholding and procurement of multiple components.

Outsourcing this specialised work can pay dividends. We have many examples where we've worked with customers to develop production and assembly processes that are far more efficient than their in-house sub-assembly operations. In some instances, this has involved product redesign, to reduce cost or enhance performance and reliability, while in others we have been able to introduce value added services, such as laser marking, customised packing and line-side deliveries.

Value benefit

Value engineering or, more specifically, high value engineering, is applicable to almost every design and manufacturing project.

To quote Lawrence Miles, from his original book Techniques of Value Analysis Engineering: 'Value Analysis is a creative, organised approach, which has as its purpose the efficient identification of unnecessary cost; i.e. costs that provide neither quality nor use, nor life, nor appearance, nor customer features'.

With an intelligent, diligent and carefully structured approach, and by working with a specialised partner with the knowledge, experience and impartiality to provide the best solution, it becomes possible to engineer true value into each manufactured component, assembly and system. It may not be a quick process, and may require investment in time, energy and resources, especially where complex systems or operations are involved, but the benefits for all concerned can be considerable.

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