DFMA Case Studies in Supplier Costing for Low Volume Medical Devices

By
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Introduction

Ortho Clinical Diagnostics designs and produces equipment and supplies to test blood for diseases, conditions, and infections. We are a global leader of in vitro diagnostics and our high-quality products and services enable health care professionals to make better informed treatment decisions to improve and save lives throughout the world.

We've been in this business for 75 years and we have customers in more than 120 countries throughout the world. We make more than 250 different products and have more than 4200 employees and we generate approximately 1.7 billion dollars in revenue yearly.

We were spun off from Johnson & Johnson and became an independent company in 2014. Since becoming independent we've had renewed focus on our core business and the cost of our products has taken on a new focus as well.

Like many medical device manufacturers, we produce two types of products. The first is our line of non-disposable machinery products which are used to conduct medical tests on blood. The second is our line of disposable products that support our machinery with supplies necessary to perform those medical tests. Our non-disposable machinery are high complexity and high cost products that are produced in low production volumes. Our disposable products are simple and much lower cost, in comparison, and they are also produced in very high production volumes. A typical annual volume for our machinery products is in the thousands of products per year while a typical annual volume for our consumables is in the millions of products per year.

This paper discusses the process I went through to select and set up costing tools that would be useful for supplier costing work and it also discusses some of the projects I've worked on during my tenure at Ortho Clinical Diagnostics. Most of these projects have focused on supplier costing, where I generate a cost estimate using the DFMA software and then use that estimate to negotiate the price that we pay to a supplier for a currently produced item. These projects have increased both my credibility and my visibility within our organization. As a result of that, I've become involved with our product design team, with some designers actively asking for help reducing the cost of their product designs. One of these conceptual design projects is illustrated in this paper.

Selection of a costing tool

Selection of a tool useful for supplier costing began when I considered a few different costing software packages, the two largest being aPriori and Boothroyd Dewhurst's DFMA.

aPriori was considered primarily because my predecessor at Ortho Clinical Diagnostics selected that software for his use in supplier costing. This selection was made because aPriori is an automatic CAD based costing system that requires very little time or effort to develop cost estimates. However, the devil is in the details, and the alignment procedure required in order to get reasonable results from aPriori makes the software unusable for supplier costing. Any costing tool that is aligned to supplier quotes cannot be used to question the data it has been aligned to. True supplier costing requires an independent cost estimate, and the alignment procedure required with aPriori eliminates that independence. For that reason, I decided against the aPriori software.

I've used several different costing tools in my cost engineering work at other companies and I've always been impressed with the accuracy and results I've been able to achieve with Boothroyd Dewhurst's DFMA software. For this reason, Boothroyd Dewhurst's DFMA software was selected as the primary costing tool I would use in my work at Ortho Clinical Diagnostics.

Set up of the DFMA software

Although alignment of costing software to supplier quotes makes that software unable to question supplier quotes, Boothroyd Dewhurst's DFMA software still required some setup to make it suitable for my use. I contacted Brian Rapoza at Boothroyd Dewhurst and provided him with the data I wanted to incorporate into the software.

The DFMA software breaks down the cost of a part into its material, process, setup, and tooling cost components with each of these requiring appropriate setup in the software.

Process and setup costs

The process and setup components of my DFMA estimates are based on hourly chargeout rates for a typical supplier. A chargeout rate is the hourly rate a supplier charges customers for a machine and operator. These supplier chargeout rates cover the cost of machine deprecation, the cost of energy and supplies used during processing, the cost of floorspace, the cost of selling, general, and administrative overhead, and the fully burdened cost of machine operators and maintenance personnel. The supplier profit for running an operation is also included. A DFMA estimate based on these chargeout rates models the situation where my company rents a machine and operator from the supplier for the time necessary to produce our parts. The cost of that rent, which is the chargeout rate, covers all the supplier costs as well as their profit margin.

Material cost

The material cost component of my DFMA estimates is based on a fully burdened material cost per unit weight which includes the base cost to buy the material as well as the cost of material delivery to the supplier. Administrative costs for tracking the material throughout the supplier facility and profit to compensate the supplier for their effort in buying, handling, and selling the material are also included. A DFMA estimate based on these fully burdened material costs models the supplier as a middleman that buys material from a material supplier and then sells that material to my company in the form of the parts we buy.

Tooling cost

Much like the process and setup cost components, the DFMA tooling cost estimates are also based on tool supplier chargeout rates which account for all of machine, supply, and toolmaker labor costs associated with tool production. Profit for the tool supplier is also included in these hourly chargeout rates. A DFMA tooling cost estimate based on tool supplier chargeout rates models the situation where my company rents the equipment, buys the supplies, and rents the toolmaker for the time required to produce our dedicated tooling. The chargeout rate covers these costs as well as the profit for the tool supplier.

Supplier profit

The most common method to account for supplier profit is to add-in a constant percentage of the part total manufacturing cost. There are problems with this approach because supplier profits are not distributed properly. Parts that require less value-added labor earn profits that are identical to parts that require more value-added labor. This means a supplier is not paid a profit in proportion to the value-added work that they perform. It also means that my company pays too high a profit to suppliers that add little value to the parts we buy.

For these reasons, a different approach for adding profit was used where a separate profit margin is added to each component of the part cost. A 40 percent profit margin for setup and processing costs is included in the hourly chargeout rates that have been entered into the DFMA software. A much smaller 15 percent profit margin is added to the material cost per unit weight values to account for the fact that the supplier must buy, store, and handle that material within their facility.

Generally, my company capitalizes the cost of dedicated tooling, so tooling costs are not always negotiated with suppliers. The production volume for this tooling is usually very low, with only a single tool normally being produced. This small production volume means the tool supplier profit margin is higher than the profit for processing and setup during part production. For that reason, when tooling

costs are negotiated, we assume a profit of 140 percent built into the chargeout rates for the tooling supplier.

Accounting for supplier profit in this way can result in some significant differences. An example that illustrates this comes by way of a negotiation I did on a large foam molded outer cover for one of our blood testing machines. My DFMA cost estimate for this part was 72.7 percent of the supplier price, and as you can see in Figure 1, most of the difference was due to supplier profit. Foam molding requires a small amount of processing cost and, as a result, roughly 70 percent of the part's price is due to the cost of the material used to make the part. The supplier applied a 40 percent profit margin to the cost of that material, which is not deserved for being a middleman in the sale of that material. In my DFMA estimate, I applied the much more appropriate 15 percent profit margin for material purchase and handling.

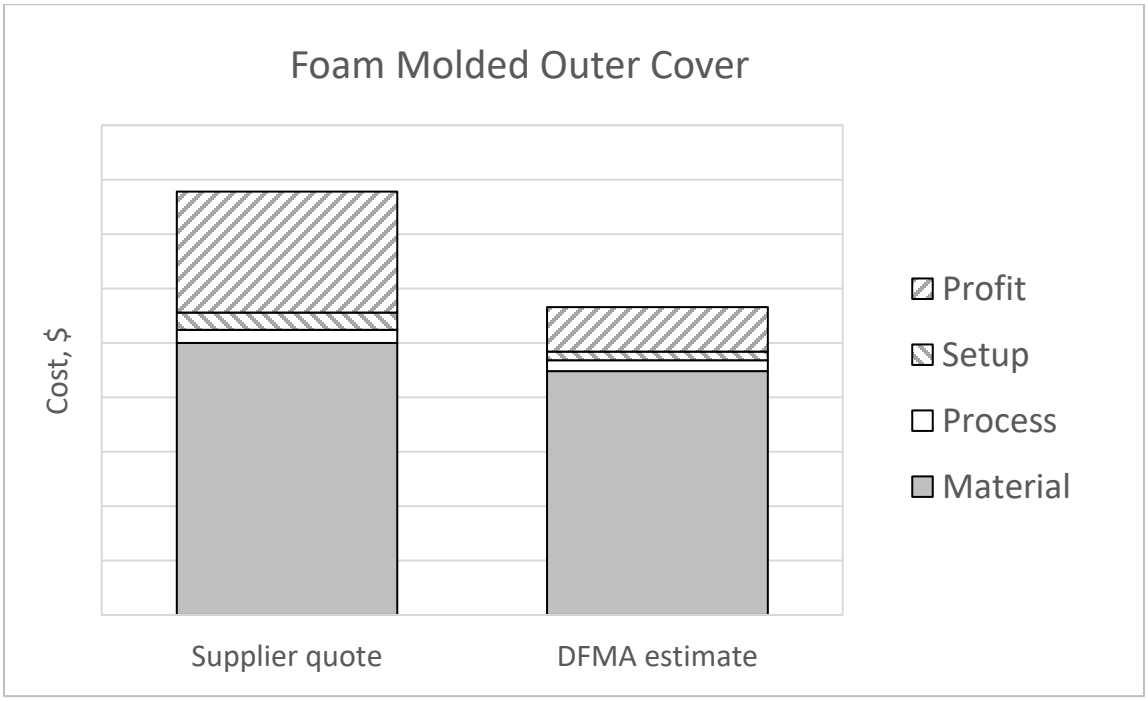

Figure 1 - Comparison of supplier quote and DFMA estimate for large foam molded cover

First costing project - Fabricated Tables

My first project at Ortho Clinical Diagnostics was a set of fabricated tables used to support, transport, level and secure our blood analysis machinery. The tables, one example of which is shown in Figure 2, are available in two different lengths and the annual production volume for each length is low with less than 1000 produced yearly. The price paid to the current supplier when I started the project for each table is shown in Figures 3 and 4. Management at Ortho Clinical Diagnostics had originally set a 10 percent cost reduction target for each table. As shown in Figures 3 and 4, my DFMA cost estimates showed that a much more significant cost reduction opportunity existed.

Figure 2 - One example of fabricated table

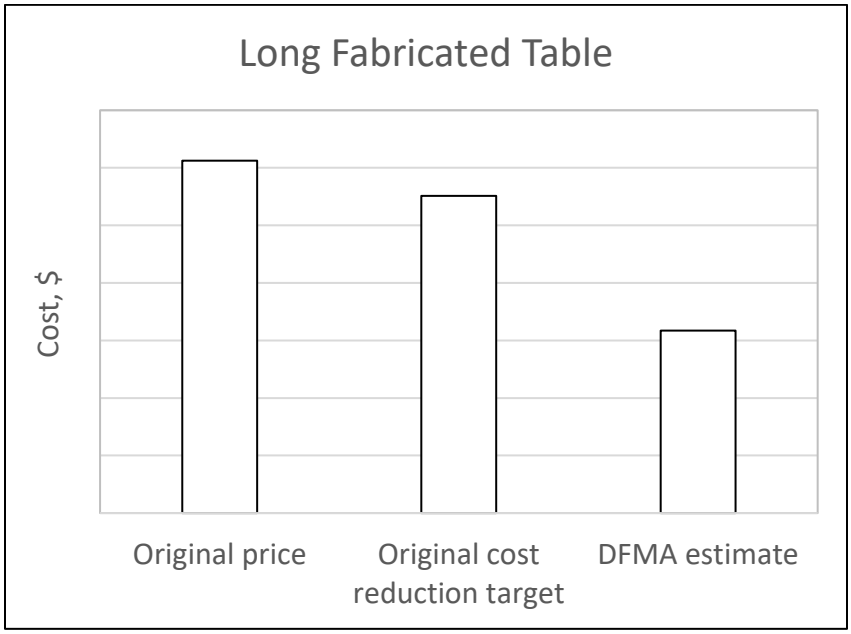

Figure 3 - Comparison of original price, original cost reduction target from management, and DFMA estimate for long fabricated table

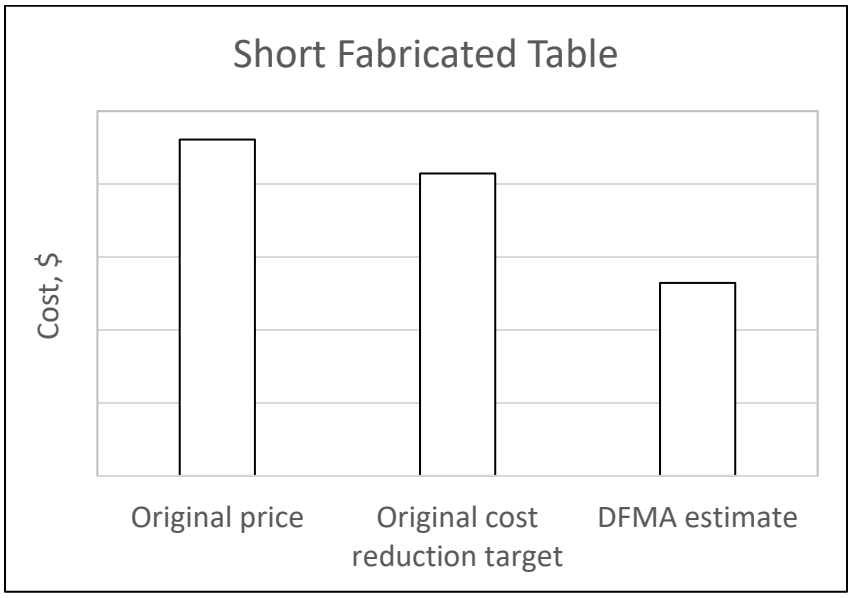

Figure 4 - Comparison of original price, original cost reduction target from management, and DFMA estimate for short fabricated table

Considering that my cost estimates for the tables were 52 to 57 percent of their current price, people within my organization at Ortho Clinical Diagnostics had trouble believing my estimates were correct. On top of that, the current supplier dug their heels in and refused to negotiate. I had a credibility problem to overcome, with many people in my organization questioning the validity of the DFMA software. Based on my previous experience, and the results I've achieved at other companies, I had confidence in my estimates, so I contacted a new supplier for a quote on each of the fabricated tables.

The quotes from the new supplier are shown in Figures 5 and 6. Note that with absolutely no negotiation, the new supplier quotes were within 7.5 percent of my DFMA estimate on the long table and within 12.2 percent on the short table. This shed some light on the accuracy of my estimates with the DFMA software and restored some of my credibility with many people in my organization.

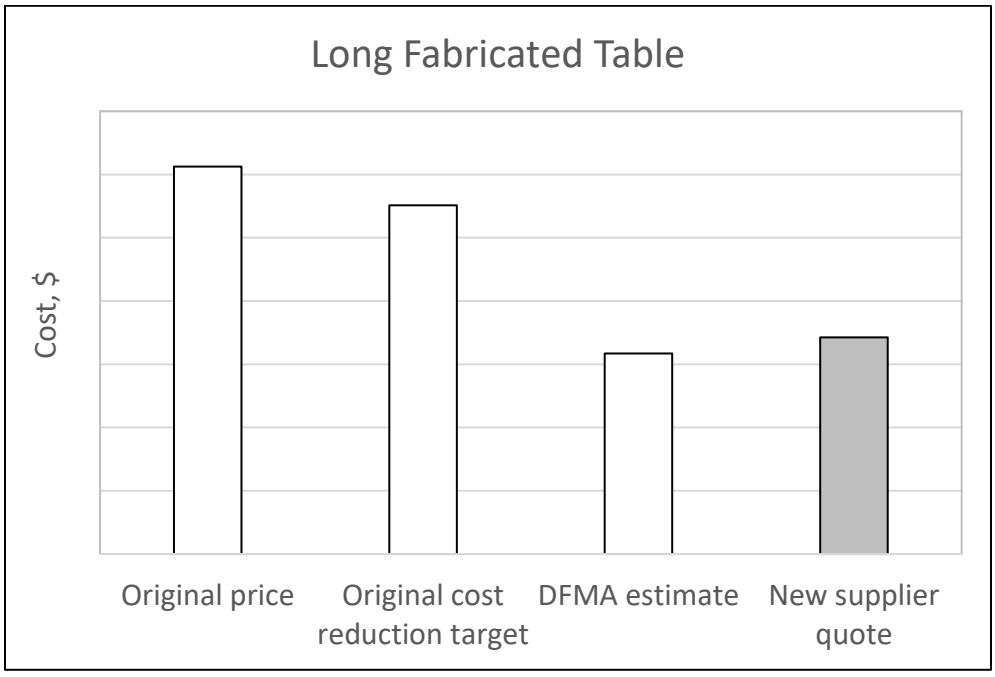

Figure 5 - Comparison of original price, original cost reduction target from management, DFMA estimate, and a quote from a new supplier for long fabricated table

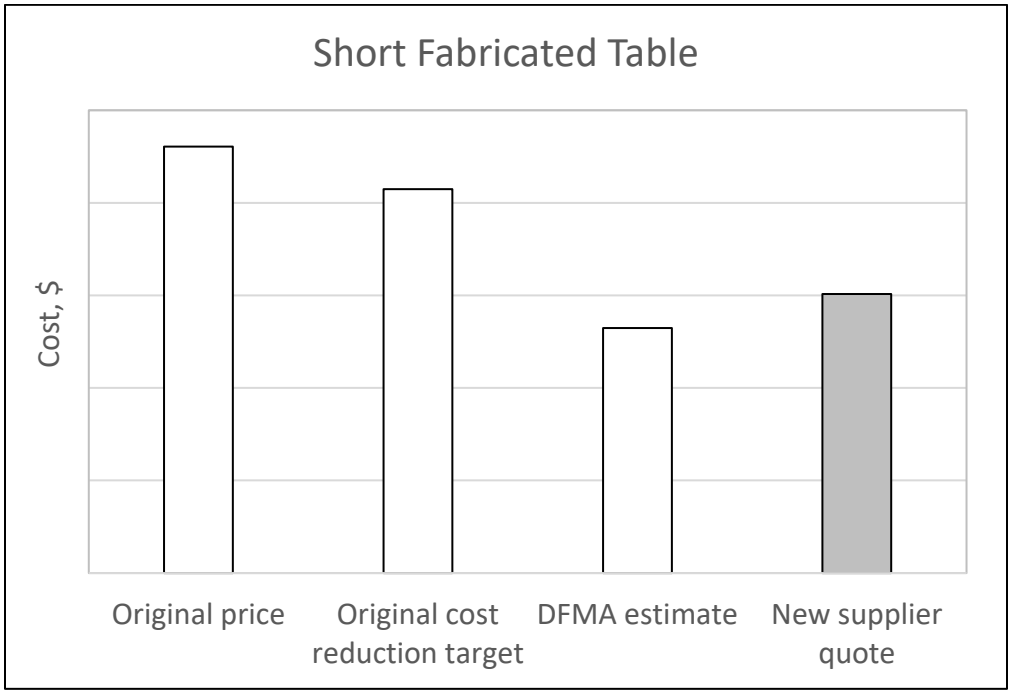

Figure 6 - Comparison of original price, original cost reduction target from management, DFMA estimate, and a quote from a new supplier for short fabricated table

Next, I negotiated with the new supplier to reduce their price further and during the negotiation we compared process steps, cycle times, and cost information. Together, we determined that in some areas they could do a bit better than they had assumed in their original quotes and their prices were reduced accordingly. We also found that some adjustments to my original estimates were necessary. Specifically, the 316-stainless steel material that many of the table's parts are made from had to be purchased by the supplier in very small quantities at additional expense. I also assumed that many of the table's parts would be painted only on a single side, but the supplier planned to paint both sides of those parts at increased cost. In these areas, I updated my original cost estimate and we converged at the purchase agreement values shown in Figures 7 and 8. When compared with the prices originally paid for the pair of tables, this means we captured a total lifetime savings of just under three million dollars. This is particularly impressive considering that the fabricated tables are produced in such low quantities.

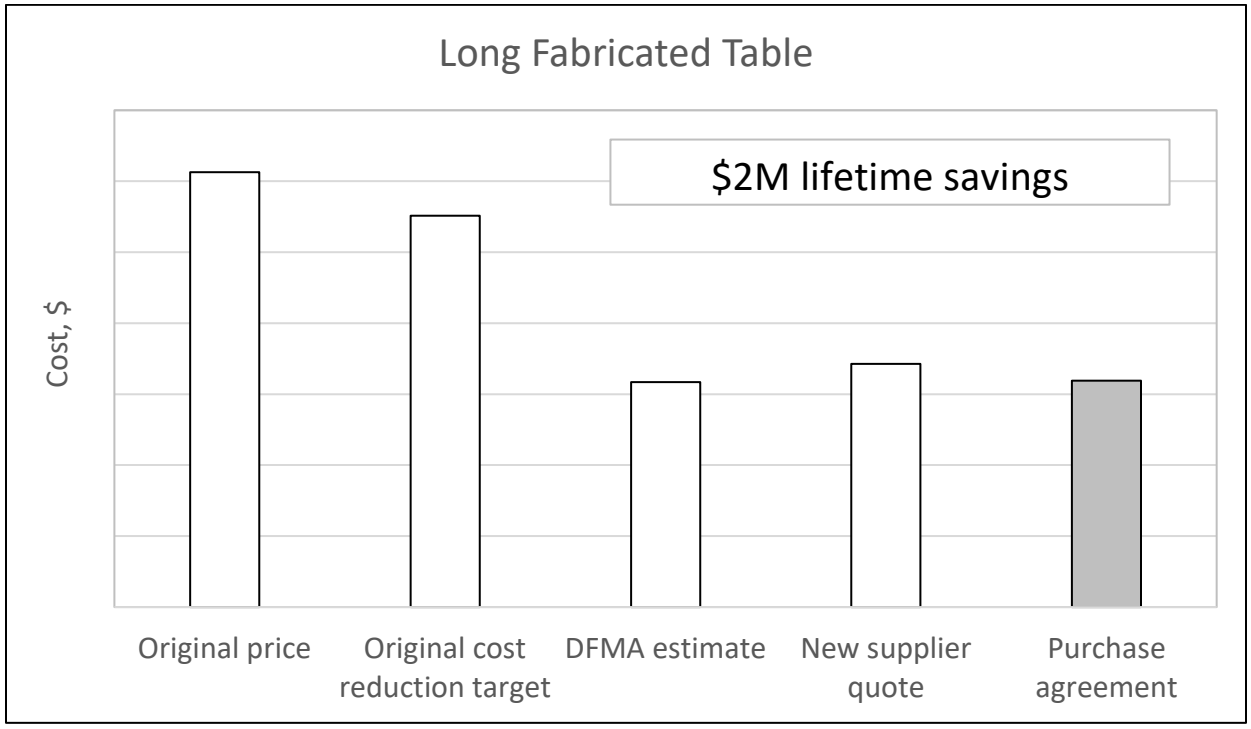

Figure 7 - Comparison of original price, original cost reduction target from management, DFMA estimate, quote from a new supplier, and the final purchase agreement for long fabricated table

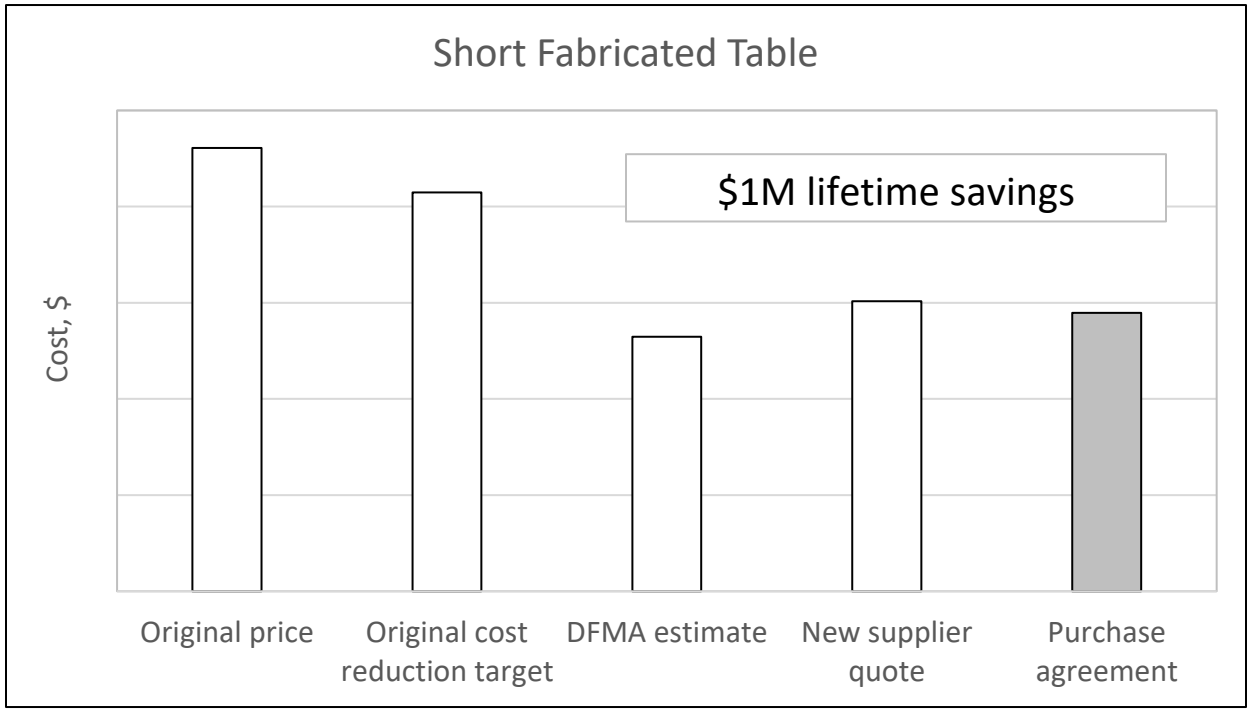

Figure 8 - Comparison of original price, original cost reduction target from management, DFMA estimate, quote from a new supplier, and the final purchase agreement for short fabricated table

Second costing project - Anchor Brackets

My next project was to cost-down some sets of anchor brackets which are used to anchor and secure machinery to the floor or wall within a building. My project was to estimate and negotiate the price for the three largest kits of anchor brackets that we produce. For reference, a single set of anchor brackets with associated hardware is shown in Figure 9. The brackets that make up the kit are primarily laser-cut, formed, and then finish machined and they are produced in low annual volumes with less than 1000 of each kit produced.

Figure 9 - Anchor bracket kit and associated hardware

As shown in Figure 10, a comparison of my DFMA estimates with the current supplier prices indicates that there exists a small but still substantial gap in two of the kits and a much larger gap in the third. The current supplier for the anchor bracket kits also refused to negotiate a price. I contacted a new supplier for new quotes on each of the anchor bracket kits and, as shown in Figure 10, there is reasonable correlation between the new supplier quotes and my DFMA estimates. After a small amount

of negotiation with the new supplier, purchase agreements were signed to re-source the anchor bracket kits which resulted in a lifetime savings of almost $700,000.

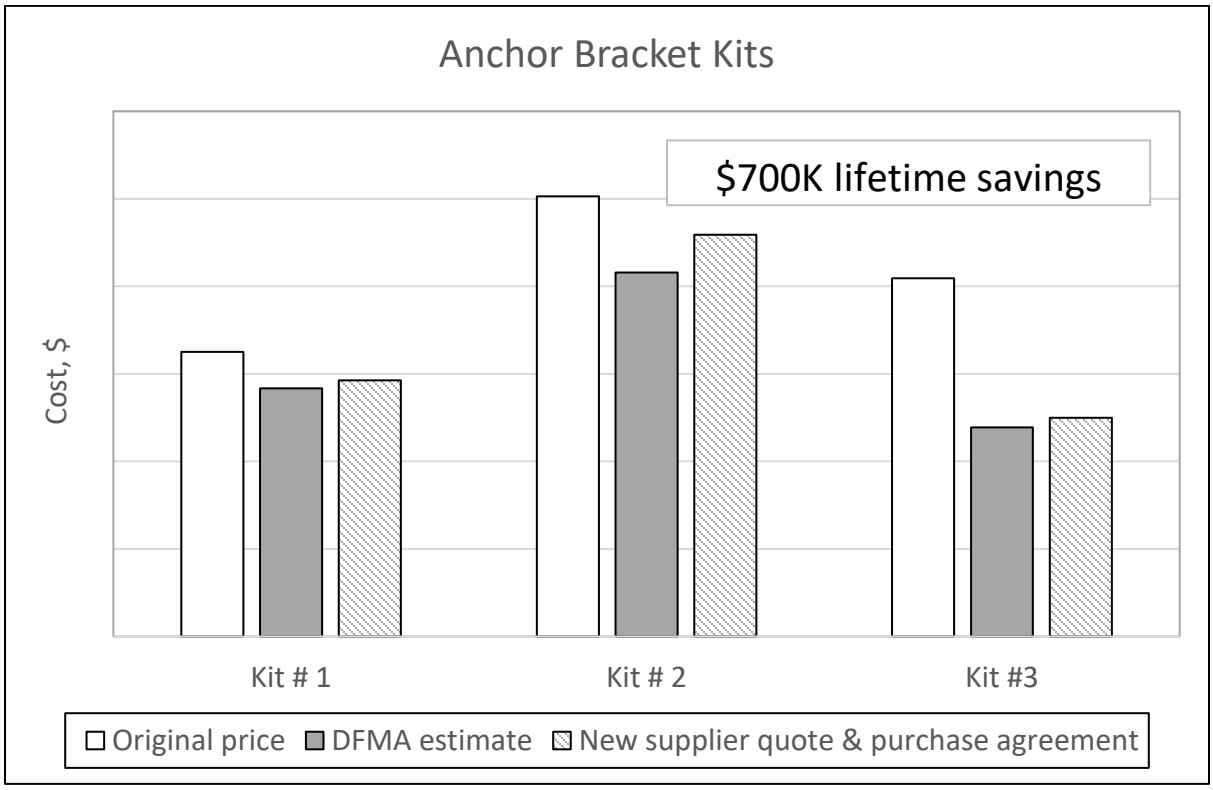

Figure 10 - Comparison of original price, DFMA estimate, and the final purchase agreement for three anchor bracket kits

Third costing project - Cart

The cart shown in Figure 11, is used to carry and store various consumable support supplies for the blood analysis machines we produce. Each cart is primarily composed of sheet metal and standard structural steel shapes that are fabricated, welded, and pop-riveted together.

Figure 11 - Cart

We produce less than 1000 of these carts annually and my initial DFMA estimate for the cart was roughly 30 percent lower than the original price. The supplier producing the cart was unwilling to negotiate and, for that reason, I investigated re-sourcing the cart to a new supplier. The initial quote from this new supplier was somewhat high, as shown in Figure 22, but they were willing to negotiate based on my estimate. During these negotiations, I sat with the design and manufacturing teams at this new supplier and we redesigned the cart so they could produce it more efficiently. The changes made during our redesign included:

1) See Figures 12 and 13 - Original design of base used standard structural steel shapes which were welded together. Redesign used a custom formed sheet metal base that provided the required rigidity and reduced costs.

2) See Figures 14 and 15 - Caster mounting brackets in the original design were very complex and required significant labor for assembly. Redesign used a set of simplified caster mounting brackets which were welded in place underneath the base. Welding of redesigned caster mounting brackets occurs during other base welding operations so that additional handling of large parts is eliminated. All base welding on the redesign occurs in areas not visible to the final customer which makes expensive dressing of welds unnecessary.

3) See Figures 16 and 17 - Rear spine on the original design was made from structural steel tubing that was welded in place. Original design of spine was produced from metric structural steel tubing so it was an expensive special purchase for the supplier. Redesigned spine uses two custom-formed sheet metal parts that are tab and slot welded together to reduce cost.

4) See Figures 18 and 19 - Top divided compartment on the original design was secured to spine with two separate brackets which were pop-riveted to the spine using 12 pop-rivets. Redesign used integral features formed into the spine to serve the function of the brackets and eliminate 13 parts.

5) See Figures 18 and 19 - Vertical dividers on original design top compartment were pop-riveted in place with many pop-rivets. Redesign used vertical dividers that were tab and slot welded to back panel.

6) See Figures 20 and 21 - Original design used four center bin brackets which were pop-riveted together and pop-riveted to the cart spine. Redesign used two central bin brackets which were tab and slot welded to the cart spine to reduce the part count. The cross section of the redesigned brackets was shaped to meet strength and stiffness requirements while still eliminating the two vertical brackets.

7) Original design countertop was made from marine board that was cut from sheet and then contoured to shape on a router and painted. The redesign countertop utilized a less expensive molded part that was molded in color.

8) The color scheme of the redesigned cart was changed so the entire cart was a single color to eliminate additional setup of the paint line.

Figure 12 - Original design of base showing standard structural shapes welded together

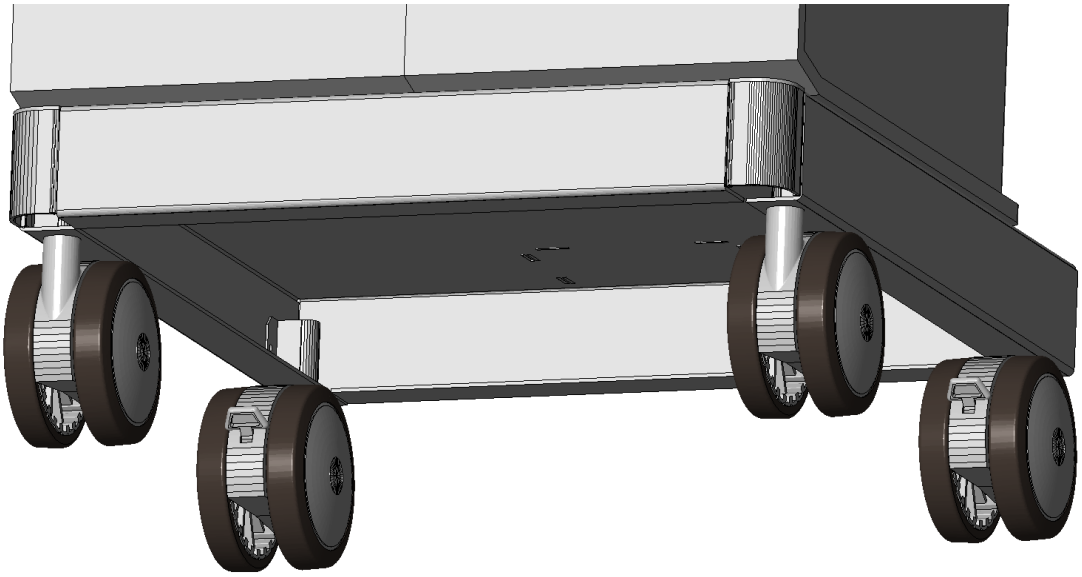

Figure 13 - Redesign of base showing custom formed sheet metal base with required rigidity

Figure 14 - Original design showing attachment of casters and exposed welds

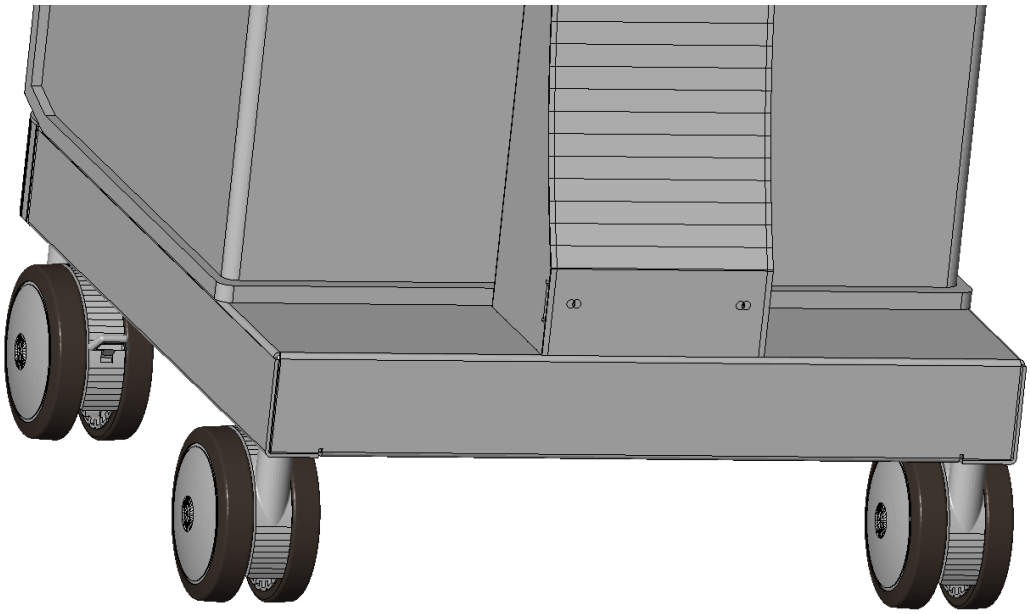

Figure 15 - Redesign showing simplified attachment of casters

Figure 16 - Original design showing structural steel tubing spine

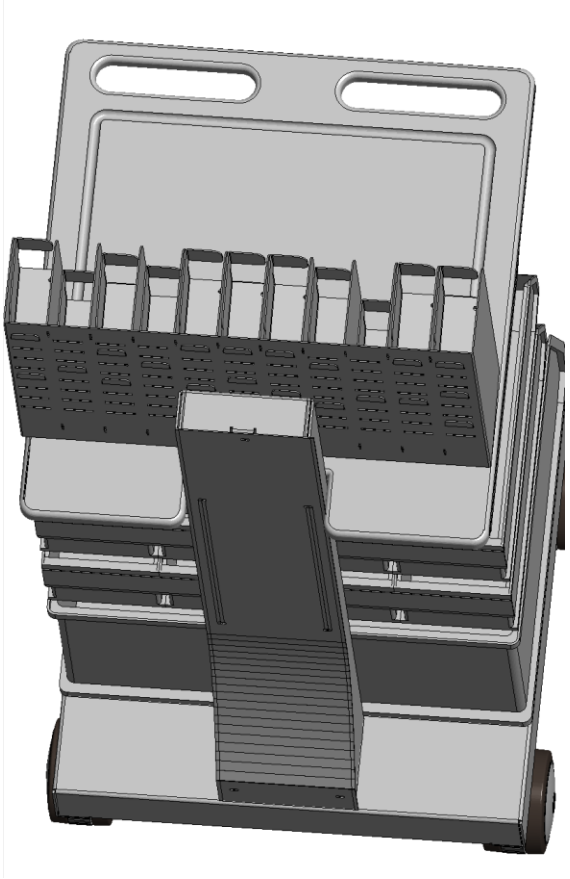

Figure 17 - Redesign showing custom formed sheet metal spine

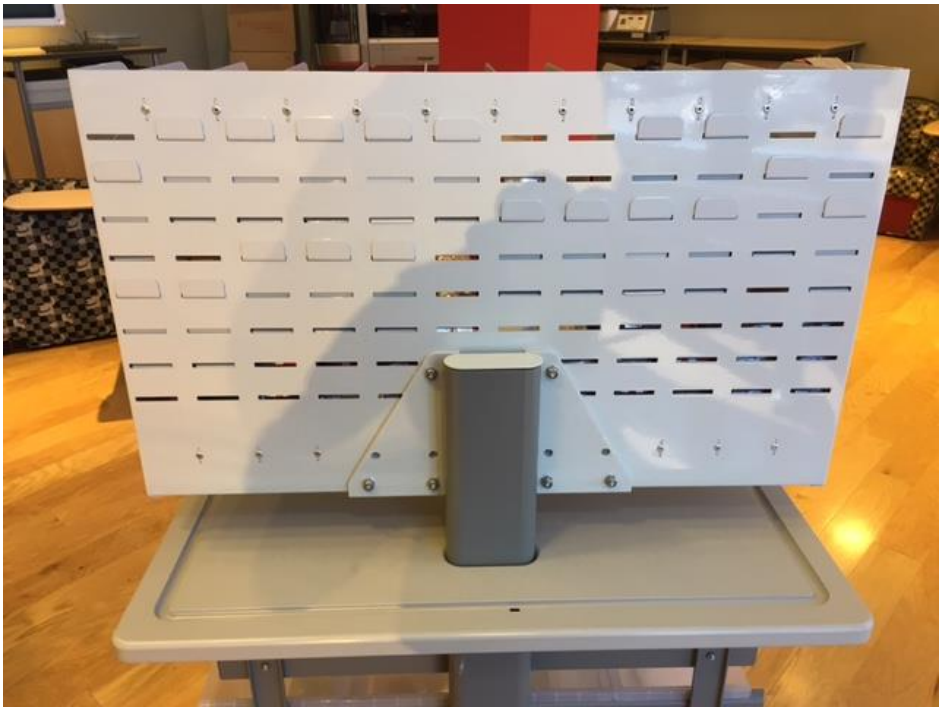

Figure 18 - Original design showing separate brackets to secure top divided compartment to spine - Also shows pop-riveted construction used on vertical dividers.

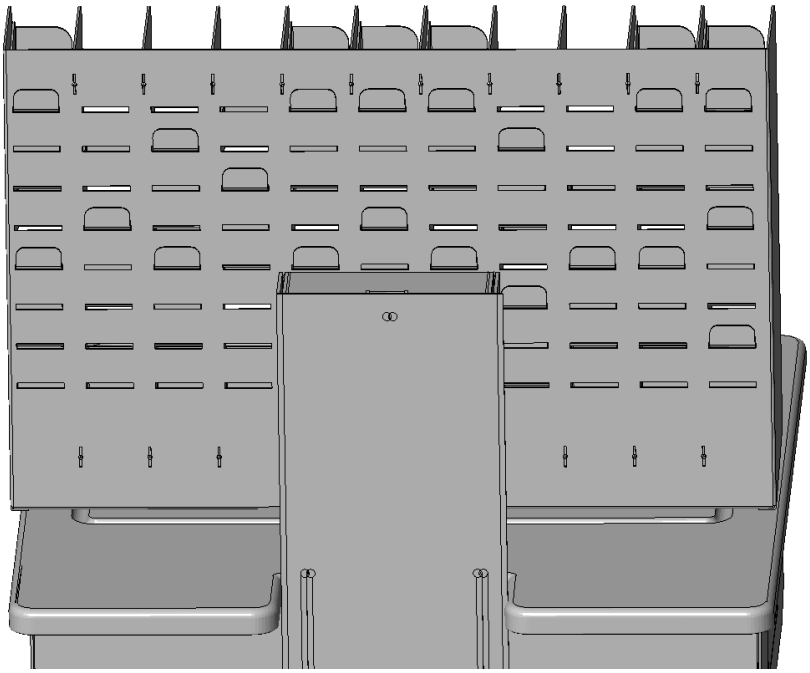

Figure 19 - Redesign showing integral features to secure top divided compartment to spine - Also shows tab and slot welded construction used on vertical dividers.

Figure 20 - Original design showing four center bin brackets pop-riveted together and pop-riveted to cart spine

Figure 21 - Redesign showing two center bin brackets welded to cart spine

After these design changes were made, I continued with some additional price negotiation and, as shown in Figure 22, the new supplier agreed to produce the cart for much less than their original quote. A purchase agreement was signed that resulted in a lifetime savings of just under $600,000, as shown in Figure 22.

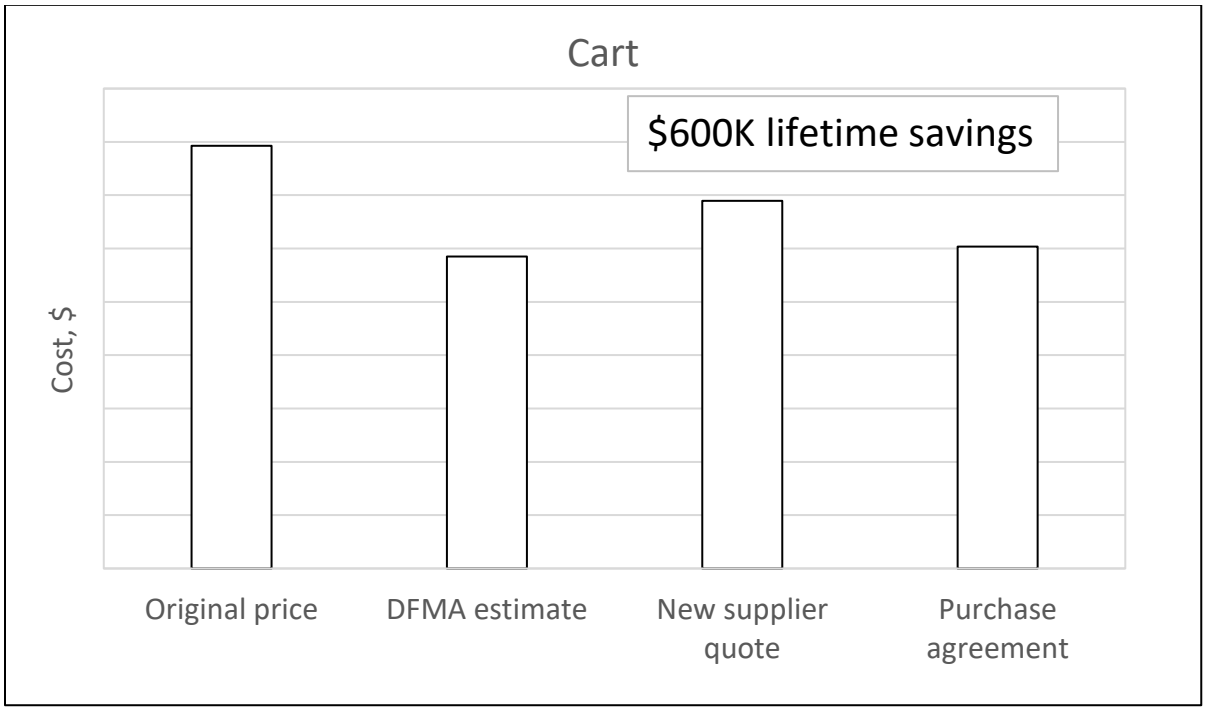

Figure 22 - Comparison of original price, DFMA estimate, quote from a new supplier, and the final purchase agreement for the Cart

During price negotiations, the new supplier also agreed to handle the logistics of selling the cart direct to our customers, which represents an additional and presently undocumented cost savings to my organization.

Most recent costing projects - Smaller assemblies and piece parts

The savings I've been able to achieve hasn't only been limited to larger assemblies and larger kits, like the examples discussed so far. Most recently, I've also achieved some significant savings on smaller assemblies and individual piece parts. For example, consider the following cap remover assembly, which is designed to automatically remove the caps from sample bottles prior to blood analysis. This assembly is made in low volumes, with less than 1000 produced annually, and it is small with envelope dimensions of 4.25 in. x 4 in. x 2.5 in.

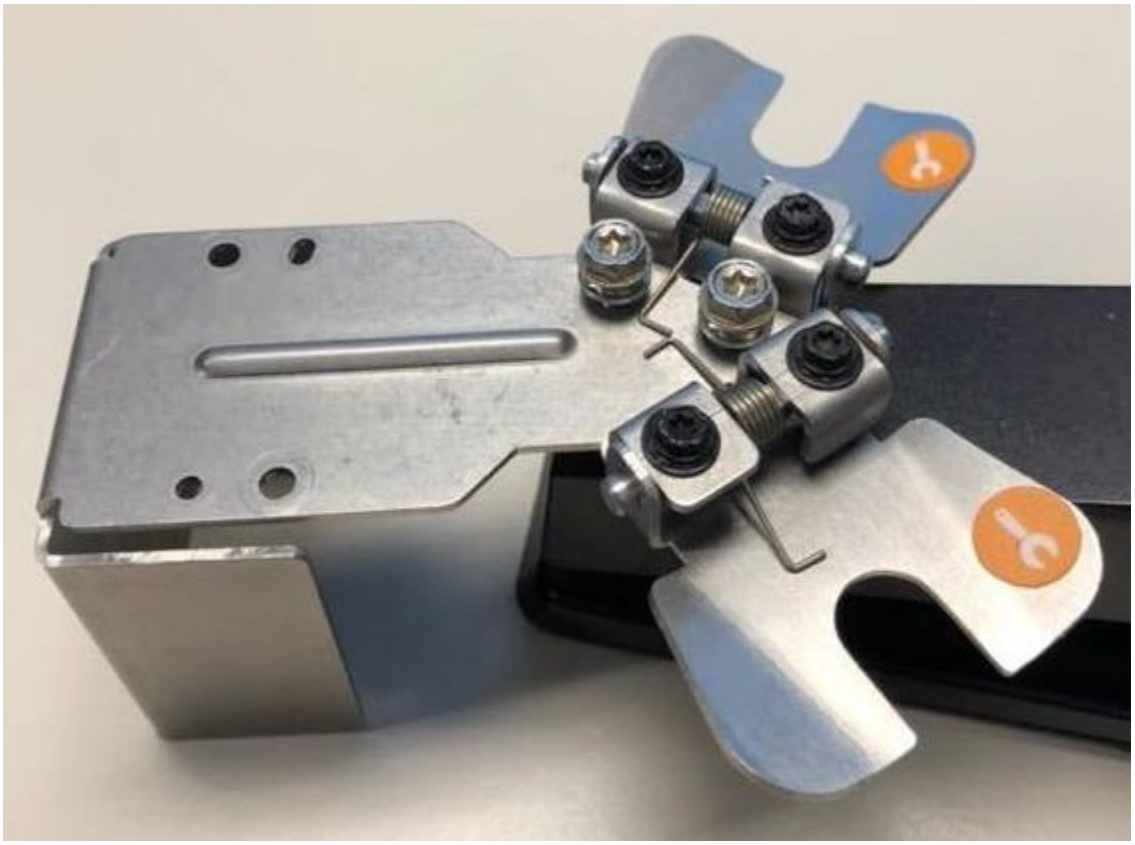

Figure 23 - Cap remover assembly

As shown in Figure 24, my DFMA estimate for this small assembly was just about 26 percent of the original price from the current supplier. The current supplier refused to negotiate, so I contacted a new supplier for a competitive quote, as shown in Figure 24. The new quote was 36 percent of our current price from the current supplier, so there is reasonable correlation between the new supplier quote and my DFMA estimate. This new quote represents a savings of $150,000 over the lifetime of the program.

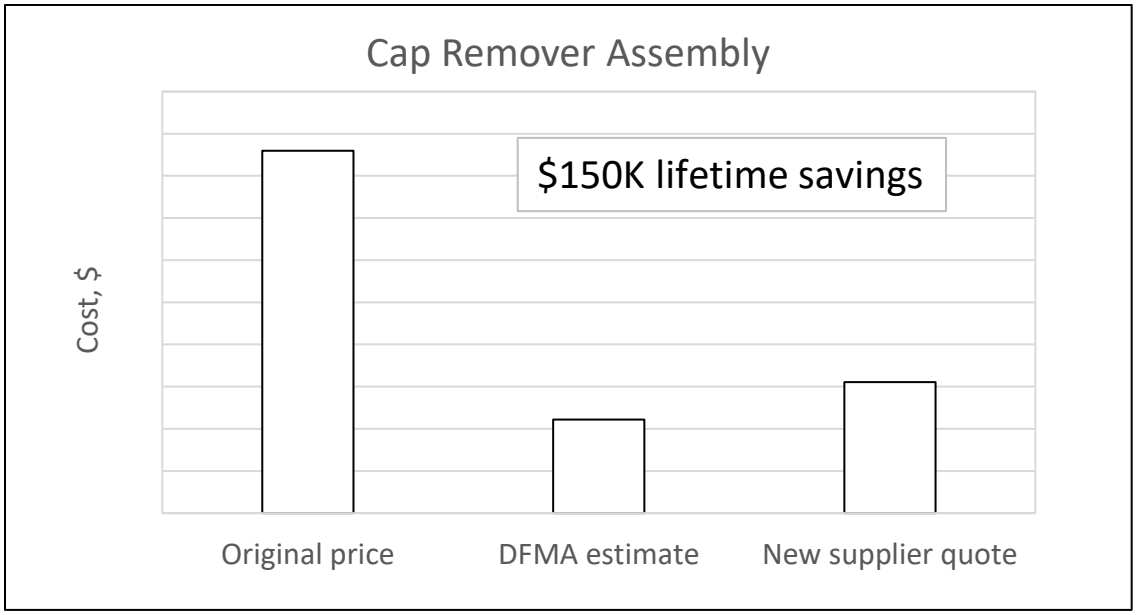

Figure 24 - Comparison of original price, DFMA estimate, and quote from a new supplier for the cap remover assembly

My most recent costing projects also included the right and left cabinet supports shown in Figures 25 and 26, respectively. These are painted sheet metal covers that support and provide rigidity to the cabinets of our blood testing machinery. Each cabinet support is just about 4 feet in length, and they are made in low volumes with less than 1000 of each produced per year. These cabinet supports were originally designed with integral sumps that each contain quarter turn PEM hardware. The current supplier claimed they could not produce these integral sumps and suggested redesigns which use separate sumps that are fastened using a series of pop-rivets. These supplier suggested redesigns are shown on the right of Figures 25 and 26, and the current pricing for these parts is shown in Figure 27.

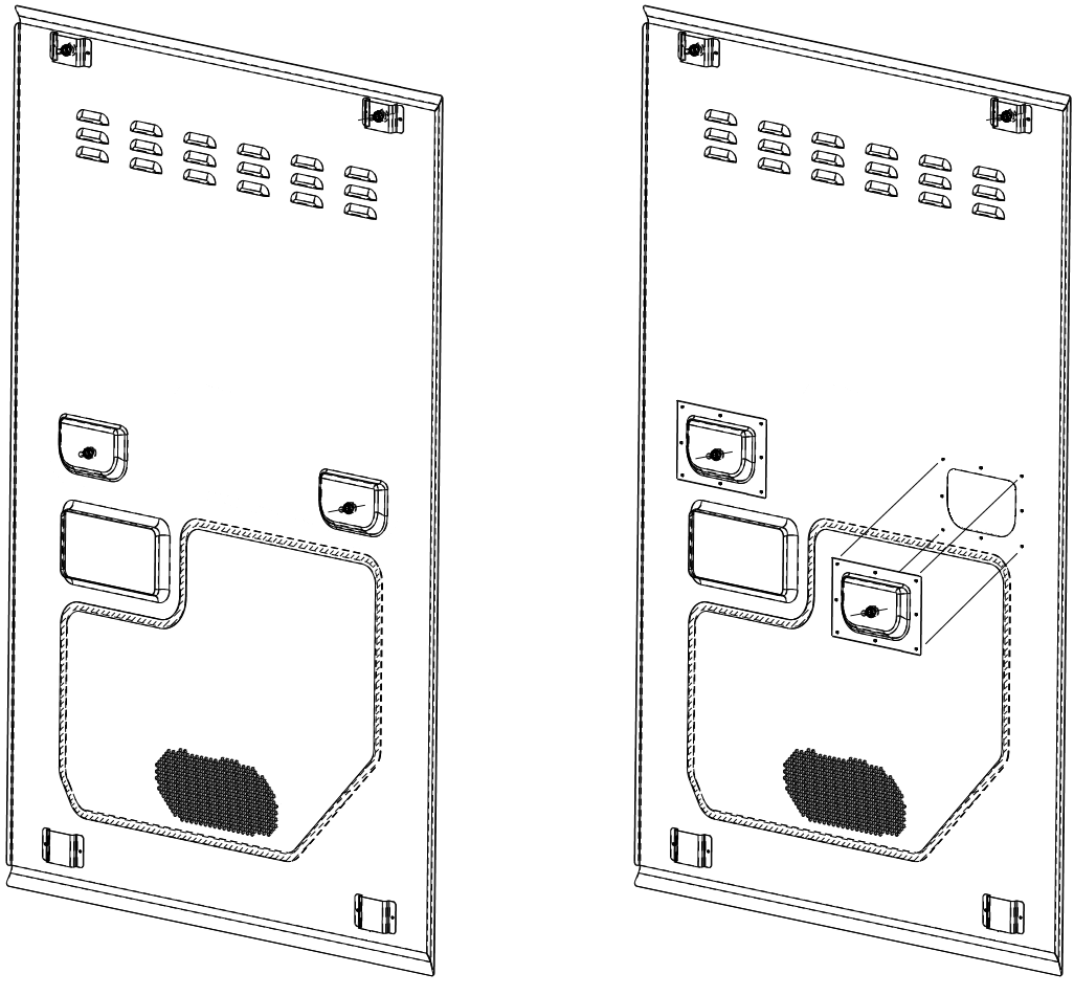

Figure 25 - Right cabinet support, original design (left) and supplier suggested redesign (right) with separate sumps that are secured with pop-rivets

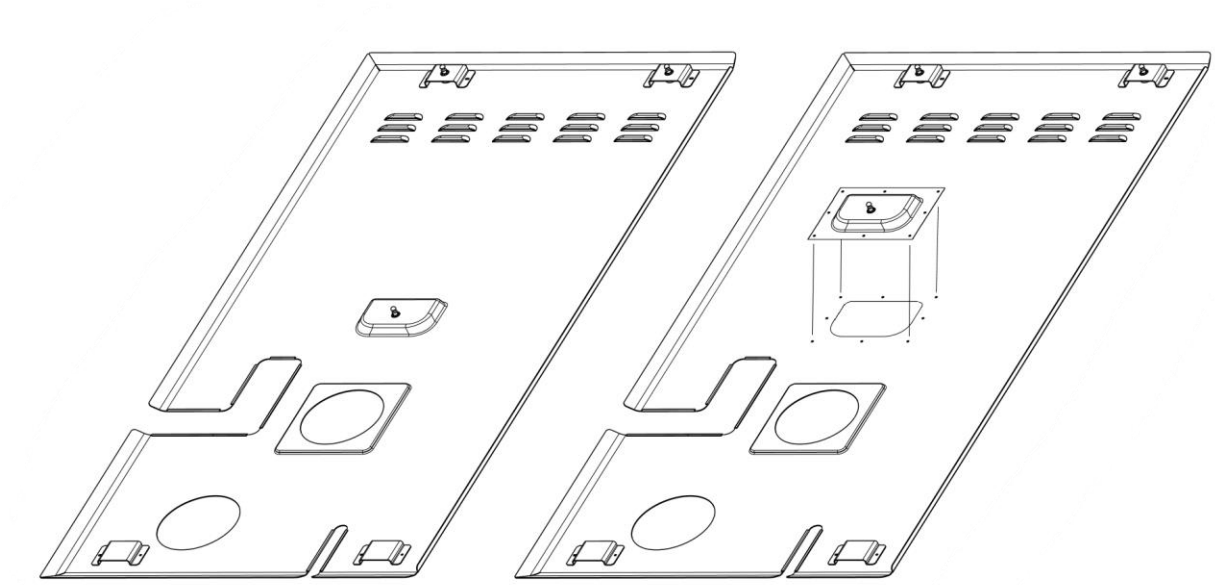

Figure 26 - Left cabinet support, original design (left) and supplier suggested redesign (right) with separate sump that is secured with pop-rivets

Because of my experience with sheet metal stamping, I believed that these sumps could be made without using the more costly separate parts. For this reason, my DFMA cost estimates were based on the use of integral sumps and I also contacted a new supplier for their opinion on that approach. The new supplier agreed on the feasibility and they also provided the New supplier quotes shown in Figure 27. My DFMA estimates match up within 15 percent when compared with the new supplier quotes and resourcing these parts at the new supplier results in a lifetime savings of 430 thousand dollars. The designs with integral sumps are not only reduced in weight because they have no overlapping material but they also provide the end user with improved ergonomics and they require no costly deburring process around the panel holes where the sumps are located.

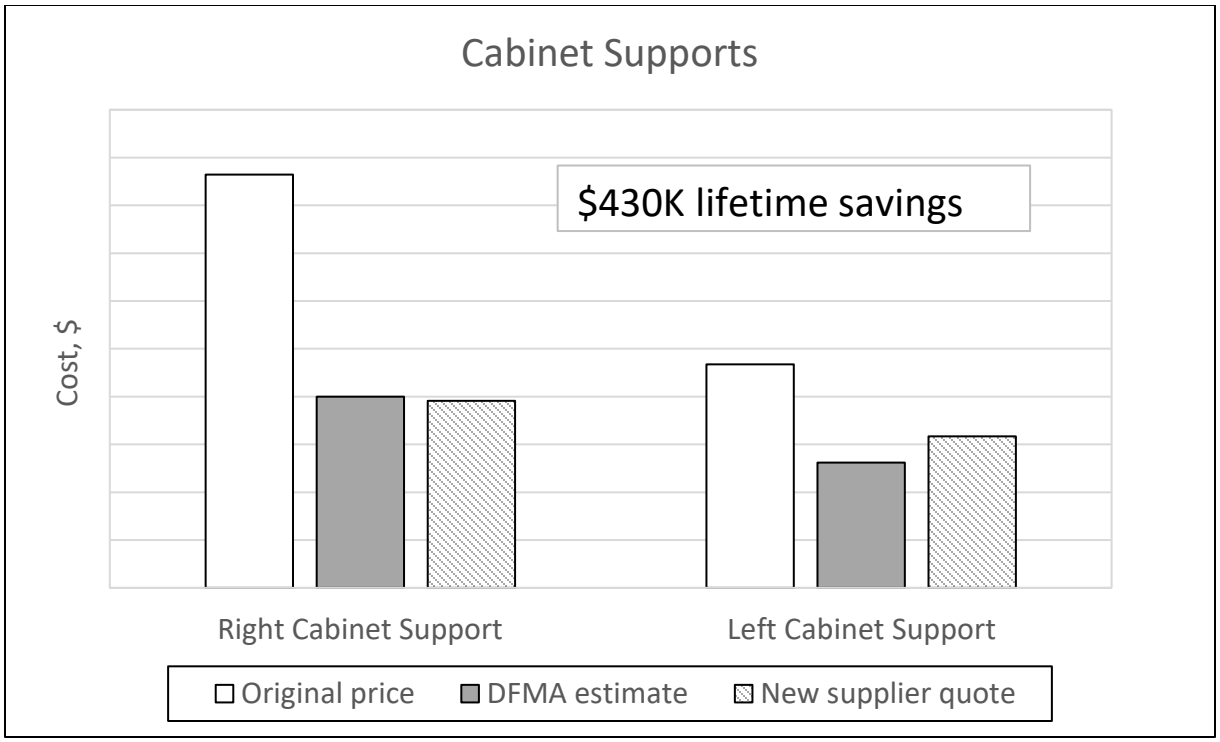

Figure 27 - Comparison of original price, DFMA estimate, and quote from a new supplier for the right and left cabinet supports

Recently, I also did some supplier costing work on the frame plate shown in Figure 28. This frame plate is produced in higher volumes than the previous components, but even so, less than 2000 of them are produced per year. This frame plate is approximately 30 in. square and it is laser-cut from stainless steel sheet stock.

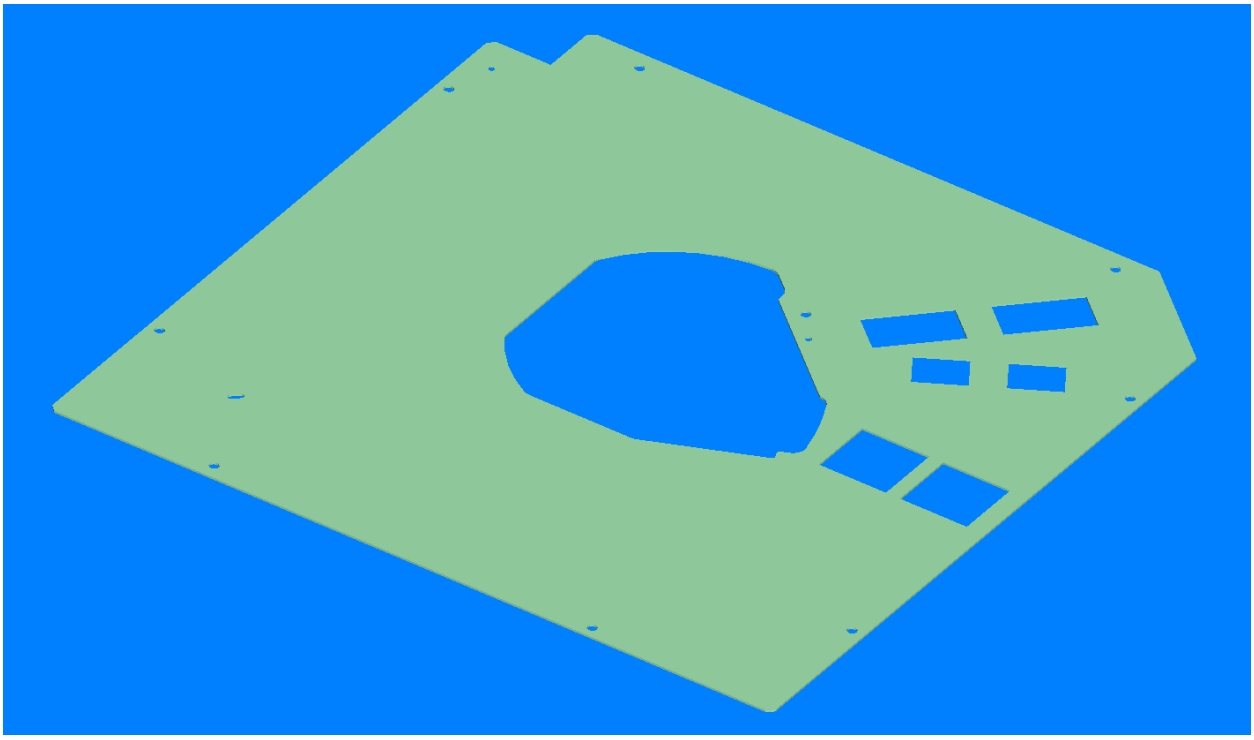

Figure 28 - Frame plate

My DFMA cost estimate for the frame plate is about 60 percent of the original price from our current supplier, as shown in Figure 29. The current supplier refused to negotiate so I contacted a new supplier for the new supplier price quote also shown in Figure 29. The new supplier price quote was 64 percent of the original price from our current supplier. This closely matches my DFMA estimate and gives my estimate quite a bit of credence. Resourcing this frame plate at the new supplier represents a savings of about $320,000 over the lifetime of the program.

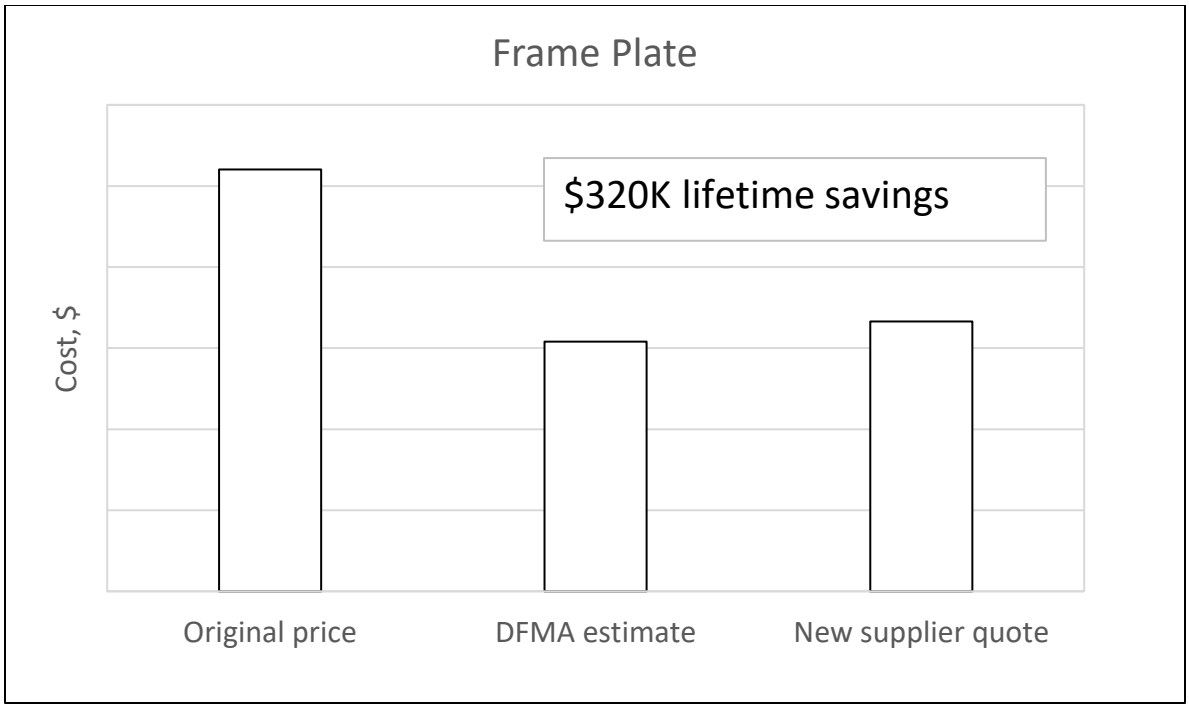

Figure 29 - Comparison of original price, DFMA estimate, and quote from a new supplier for the frame plate

Another recent supplier costing project I worked on involves the waste bin bracket assembly shown in Figure 30. This assembly supports a removable waste bin that is automatically filled by our blood testing equipment as blood tests are completed. The assembly is made from three sheet metal parts that are joined together with 11 pop-rivets and contains four separate PEM hardware inserts. The bracket assembly is produced in low volumes, with less than a thousand produced annually, and it is about two feet long with the individual parts painted prior to assembly.

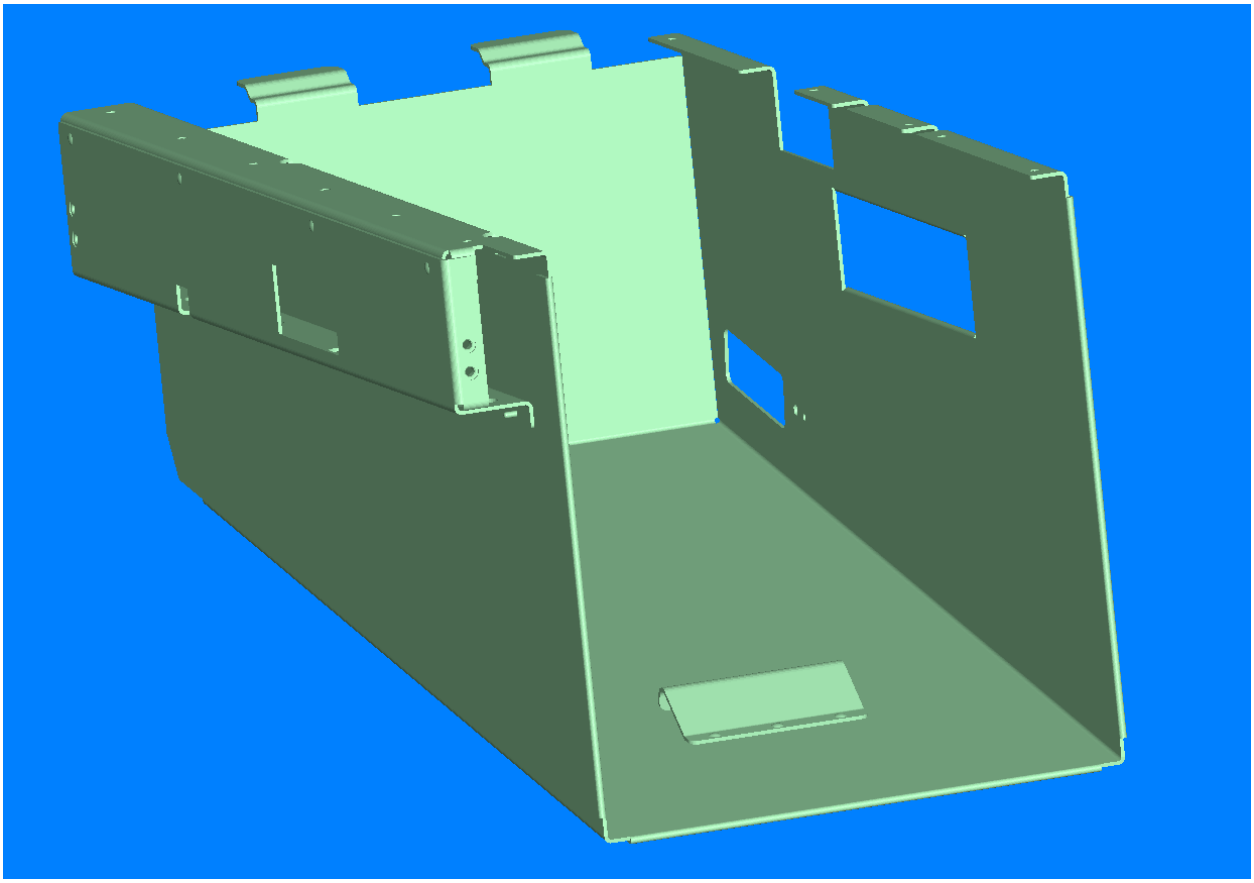

Figure 30 - Waste bin bracket assembly

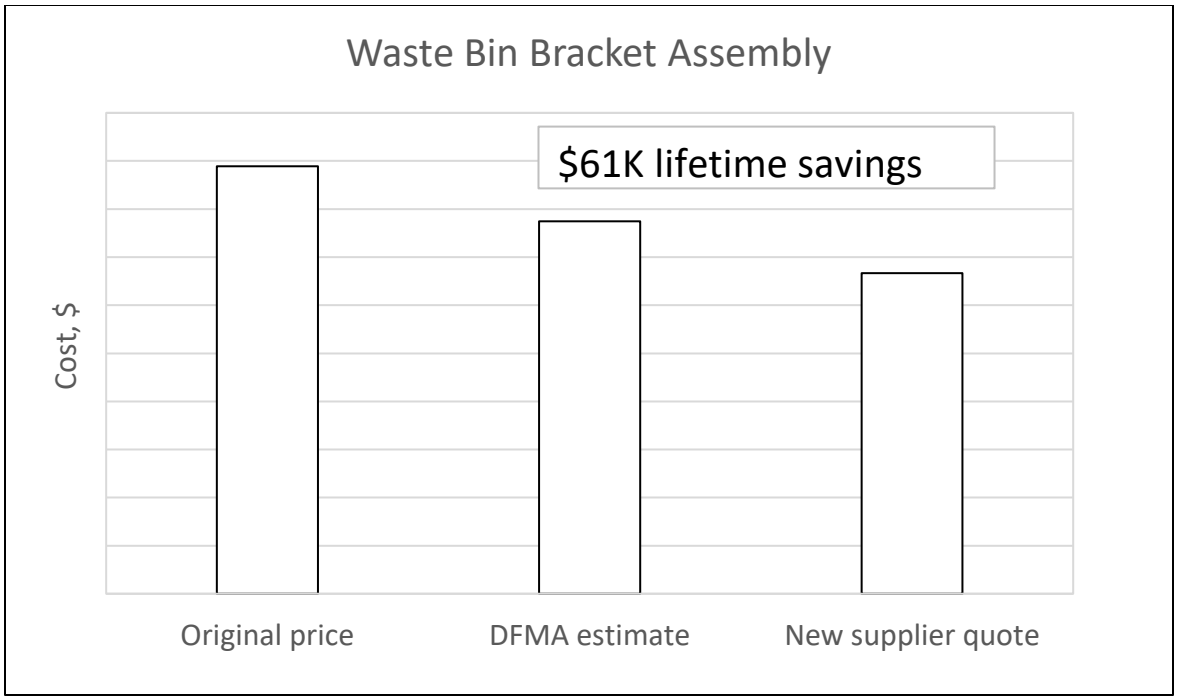

Figure 31 - Comparison of original price, DFMA estimate, and quote from a new supplier for the waste bin bracket assembly

In this case, my DFMA cost estimate for the waste bin bracket assembly was much closer to the original price from our current supplier, with only a 12 percent difference between the two as shown in Figure 31. However, when a new supplier provided a price quote, they beat my DFMA cost estimate by about 14 percent. Resourcing this assembly at the new supplier represents a savings of about $61,000 over the lifetime of the program.

Redesign for cost reduction projects

As my credibility and visibility have increased within our organization, various design teams have consulted with me on redesign for cost reduction projects and one simple example of these projects is shown in Fig. 32. Production volumes for this assembly are low with less than 5000 assemblies produced per year, and designers had difficulty meeting its cost target. The original design of the aluminum bracket is composed of four standard stock pieces which are welded together. My cost reduced redesign, shown in Fig. 33, changes the bracket to a single laser-cut sheet metal part that uses a contour shaped hole to accept the rail precisely. After the rail is inserted through the hole, the two parts are welded together on the reverse side. Using the DFMA software, I estimated that the production cost of my redesign is less than half of the original design's cost which more than meets the established cost target for this assembly.

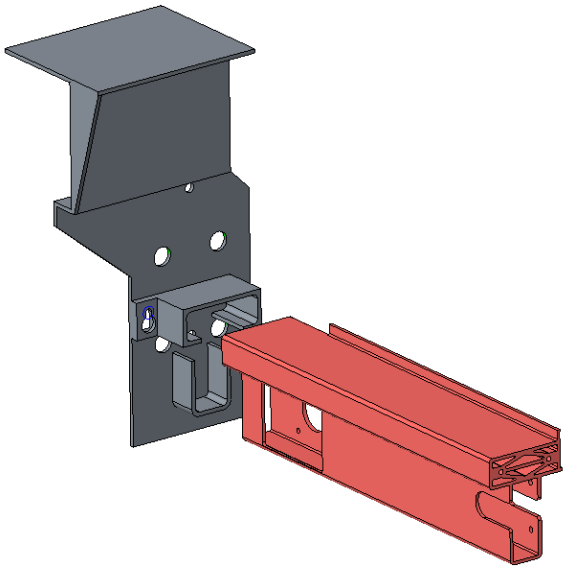

Figure 32 - Original design - bracket composed of four-piece weldment

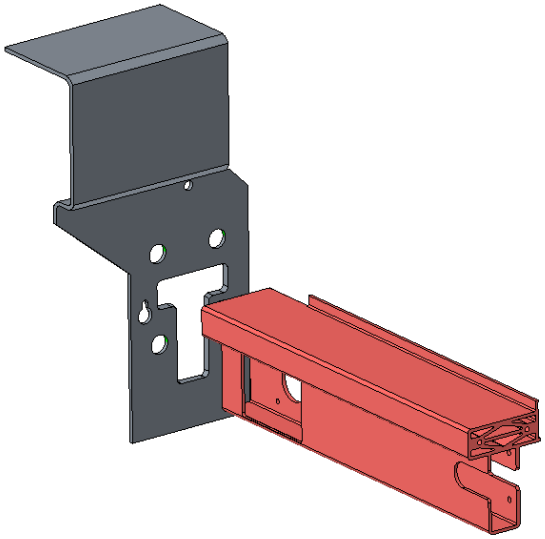

Figure 33 - Redesign that utilizes a cost reduced, single-piece bracket

Conclusions and overall supplier costing results

I started work at Ortho Clinical Diagnostics just about three and a half years ago. During that time, I've completed 38 different supplier costing projects which have been negotiated and resulted in actual captured savings. Each of these projects is similar in scope to the examples described in the present paper. A total lifetime cost savings of 33.7 million dollars has been captured as a result of these projects.

In addition, I've also worked on over 120 supplier costing projects that have yet to be negotiated with suppliers. These projects have all been completed on parts and small assemblies that are produced in low volumes and an additional 9.5 million dollars in lifetime savings has been identified.

These results are particularly impressive when you consider that my work has mostly focused on the low volume side of our business. On average, each supplier costing project that has not been detailed in the present paper has identified a lifetime cost savings of 79 thousand dollars. That may seem like a small annual savings, primarily due to the low production volume of these products. However, when these small annual savings are taken together in total, they add up to significant savings very quickly and the total savings is certainly worth the effort to capture.

In order to be successful with this type of work, you must have confidence in your costing tools and your cost estimates. Frequently, I bet my reputation and my credibility on these tools and my cost estimates. My credibility with suppliers, and within my organization itself, would be lost if my cost estimates were poor or if I was unable to back them up with knowledge and experience. Had that happened at the very beginning of my work at Ortho Clinical Diagnostics, very little cost savings would have been achieved.