Lean Manufacturing

The Real Cost of Tooling

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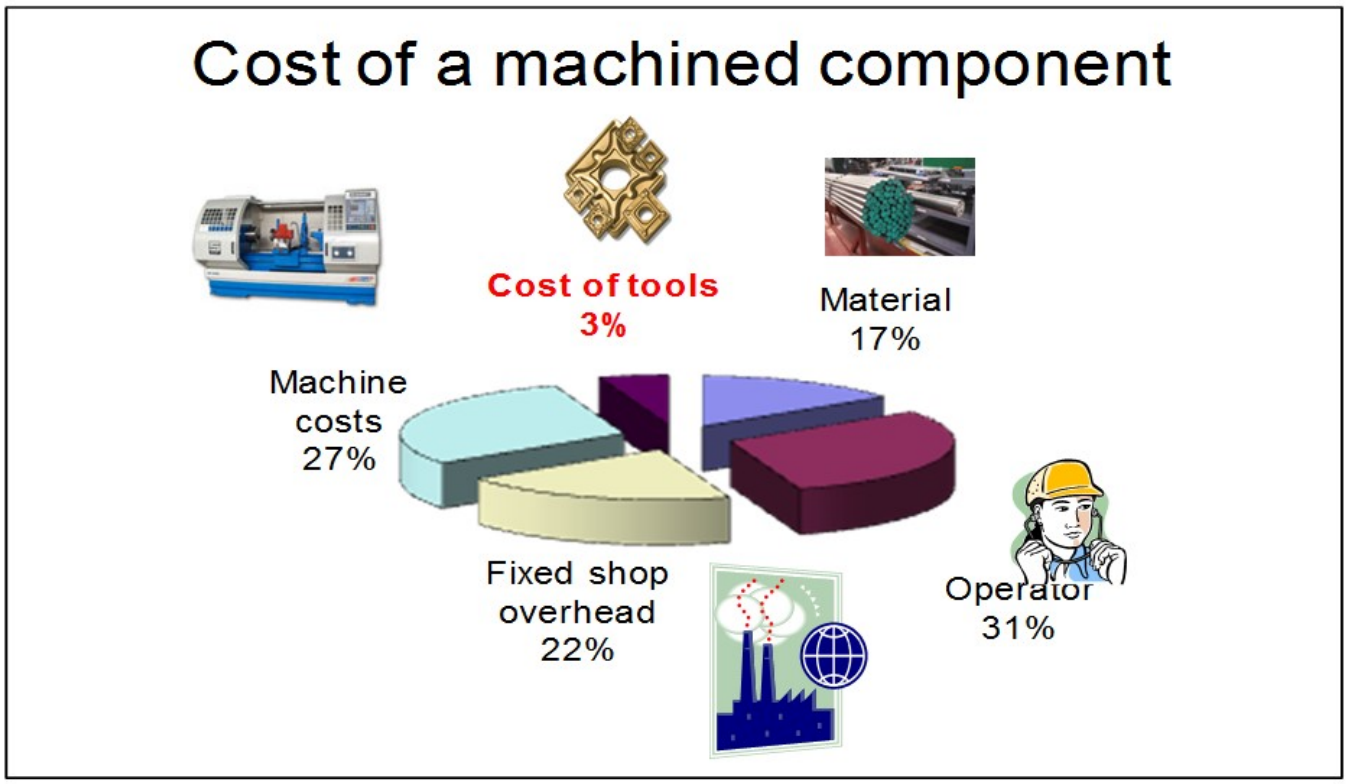
What You Need to Know

Moldmakers are concerned about containing operational costs, especially in today's challenging economic environment.
Studies have shown that labor is the prime input.
Along with tool cost, tool life is usually looked upon as a deal clincher, an obvious and incontrovertible indication of what to buy and what not to buy.

Moldmakers are concerned about containing operational costs, especially in today's challenging economic environment. There is one area, however, where too narrow a focus on cost cutting can end up hurting your bottom line. That area is cutting tools.

To explain why this is the case, let's first take a look at the actual costs involved in producing a part in the metalworking industry (Fig. 1). Studies have shown that labor is the prime input, accounting for 31% of the total cost. Next comes machinery which accounts for 27%, followed by facility and administration – a catch-all category that includes everything from bookkeeping to keeping the lights on – at 22%. Material accounts for 17% of the cost. Finally comes tooling, amounting to a mere 3% of the total cost of producing a part.

Machining Costs Fig. 1



What does this mean to the typical moldmaking shop? Let's say you secured a whopping price cut of 33% in the cost of your tooling. This 33% decrease in price would only reduce the total cost per workpiece by 1%.

The story is similar with tool life. Along with tool cost, tool life is usually looked upon as a deal clincher, an obvious and incontrovertible indication of what to buy and what not to buy. A closer look at the figures, however, tells a different tale. Since tooling accounts for just 3% of the total cost of a part, a 100% increase in tool life only reduces total cost per workpiece by 1.5%.

Clearly, the cost of one cutting tool insert as compared to another is not particularly relevant. This is not to say that cutting tools can't have a significant impact on cost. They can; in fact, they can have a dramatic impact on the cost per part, but this impact is manifested in the way that cutting tools affect productivity, and thus the shop's bottom line.

The lion's share of the cost of a part is a function of time; that is, the time a part spends on the machine tool, the amount of time the machinist must spend to produce that particular part, and the amount of overhead (what we earlier referred to as facility and administration) that is allocated to that part on a time-denominated basis. That's why if you can reduce the time required to produce a part by 20% simply by switching to a more efficient cutting tool you can typically reduce your cost per part by as much as 15% (Fig. 2). It also frees up 20% more machining capacity without any additional capital investment.

Cutting Tool Optimization Example Fig. 2

- **Shop spends $100,000 to manufacture 1,000 parts**
- **Cost is $100.00 per part**

15% = $15,000.00

	Current Cost	33% Tooling Discount	100% Increase Tool Life	20% Process Optimization
Variable Cost				
Tooling (3%)	**$3.00**	$2.00	$1.50	$4.00
Material (17%)	**$17.00**	**$17.00**	**$17.00**	**$17.00**
Fixed Cost				
Facility & Admin (22%)	**$22.00**	**$22.00**	**$22.00**	$17.60
Machinery (27%)	**$27.00**	**$27.00**	**$27.00**	$21.60
Labor (31%)	**$31.00**	**$31.00**	**$31.00**	$24.80
Cost per Part	**$100.00**	$99.00	$98.50	$85.00
Savings - **$'s , (%)**		$1.00 , (1%)	$1.50 , (1.5%)	**$15.00 , (15%)**

Process optimization will also free up 20% additional capacity

What constitutes a more efficient cutting tool? That of course depends on the type of tool you are currently using and on the application, but there are several factors to look at (Fig. 3).

Comparison Fig. 3

Before

- Tool/insert
  - Competitor 4 inch dia.
  - SNMU 1305 CVD grade
- Cutting conditions
  - DOC = (.200"in)
  - SFM = (590 SFM)
  - Feed Rate = (.006" FPT)
- Tool life
  - 4 parts
- Remarks
  - Insert started chipping at 4 parts

Optimized Solution

- Tool/insert
  - 4.00" Dia. 45 degree-lead face mill
  - SNMX 1205 12 F56 CVD grade with special post-coating treatment
- Cutting conditions
  - DOC = (.200"in)
  - SFM = (720 SFM)
  - Feed Rate = (.008" FPT)
- Tool life
  - 16 parts
- Remarks
  - Ran faster smoother, quieter
  - Convince customer based on overall savings versus cost per insert
  - $12 versus $18

Consider the geometry. Often, the primary factor limiting material removal rate is the horsepower of the machine tool. However, some of the newer high feed rate milling cutter inserts feature a more aggressive geometry allowing for freer cutting. This typically takes the form of a lead angle of around 15 degrees. These newer designs permit faster feeds and greater material removal rates without an increase in horsepower.

Tool geometry can also impact chatter. Chatter is often a systemic problem, with insufficient machine and spindle rigidity a frequent contributor, but there is no doubt that tool geometry is a major factor. Because of their freer cutting action, these newer tool designs decrease the likelihood of chatter. Though difficult to quantify, this tends to increase both part quality, specifically in the area of surface finish, and tool life as well.

Consider the coating. This is an involved subject, one that can easily merit an article of its own. However, we will cut right to the chase and focus on a couple of new developments that could have great significance for moldmakers. First, look for roughing grades featuring newer forms of

CVD-Al_2O_3 coating. When combined with newer forms of post-deposition surface treatment, tools with this coating exhibit superior wear resistance and toughness, as well as increased resistance to thermal cracking. This allows the tools to be run at higher speeds, boosting productivity and netting savings in machine, operator and overhead costs. Also, the greater resistance to thermal cracking increases tool life. This decreases tooling costs and, more importantly, it also decreases machine downtime as the machine doesn't have to be stopped as often to change out chipped tooling. As discussed above, this can have significant effects on a shop's bottom line.

Consider the support. Application support can be a major source of productivity enhancement for moldmakers, one that is often overlooked. Although advertising and promotional material can be helpful, and tooling company salesmen can typically provide useful information, when considering a tooling purchase these two sources of information are not enough. Moldmakers should contact the cutting tool company's applications staff. These are the people who should be able to provide you with

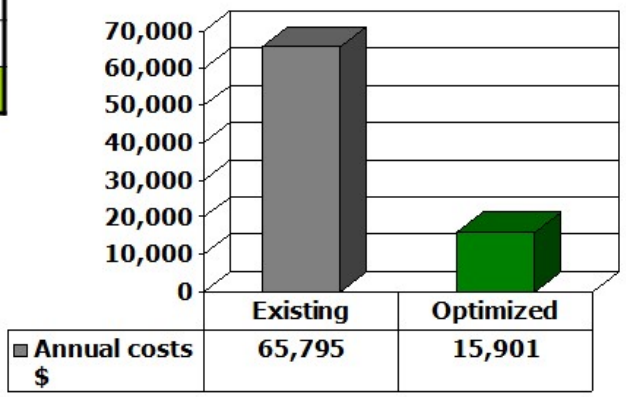
real-world information relevant to your specific applications. After discussing your needs with an applications professional, you will probably wish to test the product in conjunction with that applications pro. Along with imparting information about tooling, a knowledgeable applications pro can sometimes provide you with valuable insight into your overall production process.

These are some of the ways in which the correct tooling can boost your productivity. An optimized savings/profitability scenario is presented in Fig. 4. Regardless of application, the factors discussed all can have a sizeable impact on the bottom line and they all dwarf the cost of the tool itself.

Savings/Profitability Fig. 4

Cutting costs	
Existing	Optimized tool / grade
Tool life/edge: 4 parts	Tool life/edge: 16 parts
Cutting costs/year: $20,280	Cutting costs/year: $7,605
Savings: $12,675	

Machining costs	
Existing	Optimized tool / grade
Hourly rate of the machine = $120	Hourly rate of the machine = $120
6760 pieces/year	6760 pieces/year
2.37 Minutes contact time/piece	.36 Minutes contact time/piece
Machining costs/piece $4.73	Machining costs/piece $.73
Machining costs/year $31,995	Machining costs/year $4,916
Savings: $27,079	



Total saving: $49,894

Key Takeaways

- There is one area where too narrow a focus on cost cutting can end up hurting your bottom line. That area is cutting tools.
- The greater resistance to thermal cracking increases tool life.
- Moldmakers should contact the cutting tool company's applications staff. These are the people who should be able to provide you with real-world information relevant to your specific applications.

Looking for cost savings and productivity improvements? Try our ***Productivity Calculator***.