NCSS
THE SOFTWARE COMPANY FOR COMPLIANT PARTS

CASE STUDY: NC TOOL COMP
5 AXIS CUTTER COMPENSATION WITH TOOL MANAGEMENT

Background

In CNC mill machining, tooling is a significant cost component of the overall process. Each individual shop tries to determine how long a cutter can be pushed before the risk of failure becomes too high. The negative effect of catastrophic failure requires a decision to retire a cutter with usable life still remaining. On a positive note, cutters in good condition are excellent candidates to be re-sharpened with minimal reduction in diameter. If a robust process is put in place that will utilize these undersize cutters a significant cost savings will be achieved. There are 2 risks to be mitigated for undersize cutter usage: human error in identifying the actual tool size at time of application, and a "cutter compensation" system which correctly adjusts the cutter path to match the new size. Attempts to utilize re-sharpened cutters without addressing both of these issues will result in reoccurring instances of non-conforming or scrap parts.

Problem

When cutters are resurfaced, the physical dimension of the tool is changed (usually the diameter). Because of this, an offset (Cutter Diameter Control or CDC) is required to adjust the cutter path in order to continue to produce conforming parts. The traditional CDC methods, machine controller algorithm and reposting of the NC program, have inherent limitations and include significant risk such as:

- Machine Controller Algorithm
  - Algorithm may have errors
  - New cutter paths are not able to be simulated
  - Potential machine crashes due to offsets
  - Potential human error in input of values
  - Increased possibility of escapes to customer
- Repost Method
  - Must be reposted and reviewed for errors
  - May or may not be simulated
  - Time consuming for NC programmer
  - Possible issue with FAI buyoff
  - Prone to errors in coordinating which program to be used
  - Machining paths may change

Program

In collaboration with a major US aerospace parts supplier, NC Software Solutions developed a hybrid process using the Cross Vector Offset Algorithm method in 2006. The solution is a full 5-axis compensation system and the eliminates the inherent risks of the other current methodologies.

In the NC Software Solutions Cross Vector Offset methodology, the machine code is the baseline for offset correction, which preserves the original "centerline" data, FAI integrity, and eliminating human input error through automated inputs. The results are:

- Cross Vector Offset Algorithm
  - Program can be simulated and validated at program release (simulate both high and low cutter size conditions)
  - Dynamic / real time adjustment (no programmer involvement)
  - Infinite sizing of cutter within allowable range (allows more re-sharp cycles)
  - No operator interface or input error
  - FAI integrity is held intact

Results

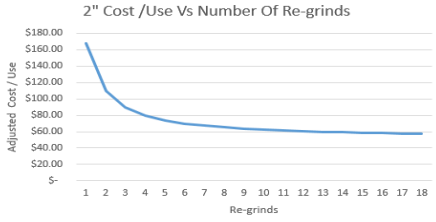
Two of their high-volume cutters included a ¾ inch carbide finishing cutter and a 2-inch Rougher and are the focus of this study. Annually, 7,200 (3/4 inch) and 4800 (2 inch) cutters were projected to be used in the year of implementation.

It was determined that each tool could be resurfaced 11 times, making a total of 12 "uses" per purchased tool although in some machine / material instances, tools were only resurfaced 4 times, yielding 5 "uses".

As indicated in the table below, a 56-65% savings in the tooling expenditures was realized over a 12-month period.

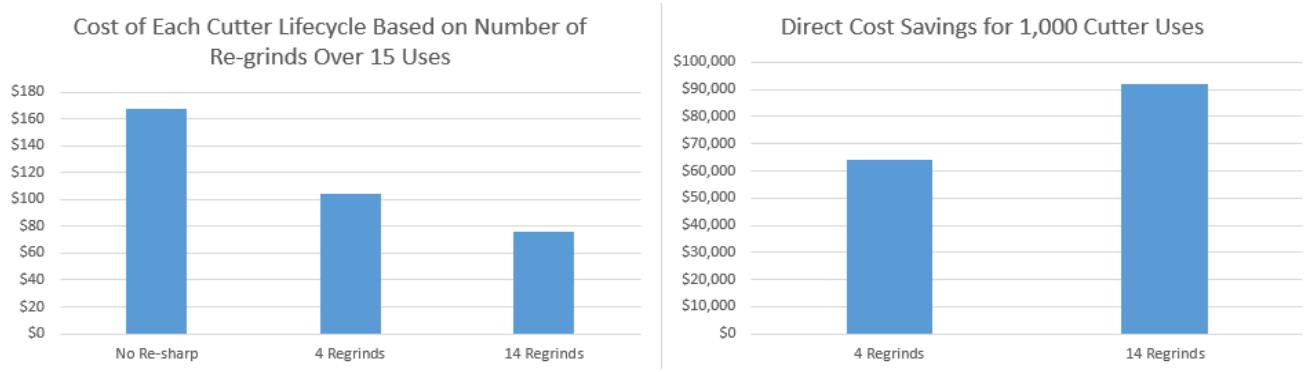
	Not Using Re-sharps			Using Re-sharps				
	Cost	Used / Yr	Cost	Re-sharp Cost	# of Uses	Adjusted Cutter Cost	Cost/Yr	Savings
3/4 Dia x 2" Flt Carbide EM								
4 Re-grind Cycle Life	$ 122.00	7200	$ 878,400	$ 36.60	4	$ 53.68	$ 386,496	$ 491,904
11 Re-grind Cycle Life	$ 123.00	7200	$ 885,600	$ 36.60	11	$ 43.80	$ 315,360	$ 570,240
2' Dia x 4"Flt Rougher								
4 Re-grind Cycle Life	$ 168.00	4800	$ 806,400	$ 50.40	4	$ 73.92	$ 354,816	$ 451,584
11 Re-grind Cycle Life	$ 169.00	4800	$ 811,200	$ 50.40	11	$ 60.28	$ 289,360	$ 521,840

Regrinding cutters is not a linear in cost savings. As the graph below indicates, the cost of a new cutter is quickly absorbed in 3-4 re-sharp cycles then begins to level off. View the chart as anything above the curve shown is direct cost savings of that amount at each instance. Primary factors in the calculation are initial cost versus re-sharp cost.



Example of Cost Savings:

Using the 2” rougher mentioned above, the chart at left below displays the actual cutter cost compared to how many re-sharp cycles are achieved. The chart at the right defines the amount of cost savings per each 100 uses of the cutter.



Notes on findings:

1. In most cases NCSS would recommend only using the system on high use expensive cutters, which considerably streamlines the initial implementation phase
2. This study only includes two of many cutter types used at the facility. Some cutters are not good candidates for re-grind due to the type of the cutter or if the cost to replace the cutter is negligible to the cost of re-sharpening it.
3. In the re-sharpen cost there is normally a volume discount (cost / re-sharp reduces as volume goes up), which would increase savings.

Other Benefits

To properly install and run an autonomous Cutter Diameter Compensation system a comprehensive tool management system must be in place, which NCSS has developed to complement the CDC system.

The added benefits of this system are:

1. Tool life management
2. Elimination of operator input error
3. Elimination of incorrect tool (any type) being run.

Offer

NCSS has developed implementation plans to fit your facility needs. One of which is for NCSS to install our NC Tool Comp with TAC solution in your facility with low upfront costs and we’ll maintain it for only a fraction of your actual realized tooling savings.

Get with your NCSS representative today to see if you qualify.