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BY KEITH JENNINGS

Machine shops as immigration agents

For several months now, U.S. job shops and other employers have been adjusting to more stringent employment laws, especially ones regarding illegal immigrants in the workforce. Regardless of their views on immigration, shop owners and managers have an obligation to ensure compliance with labor and immigration laws.

Throughout U.S. history, politicians tended to "correct" problems and proudly take credit for their "hard work." In many cases, the remedy is nothing more than passing the burden to employers, requiring them to engage in a tremendous amount of non-revenue-generating activities, such as the collection of taxes and immigrant screening, to name a couple.

Manufacturers handle these tasks with a reasonable degree of efficiency, but they shouldn't be their responsibility. However, manufacturers are held accountable if they fail to adhere, even though they're supposed to be producing products and not scrutinizing an employee's legal status. After all, wasn't the Immigration Reform and Control Act of 1986 (Simpson-Mazzoli Act) supposed to have reformed U.S. immigration law? That legislation made it illegal to knowingly hire or recruit illegal immigrants, required employers to attest to their employees' immigration status and granted amnesty to illegal immigrants who entered the U.S. before Jan. 1, 1982, and resided in the country continuously.

Now, 20 years later, the U.S. Congress and state legislatures are once again "fixing" laws that are already in effect, but, obviously, not well enforced. With national security matters being what they are, though, it's impossible to expect the government to handle this enforcement burden without assistance from employers, who are part of the system—like it or not.

Our company outsources payroll responsibilities. Earlier this year, after getting a couple of calls from the payroll company emphasizing the importance of employment screening, we agreed to a meeting to ensure our company was screening and hiring in compliance with the new laws. The meeting was an eye-opening session about our responsibilities. It became obvious we had to make sure we were hiring only legal employees.

There was also some concern that we could be held liable for some goofy paperwork snafu and potentially end up in court defending ourselves, even though we've always obtained copies of driver's licenses, Social Security cards and any other required identification. Wasn't this enough? How were we supposed to guarantee an employee was really legal? In the end, we were told, "It's your responsibility and here are some tools to help." So, another government function has become part of our hiring routine.

Ultimately, there's no foolproof way to screen employees and guarantee they have a legal Social Security number and proper identification. The good news is the U.S. government wants to see a consistent application of employee verification, knowing that occasionally there can be a mistake. As long as the employer is able to show a consistent pattern of hiring, screening and ID checking practices, a company probably won't be liable for employing a worker who turns out to be illegal. The exact response may vary from state to state, so it's advisable to get legal counsel to ensure compliance.

As far as available resources for the screening and validation process, the tools are often accessible on the Internet. They offer a way to confirm a company's due diligence on the matter and go a long way towards avoiding legal trouble. One good way is to access the Social Security Administration's Business Services Online pages at www.socialsecurity.gov/bso. This service is available at no charge to private businesses as a way to verify an applicant's Social Security number according to name and birth date. I found out about it from our payroll company, which instructed me to use it fairly and consistently to verify potential employees' identification.

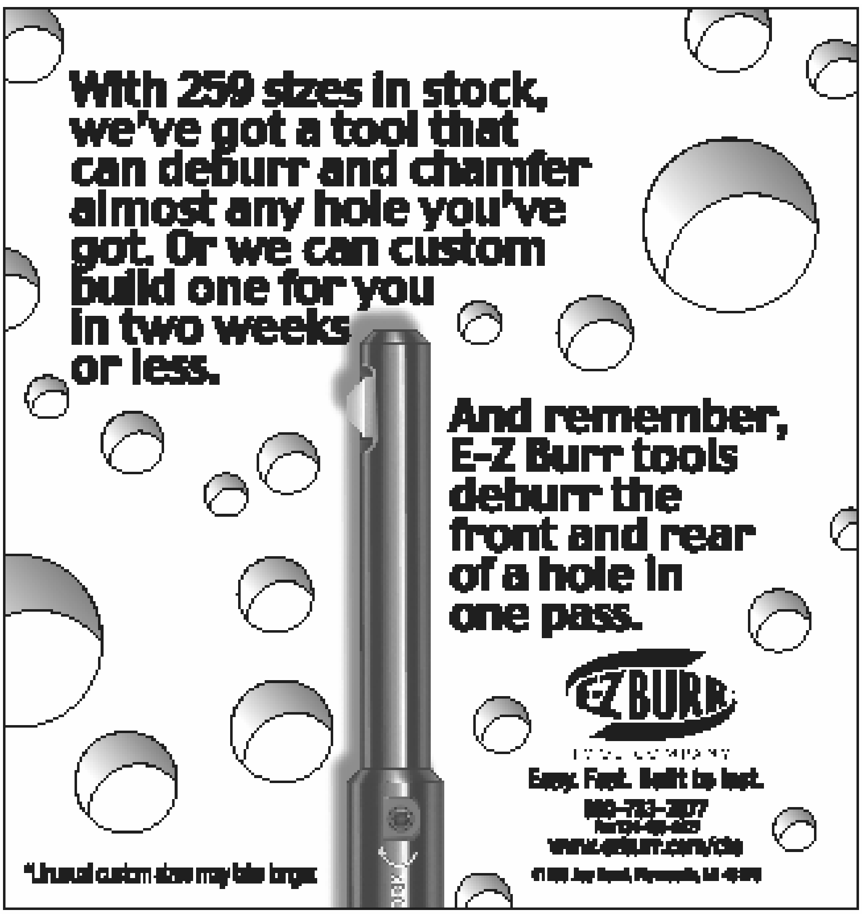
Before the service can be accessed, the employer must go through a secure online registration process. It then takes 2 weeks to receive the login information via mail. This is the government's method to ensure only legitimate businesses use the service.

If the verification check results show that a name and number do not match, this does not necessarily mean the person is illegal. There could be a data-entry error or other discrepancy that's not an applicant's fault. If a discrepancy is possible, the Social Security Administration instructs a business to tell the applicant to go to the local Social Security office and explain the discrepancy. The office will correct the data or should provide a letter that confirms the visit and authorizes employment until the matter is resolved. However, illegal immigrants will not voluntarily go to any government agency. They most likely won't be back at your shop either.

Whether manufacturers like it or not, we are now part of an enforcement system that was largely already on the books. It's unfortunate because most immigrants, legal or otherwise, like the U.S. and want to be loyal, hard workers. Nonetheless, you need to do your part and keep records to prove you are doing what the politicians have required. After all, they "fixed" the problem.

About the Author

Keith Jennings is president of Crow Corp., Tomball, Texas, a family-owned company focused on machining, laser cutting, metal fabrication and metal stamping. He can be e-mailed at kjennings@jwr.com.



Orthogonal chip formation

BY DR. LAROUX K. GILLESPIE

Understanding what is happening as the chip is formed helps solve many machining problems.

The simplest form of metal removal is orthogonal cutting, where the tool's cutting edge is perpendicular to the direction of feed. Any side cutting edge angle other than zero is nonorthogonal cutting.

The chip produced is as much as five times thicker than the DOC, and the chip length is always less than the length of the uncut chip, or chip that's not yet removed from the parent material, by the cutting ratio determined via the equation:

$$r = \frac{t}{t_c} = \frac{l_c}{l}$$

where t is DOC, t_c is chip thickness, l is length of uncut chip and l_c is length of cut chip.

Orthogonally cut chips are classified as continuous, continuous with built-up edge, continuous serrated (or segmented) and discontinuous.

Continuous chips when cutting ductile materials indicate that cutting forces and temperatures are low, fine surface finishes are being imparted and tool life is long. "Continuous" means the cutting action is a steady, smooth process. Chipbreakers often take all three variations of continuous chips and break them into manageable sizes for disposal and to prevent damage to the part and tool. Because the process at the cutting edge is producing a continuous chip that is broken only after the chip leaves the face at the cutting edge, even chips with a "6" shape represent a continuous cutting mode.

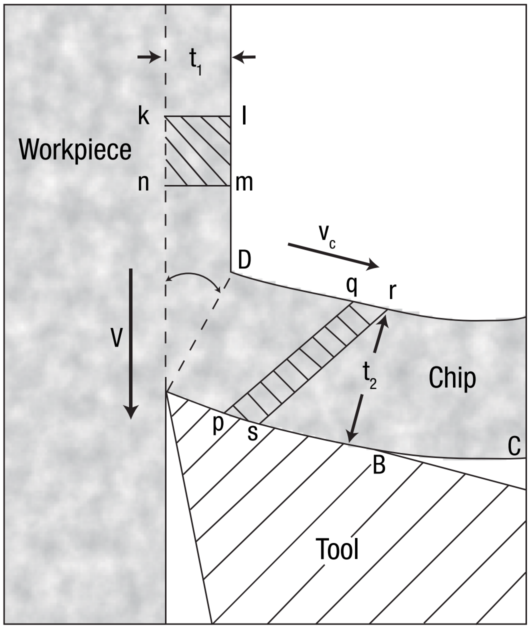
Chips are continuous, including segmented, when machining 4340 steel. In 4340, the chips are smoother and more continuous at higher speeds and low workpiece hardness. Segmented chips are more common as hardness increases. Segmented chips appear like a stack of playing cards arranged in a continuous pile. The chip forms through a series of slip-stick-type actions. The chip may come off the workpiece in a long ribbon, but the multitude of small, ragged steps identifies the chip as segmented. As cutting speed increases, the separation of the segments is more pronounced until complete separation of the segments occurs.

Continuous chips with BUE often occur when cutting ductile materials at slow speeds. BUE is the principle reason for rough finishes, and it also shortens tool life and creates higher than necessary cutting forces. Splotches of BUE material are present on the chip's back side and on a part's diameter. BUE will not form when the cutting speed exceeds a critical rate for a workpiece material. Large rake angles, light feed rates and smooth, sharp cutting edges also help eliminate BUE.

Discontinuous chips are produced when machining cast iron, cast brass and most brittle materials. They also form in some ductile materials when cutting at low speeds and high feed rates. Titanium is one material that typically results in discontinuous or segmented chips, even at normal cutting speeds.

Negative rake angles produce discontinuous chips more frequently than large positive angles. For many materials, the chips go from discontinuous to continuous as the rake angle increases from -10° to 30°. The angle at which the change occurs depends upon workpiece material properties.

When cutting very hard materials at very high speeds, the chip cannot dissipate the energy it can during more conventional machining and chips revert to segments. For example, 4340 steel cut at a 0.020-ipr feed rate with a tool having a -5° rake angle starts to produce segmented chips at a cutting velocity of 1,600 sfm. At a hardness of 50 HRC, segmented chips occur at 320 sfm. Increasing the cutting velocity above these speeds will produce segmented chips.



ASME International

An example of orthogonal chip formation.

Image key:
- **V** velocity of work past cutter
- **t_1** DOC
- **t_2** chip thickness
- **klmn** unit of material to be cut
- **pqrs** unit of material after cutting
- **B** last point at which chip touches tool
- **D** front of shear zone
- **C** point where chip has left tool

About the Author

Dr. LaRoux K. Gillespie has a 40-year history of precision manufacturing and deburring. He is the author of 11 technical books and 200 technical reports and articles on precision machining. He can be e-mailed at laroux1@myvine.com.

Flying solo

BY BILL KENNEDY, CONTRIBUTING EDITOR

At DSO Machining & Consulting Inc., a one-man shop in Cohoes, N.Y., Kevin Orr designs, programs and machines prototype and aerospace parts. Orr continually finds ways to run his parts with minimal attention but maximum reliability and quality.

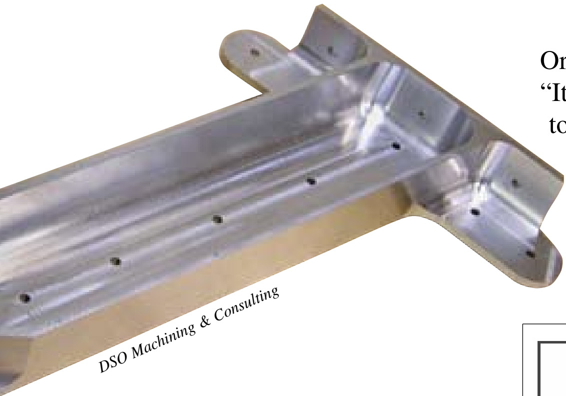
For an aluminum aircraft structural part, Orr designed quick-change workholding, chose tooling and wrote an NC program that enables him to perform most of the machining untended while processing two parts at a time.

The part itself can be described as a weight-loss success story. The part begins as a 10½"-long × 5"-wide × 2½"-thick piece of 7075 aluminum bar stock weighing 13 lbs., 5 oz. When completed, it features complex contours and holes and weighs just 10 oz. The process makes a lot of chips. "Two parts fill a barrel," Orr said.

The parts are replacements for forged components that were designed before CAD models became commonplace. Orr used the customer's 2-D drawings and created a model in Pro/Engineer. He programmed the part in Pro/NC and machines it on a Fadal 3016 FX vertical machining center.

In the first machining operation, Orr clamps the stock in a vise and face-mills the 5"-wide side flat and square with a Seco 2"-dia., square-shoulder facemill. The cutter is tooled with five inserts and runs at 8,800 rpm, a 200-ipm feed rate and a skim DOC. In the same clamping, Orr drills and taps four ¼-20 holes at the part's corners.

The holes are part of a workholding setup to permit untended machining and speed part changeovers. Orr made fixture plates with countersunk holes that match the holes in the part, and he uses ¼-20 bolts to mount one part on each plate. Jergens quick-change, ball-lock clamping units attach two plates



The NC program, workholding and tooling employed to machine this 10½"-long 7075 aluminum aerospace component were engineered to maximize precision and reliability while minimizing operator intervention.

at a time to a tombstone that mounts on the VMC's rotating full 4th axis. In addition, the machine is fitted with a Renishaw tool probe that checks each tool after it runs to assure the appropriate tool is there to machine the next feature.

Orr rough profiles the part on the tombstone with the 2"-dia. facemill at the same feed and speed as used previously, but at a 0.100" DOC.

Next, Orr performs rough, semifinish and finish profiling and pocketing with a Mitsubishi BXD 1"-dia. square-shoulder endmill tooled with two coated inserts that have 3⁄16" corner radii.

When roughing, the through-coolant cutter runs at 15,000 rpm, 285 ipm and a 0.200" DOC. Orr said he employed the Pro/NC roughing feature that produces a constant load on the tool. "The tool kind of zigzags across the part," he said.

For the finishing passes, the feed is 200 ipm, and the DOC is 0.010".

Next, Orr confronts some of the part's more challenging aspects. Because the component was originally a forging, its walls taper 1° or less to provide the draft required for the forging process. Although the part is relatively small, some pockets are 2" deep. Walls are as thin as 0.100" and feature corner radii. Most tolerances are ±0.005", but the true position tolerance is 0.003" on some of the holes.

To mill the small, precise details, Orr first applied a ⅜"-dia. ball endmill. "It didn't work," he said. "It chattered too much." To boost tool rigidity, he switched to a ½"-dia., 3-flute, 45° helix, uncoated, solid-carbide endmill from YG-1. Because he had to generate a ¼" inside radius and a 3⁄16" bottom-fillet radius, Orr had 3⁄16" radii ground on the tool corners. "I couldn't find ½"-dia. endmills with corner radii larger than ⅛"," he said. The endmill runs at 11,000 rpm, 250 ipm and a 0.010" DOC.

Orr then drills 11 small rivet holes. After spotting them with a Keo ¼"-dia. spotting HSS drill, he runs a 0.098"-dia. HSS drill with flood coolant at

4,000 rpm, 10 ipm and about 0.150" deep. The holes eventually become through-holes, Orr explained, because the first-operation facemilling leaves material on the part that is later milled away.

After the part is rotated 90°, Orr cross-drills a ⅝"-dia. hole with an HSS drill and circular-interpolates it to a 0.688" diameter with a Duramill 3/16"-dia. carbide endmill run at 10,000 rpm and 15 ipm. Orr said he interpolates the hole because a drill wouldn't be able to hold the required 0.003" true position tolerance, and boring would take too long.

For the two parts on the tombstone, the first set of operations on the 4th axis takes about 4½ hours, with the 2"-, 1"- and ½"-dia. mills each consuming about a third of that time. Orr noted that he can work on other things during this set of untended operations.

The 4th axis then comes off the machine, and the part is clamped in a vise on the table. The 2"-dia., square-shoulder mill machines the first side of the part again to bring the part to its final 2¼" thickness. The 0.098"-dia. holes become through-holes at this time. Then, with a Niagara ¼"-dia., solid-carbide endmill run at 15,000 rpm, 500 ipm and a 0.008" DOC, Orr machines a 33" radius, which has a 6° taper, on one end of the part.

For an aluminum aircraft structural part, Orr designed quick-change workholding, chose tooling and wrote an NC program that enables him to perform most of the machining untended while processing two parts at a time.

In a final set of operations, Orr again clamps the part in the 4th axis. He drills a 0.487"-dia. hole and reams it to 0.500", +0.001"/-0.000", with a Yankee ½"-dia. HSS reamer. The hole passes perpendicularly through the 0.688"-dia. hole made earlier. To complete the part, Orr drills three more 0.098"-dia. rivet holes, rotates the part 170° and drills another three through the tapered radius machined earlier.

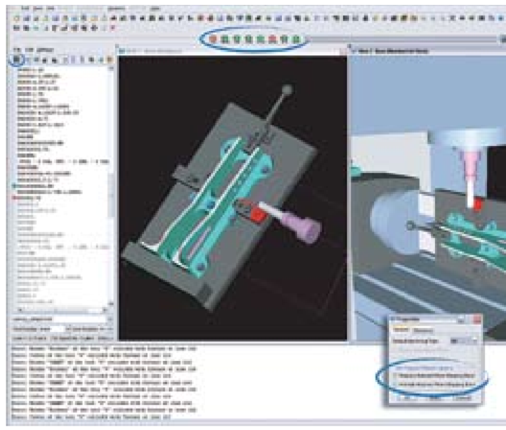
Orr deburrs each part by hand and inspects every one, checking true positions on a surface plate using gage blocks and a test indicator. The recurring job is generally run in lots of 30.

For more information about DSO Machining & Consulting Inc., call (518) 237-2900.

Reviewed, improved

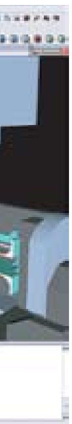
CGTech, Irvine, Calif., recently released VERICUT Version 6.1. VERICUT simulation and verification software allows machine shops and manufacturers to simulate machining scenarios, including multiaxis and rapid motions, multiple setups, complex tool shapes, holder collisions, fixture collisions, machine kinematics and complex controller functions. It can verify output from CAM systems, allowing users to check toolpaths generated from these systems as well as post-processed or manually programmed G codes. VERICUT can simulate entire NC programs to check for collisions and compare cut parts with the original design model.

In Version 6.1, NC program review is now integrated in VERICUT's main desktop. An icon button in the NC program window switches modes between the info display and the review display. When in review mode, the user can navigate backwards from the last NC program line simulated. Error messages and NC program text is highlighted when a collision on the stock or fixture is detected. Entering review mode adds step-backward and play-backward buttons to VERICUT's other VCR buttons. The existing step, play, rewind and reset buttons also change to interact in review mode, providing navigation through the NC program.



A new logger display (see text above, left) shows messages in a scrolling list. Messages are organized by category. When stepping or playing backwards, the machine can now be animated (see Windows menu above, right). When this option is selected in the properties dialog, VERICUT stores the machine locations for backwards animation. Additional VERICUT status lights indicate activity during simulation (see toolbar above, top).

Optionally, material can be replaced while stepping backwards and then removed again while stepping forward, providing the ability to identify and evaluate problem areas. Both machine and profile views are now active in review mode. Synchronized subsystem simulation (such as for multichannel



CGTech

controls) can also be displayed in review mode.

The AUTO-DIFF constant gouge check can now optionally check for a minimum amount of excess material relative to the design model. This is typically used where roughing cuts should leave a specific amount of material for subsequent machining. AUTO-DIFF profile has been improved to give better results on large and complex profiles where the design and cut stock models are nearly coincident, according to CGTech.

MDI dialog has been enhanced to include axis-jog buttons and tool positioning by graphical picks. This can be especially useful during planning. Using the MDI controls, the user can ensure that the machine's tools can reach all the necessary part features.

Encrypted machine and control files may be optionally created and used. The encrypted files cannot be modified. Menu features have been reorganized so project-specific settings and machine/control-specific settings are clearly separated. When using encrypted machine/control files, the machine/control configuration menus are disabled. The user can also remove the machine/control configuration menu from VERICUT's main menu bar. These changes allow sites with multiple VERICUT users and machine configurations to better manage their machine simulation environment.

Turning tools with multiple inserts are now supported. Each insert's position is checked for valid turning orientation and must lie in a valid turning plane before it will cut. Checking of cutting limits (added in 6.0) has been enhanced to include minimum and maximum rpm values.

VERICUT's CAD/CAM interfaces allow verification of NC programs from within the user's CAD/CAM system. The user can verify individual operations, a series of operations or a set of complete NC programs. All stock, fixture and design geometry is automatically transferred to VERICUT in the correct orientation, along with the NC program, tooling, machine and control data and other simulation parameters. Also, the following CAD/CAM interface updates have been made in 6.1:

- Unigraphics interface—merges tools from the UG session with tools in the template project file's tool library.
- CATV interface—CATIA Version 5 users can choose how to apply the part operation's machining axis in their VERICUT simulations by selecting the offset table (program zero, work offset, etc.) and relationship to the machine (tool, rotary axis pivot, etc.). CATV allows the user to select sketch geometry used to define tool shapes in CATIA. This geometry is then used to create tools in VERICUT. CATIA length units (inch or millimeter) are now automatically detected and set in the VERICUT session.

Next!

BY MICHAEL DEREN

The higher a person's position in a company, the more authority he or she has. But that rule is set in air, not stone. A manager or officer can soon find his authority gone if he's undercut by his superiors or co-workers. Undercutting typically occurs if he tries to change how a company operates.

Shortly after I started at a company not too long ago, my fellow employees told me the engineering manager wasn't going to last long. He had only been on board a few months before he hired me, and he was engineering manager No. 15 in the last 17 years!

During the interview process, I had thought the engineering manager brought a certain amount of professionalism to the company and looked forward to working for him. Alas, that was to be short lived. About 4 months later, he was gone.

What happened? He was an effective manager, delegating responsibility, assigning projects and instituting brief staff meetings. He stood up for his engineers and the work they did. He also had some sound ideas to help the company advance. One of them was establishing engineering as the company's driving force, but manufacturing wasn't going to tolerate that. When he started, he didn't realize he had an uphill battle in front of him. The odds were stacked against him in the form of the same guy who hired him—our vice president.

During the 4 months I worked for him, I could tell he was becoming a beaten man. He went from a cheerful and positive individual to one without any motivation. On the upside, when he left our organization, he took a position as a company director elsewhere and was reportedly quite happy. If I'm not mistaken, it was at the same company he previously left.

So where did that leave our engineering department? For the first couple of weeks, we were adrift. Then the V.P. decided to take control of engineering, which was not a good thing for several reasons. First, he was also in charge of manufacturing. Now, manufacturing was going to drive the engineering department. He also loved meetings. Some of us had meetings at least twice if not three times a day! How did we get anything accomplished?

What made matters worse was he would assign the same tasks and projects to several different individuals. What's wrong with that? These individuals didn't know the others were working on the same thing. I guess that was his way of ensuring something he assigned would get done. Or was he just forgetful?

He also liked to not pass along information from customers to the engineer on record. So here I am, asking a question the customer already addressed. Talk about looking foolish! I couldn't complain though; the V.P. was good about giving me merit pay increases. After about a year, though, he was stretched to his limits and finally decided to hire a new engineering manager.

It took a while, but when he did find someone, everyone wondered what the new manager was going to be like. He was a former college instructor with years of manufacturing experience. He came from a large organization and loved all the buzzwords: Gantt charts, failure-mode and effects analysis (FMEA), 5S (sorting, simplifying, sweeping, standardization and self-discipline), root-cause analysis and poke-yoke (error proofing). His first act was to get Microsoft Project so we could create and live by our Gantt charts.

The higher a person's position in a company, the more authority he or she has. But that rule is set in air, not stone.

We had FMEA meetings two or three times a week. Now, these meetings involved not only office staff, but shop personnel as well. This took production time away from the shop, which went over like a lead balloon. These meetings lasted for about 3 weeks before the shop people refused to attend.

It didn't take him long to find problems at the facility, either. In most instances, new managers can find a treasure trove of things to improve at a company, especially when moving from a large corporation to, basically, a mom-and-pop shop because smaller companies are rather informal and not nearly as bureaucratic.

Predictably, the new manager faced resistance from some of the other managers. FMEA and root-cause analysis showed where the problems were in the company. In addition, Gantt charts showed where the bottlenecks were in the various departments. The finger pointing began.

I knew it would just be a matter of time. Soon we were making wagers as to when our new boss would pull the plug and follow his predecessors. He lasted less than a year. Next! △

About the Author

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