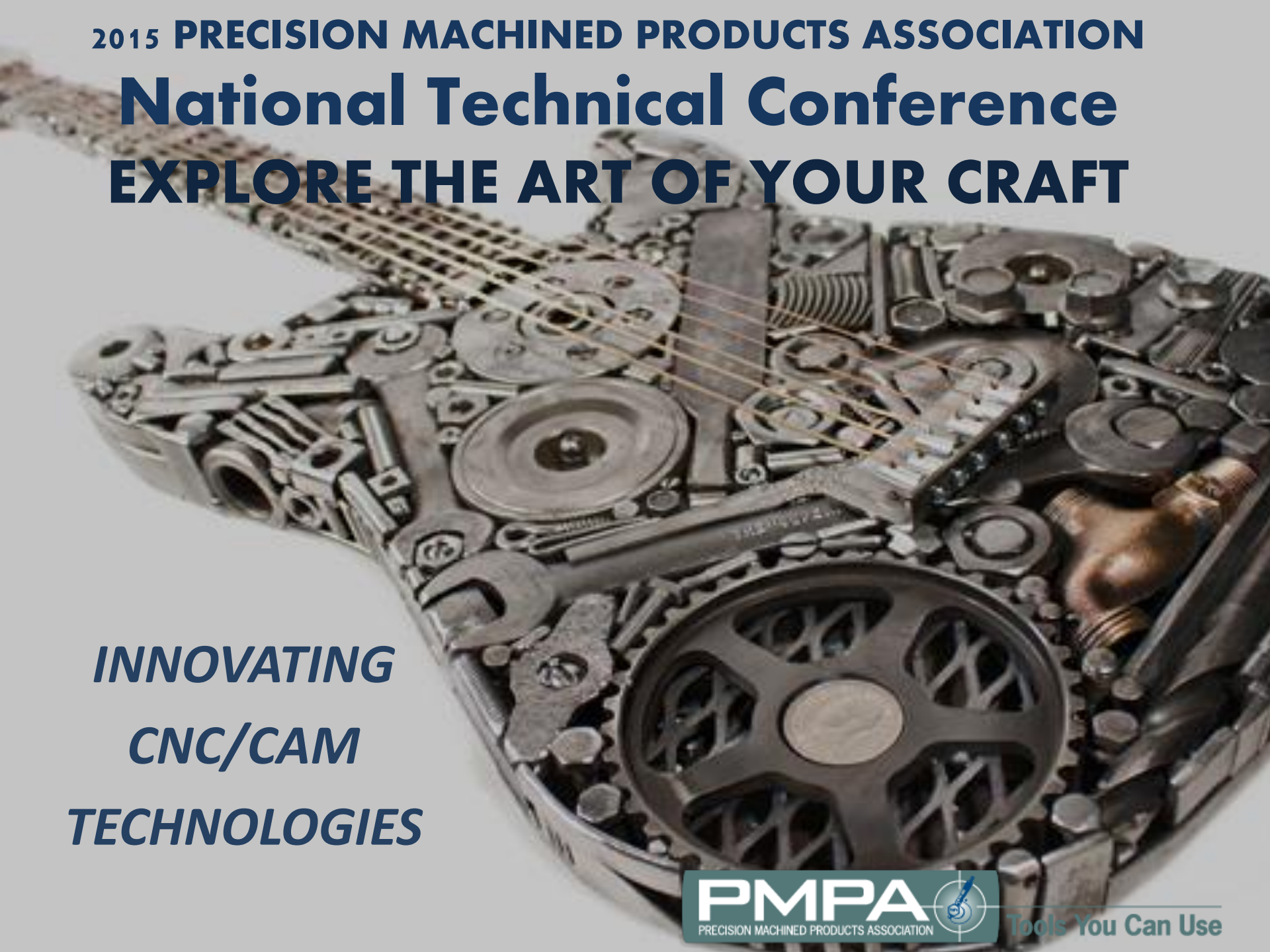
2015 PRECISION MACHINED PRODUCTS ASSOCIATION

National Technical Conference

EXPLORE THE ART OF YOUR CRAFT



INNOVATING

CNC/CAM

TECHNOLOGIES

PMPA
PRECISION MACHINED PRODUCTS ASSOCIATION
Tools You Can Use

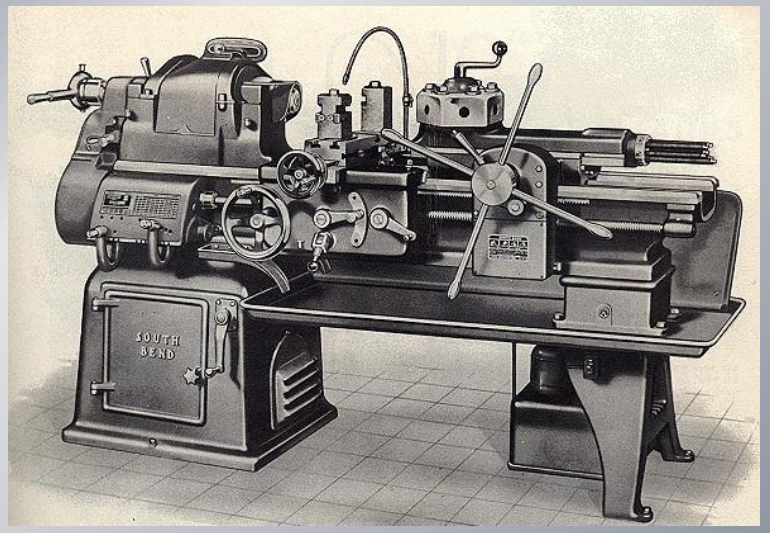
WHAT IS INNOVATION?

- By Definition: Innovation is a: new idea, device, or process (invention)
- Innovation is the “act” of applying better solutions to meet new or existing requirements
- Therefore Innovation can be accomplished through more “effective” products processes services technologies or ideas.
- Innovation differs from invention in that, innovation refers to the use of a better idea or method, whereas invention refers more directly to the creation of the idea, method, device itself.

Example of the Turret Lathe:

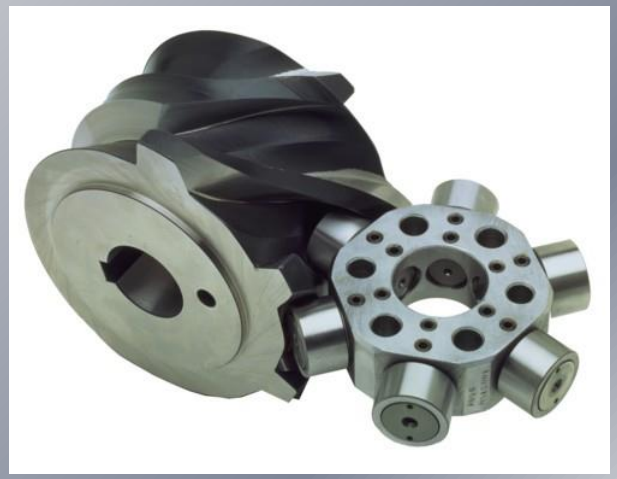
The New Idea (Invention)

The development of the turret lathe in the middle of the 19th century was a key aspect of the advancement of manufacturing technology.



Unlike bench lathes, engine lathes, and tool room lathes on which each tool change involved some degree of setup, turret lathes allowed for multiple tool changes and tool paths.

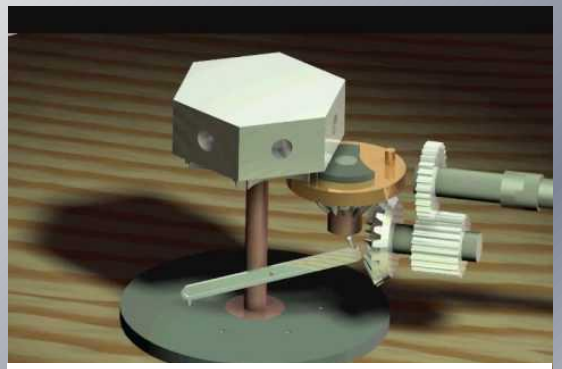
By taking the tool changing and tool path control out of the hands of the operator and building it into the machine, it made interchangeable parts easier, faster, and thus cheaper to produce.

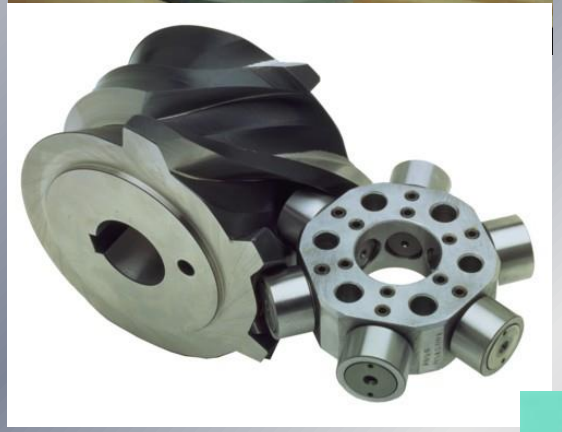


It made production possible with less skilled labor. So long as a few skilled engineers, toolmakers, and setup technicians made and equipped the machine correctly.

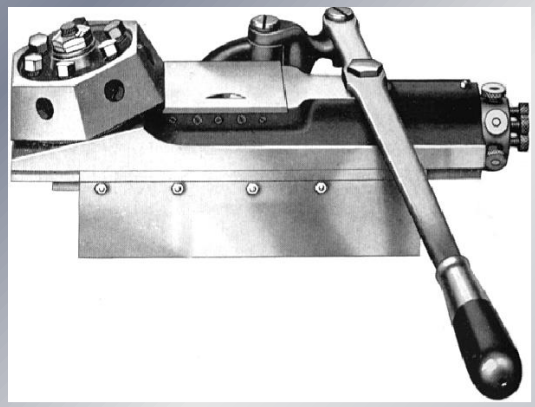
Evolution

It took an idea (Indexing Cam)
To build a prototype

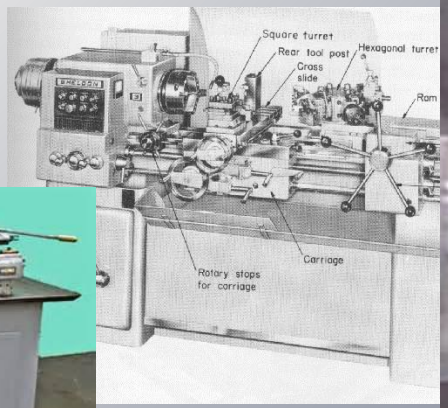




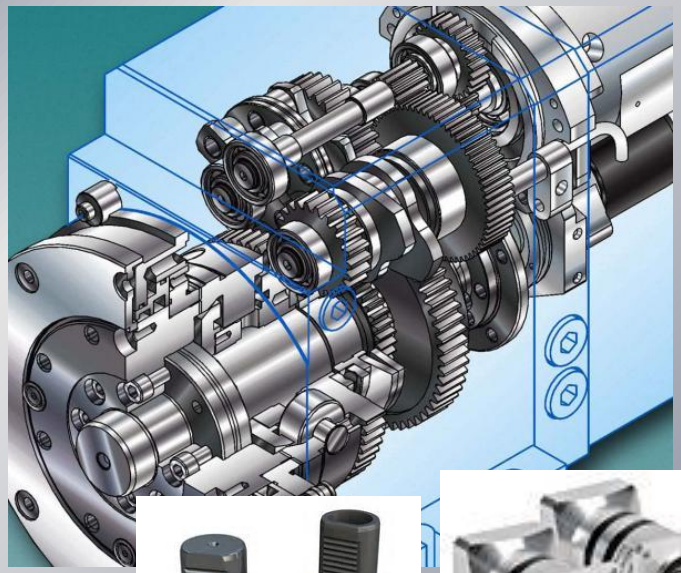
That Idea was Applied
To Industry



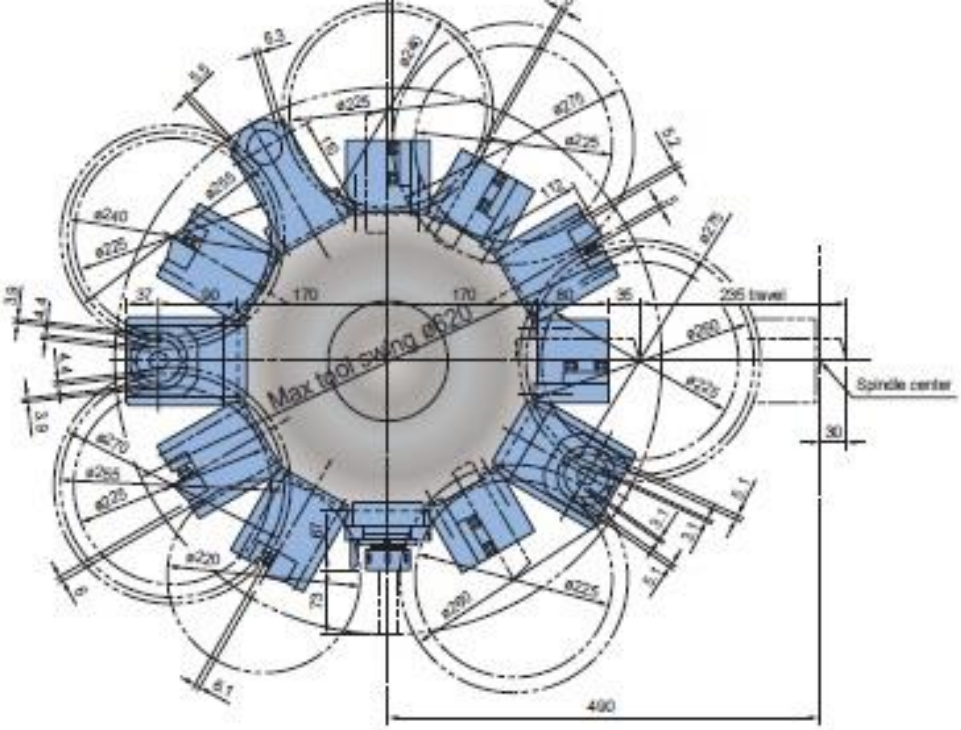
Studied and found
Effective

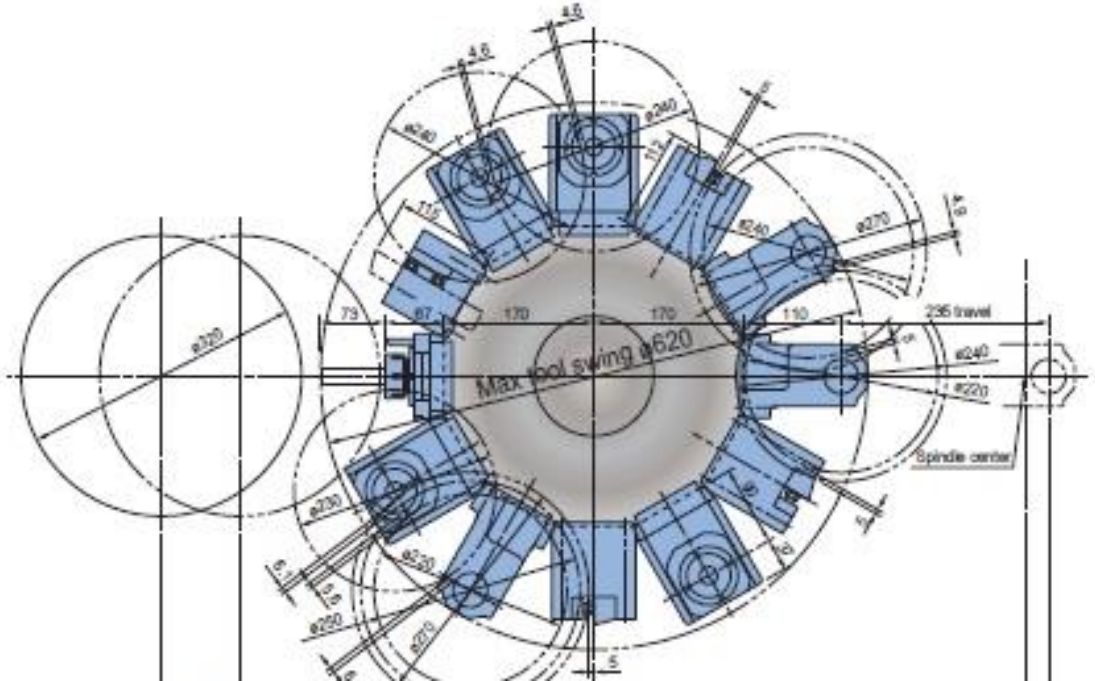


Improved upon over time

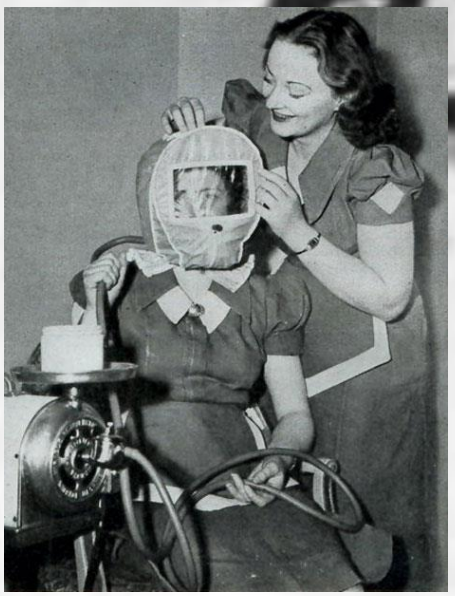


- [NC Turret Animation]



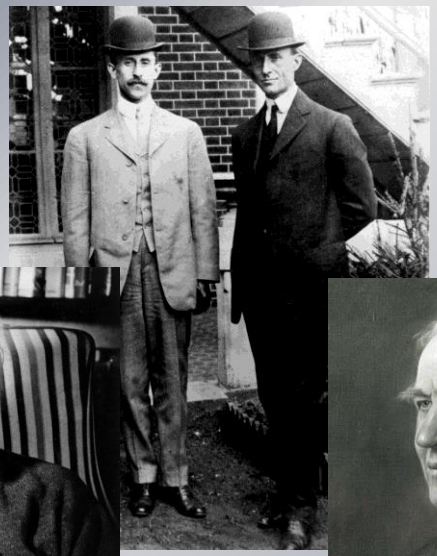
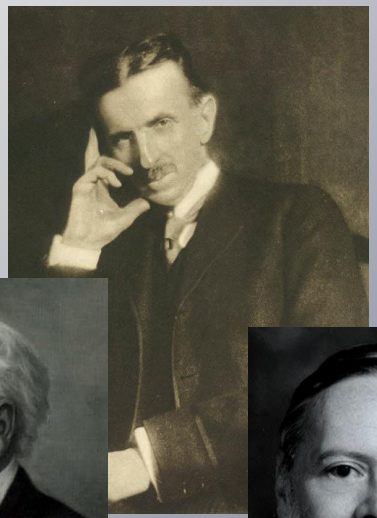
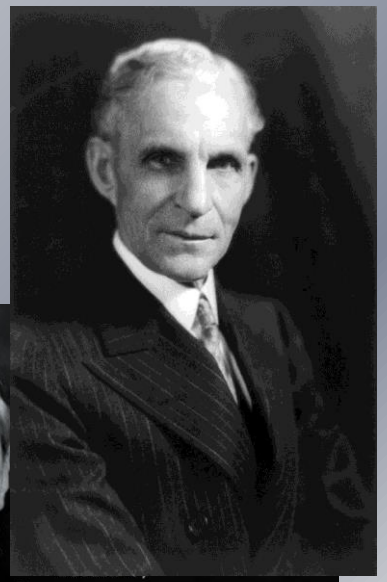
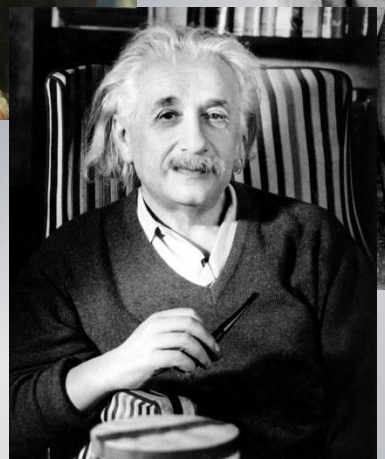
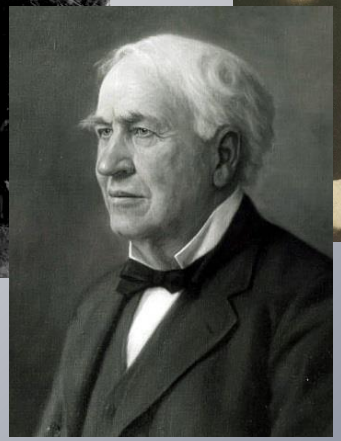
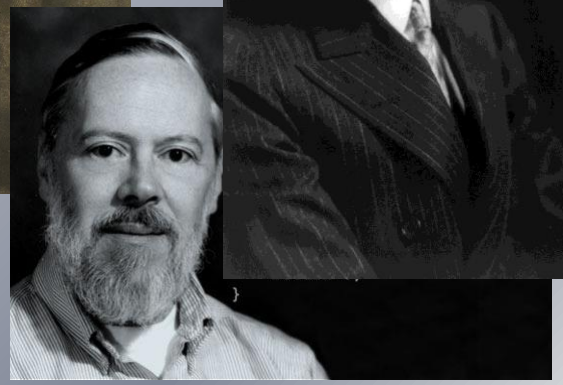


Effective Solutions?



THE INNOVATOR

- By Definition: is a person "___" who is one of the first to introduce into reality something "better than before."
- That opens up a new area for others and achieves an innovation.

Attributes of a Good Innovator

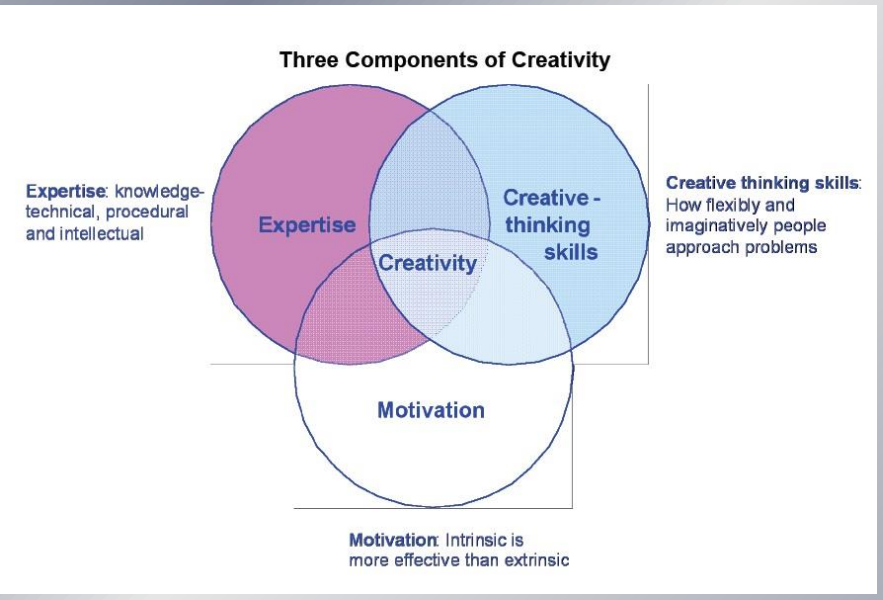
Challenges status quo:
Dissatisfied with current reality.
Questions authority and routine.
Confronts assumptions

Curious: Actively explores their environment. Investigates new possibilities. Honors their sense of awe and wonder.
(Analytical Mind)

Visionary: Highly imaginative. Maintains a future orientation. Thinks in mental pictures.

Self-motivated: Proactively initiates new projects. Intrinsically rewarded for efforts.

Takes risks: Goes beyond their comfort zone. Experimental and nonconforming.
Courageously willing to "fail" (but learns from feedback).



Company-wide Culture

- The Innovator by definition: is a person "or organization" who is one of the first to introduce into reality something better than before.
- It says so, right here in our quality policy!

Thou Shalt Continuously Improve

- Can Innovation and Lean Coexist?

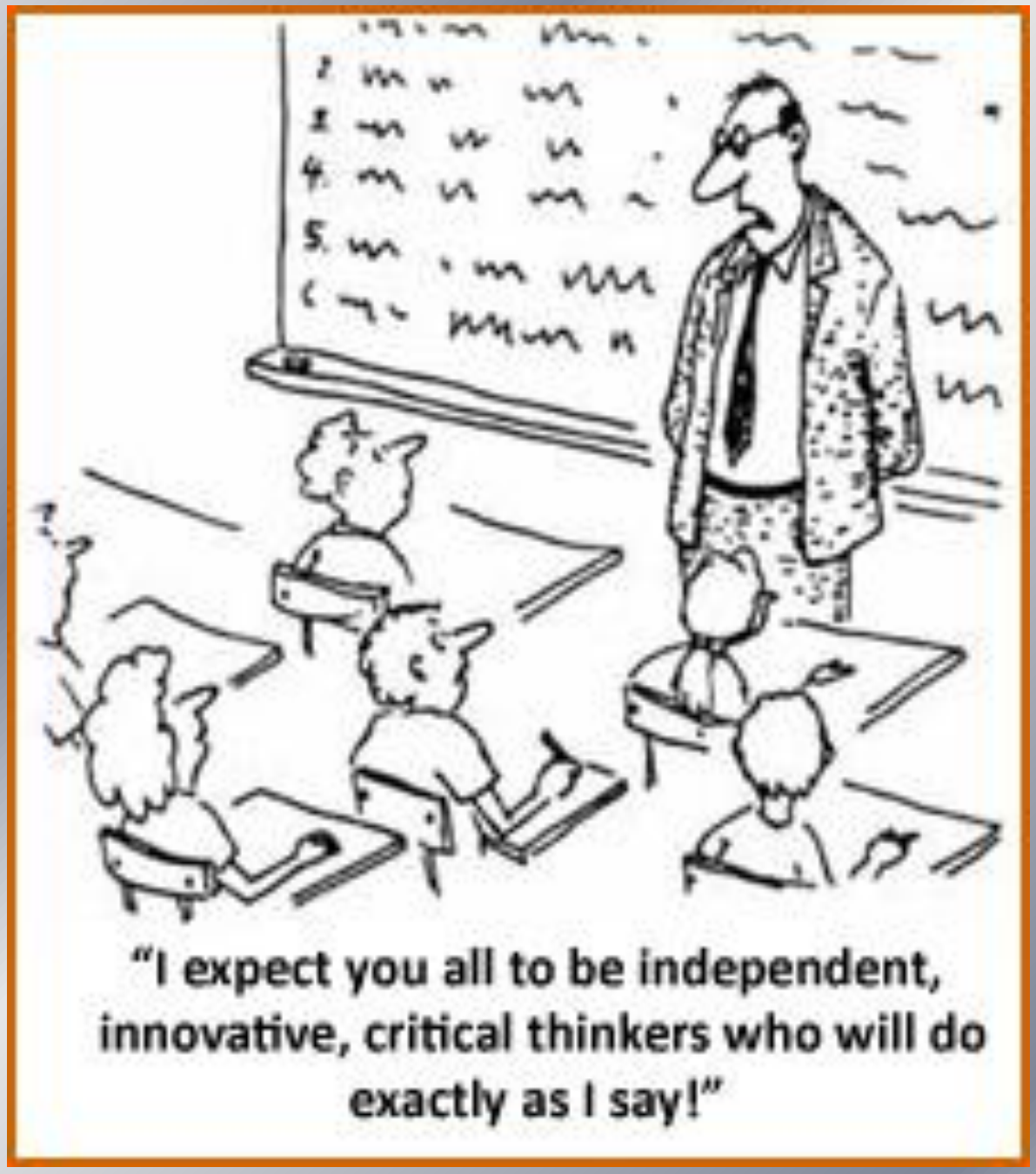
Both share a common goal: to meet customer needs in a cost-effective manner [The Boston Consulting Group]

Both Fail in the same manner

Focusing on tools and methodologies and fail to focus on philosophy and culture

LEAN PROVIDES A FRAME WORK FOR INNOVATION

- Emphasize team based collaboration and continuous feedback to overcome creativity road blocks while monitoring progress, but without the stress of top down management [Disney Pixar]


"I expect you all to be independent, innovative, critical thinkers who will do exactly as I say!"

Management and Innovation

- During Growth Phase, Need to Hire Managers…
- To Excel at Planning, Analyzing, Optimizing
  - Skills taught as MBA School of Business
  - To Scale and Manage Existing Business

What They are Not Taught is how to create a customer. Consequently they can optimize and execute on existing business, but do not seem to have the skill set required to create innovative new products or services.

Forbes Notes 50 of 526 companies surveyed were able to reinvigorate their innovation initiatives. This shows it is rare but can be done.

- Of those Surveyed what techniques were employed?

1. INSIGHT: questioning observing experimenting networking
2. DISCOVERY, (the job to be done) Gemba

   Start with a problem, not a solution

   Start with data, not a conclusion
3. SOLUTIONS, The problem solvers, Root Cause
4. PROTOTYPES , for minimum build scale, simplicity
5. Business Model, market solutions

Conclusion: Managers will need to learn a new set of management tools. They need entrepreneurial management, the principles used in effective startups, rather than traditional management. Traditional Management works well in relative certainty. The Innovative Approach teaches to create value, while traditional management excels at capturing value.

Cultural Building Blocks

- Values
- Behaviors
- Climate
- Resources
- Processes
- Sucess

Strong innovation is driving Sandvik's research and development (R&D) forward. The strategic initiatives to boost the Group's R&D competitiveness are long-term and comprehensive. (pictured Sandvik Coromant's Productivity Center)

Whitewater Technology Park. The Innovation Center was specially designed to offer collaborative space, resources, and services to entrepreneurs and growing businesses. Those who build or grow their company in the Whitewater community benefit from support from the University of Wisconsin-Whitewater, the Whitewater Community Development Authority, the City of Whitewater, as well as the broader entrepreneurial ecosystem of southeastern Wisconsin.

HERE COMES DA J

Zipfer Urtyp

CASE
148
CASE

IRONMAN

SOURCES OF INNOVATION

- Innovation occurs as a result of a focused effort , chance, or failure

- The Unexpected
- Incongruities
- Process Needs
- Industry and Market Structure
- Demographics
- Changes in Perception
- New Knowledge

Source: Focused Effort, Case Study

- Machined Flightings (Food Processing Auger)
- 16 Ra Surface Finish Required on all Features

-Pitch exceeds maximum rapid traverse

-How do we deal with the Length (52”+)

-OD is Too Large for Conventional Swiss

-No Mismatch or Tool Marks on Flanks

Therefore No Re-entry into Cut

-Unfamiliar Process, Radial Turn Milling

-No 5 Axis Machining Capability

-Related machine controller limitations

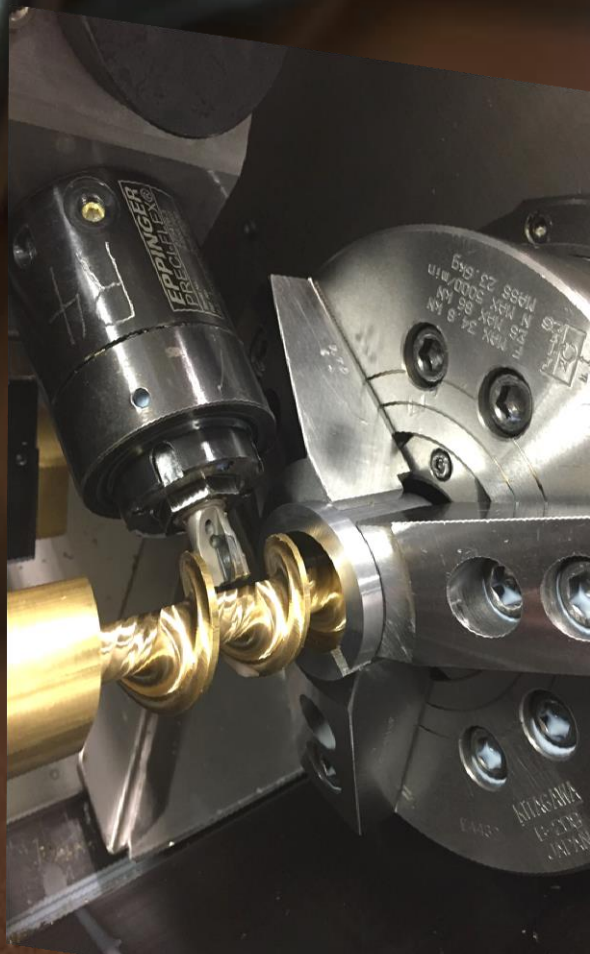
80-85% PROFIT MARGINS

New Customer, Potential Business, Diversified Market

Creative Process Solution

Turn Milling Allowed for:

- -Continuous Cutting motions
- -Slower C axis (Work Spindle) RPM's
- -Climb Milling Reduced Deflection
- -Z axis Feed below Rapid Traverse
- -Pinch Milling Increased Stability
- -Y axis provided 5 Axis Profile
- -Optimized Tool Life & Finish



Critical Thinking

The Swiss Guide Bushing and Headstock allow for Long Length to Diameter Ratios

Can the Guide Bushing concept be applied to a Fixed Headstock machine?

-The W Axis (Sub Spindle Z Traverse)

-Free Sliding Fit

-Hydraulic Chucking

-Stationary Bar

-Spindle Follows Cutting Tool along Work

-Increased Rigidity / Support

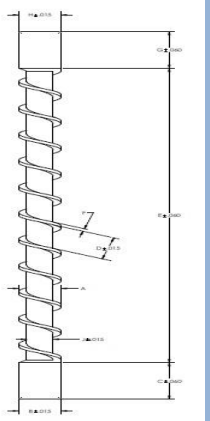
Video Link

Innovative Programming

- Programming for High Variety, Low Volume
- Macro B / User Task II
- Understanding Variables
- Applying Variables
- Machine Tool Controller Limitations

  Functional limitations (pulse generator)

PART#	DESCRIPTION	A AUGER DIAMETER	AUGER TOLERANCE	B STEM DIAMETER	C STEM LENGTH	D PITCH	E AUGER LENGTH	F FLIGHT THICKNESS +.003/-.0	G ROD LENGTH	H ROD DIAMETER	J ROD DIAMETER	MATERIAL	Finish (RMS) [µIN]	FLIGHTING DIRECTION
V30745.801	FLIGHTING,0.125,RP-MACH,316,12"OAL	0.125	+.0002/-.003	0.125	1.000	0.125	12.0	0.030	N/A	N/A	0.093	316L	32	LH
V30745.802	FLIGHTING,0.25,FP-MACH,316,28"OAL	0.250	+.0002/-.003	0.250	1.000	0.250	28.0	0.075	1.000	0.250	0.134	316L	32	LH
V30745.803	FLIGHTING,0.375,RP-MACH,316,28"OAL	0.375	+.0002/-.003	0.375	1.000	0.375	28.0	0.075	1.000	0.375	0.188	316L	32	LH
V30745.804	FLIGHTING,0.50,FP-MACH,316,28"OAL	0.500	+.0002/-.003	0.500	1.000	0.500	28.0	0.075	1.000	0.500	0.250	316L	32	LH
V30745.805	FLIGHTING,0.75,HP-MACH,316,30.5"OAL	0.750	+.0002/-.003	0.500	0.550	0.375	30.5	0.125	N/A	N/A	0.406	316L	32	LH
V30745.806	FLIGHTING,0.75,FP-MACH,316,28"OAL	0.750	+.0002/-.003	0.500	1.000	0.750	28.0	0.125	1.00	.75	0.500	316L	32	LH
V30745.807	FLIGHTING,0.75,HP-MACH,316,26.5"OAL	0.750	+.0002/-.003	0.500	0.550	0.375	24.5	0.125	N/A	N/A	0.500	316L	32	LH
V30745.808	FLIGHTING,1.00,HP-MACH,316,30.5"OAL	1.000	+.0002/-.003	0.375	0.550	0.500	30.5	0.125	N/A	N/A	0.375	316L	32	LH
V30745.809	FLIGHTING,1.00,FP-MACH,316,30.5"OAL	1.000	+.0002/-.003	0.375	0.550	1.000	30.5	0.125	N/A	N/A	0.375	316L	32	LH
V30745.810	FLIGHTING,1.00,HP-MACH,316,26.5"OAL	1.000	+.0002/-.003	0.375	0.550	0.500	24.5	0.125	N/A	N/A	0.375	316L	32	LH
V30745.811	FLIGHTING,1.00,RP-MACH,316,26.5"OAL	1.000	+.0002/-.003	0.375	0.550	1.000	26.5	0.123	N/A	N/A	0.373	316L	32	LH
V30745.812	FLIGHTING,1.00,FP-MACH,316,28"OAL	1.000	+.0002/-.003	0.423	1.000	1.000	28.0	0.103	1.000	1.000	0.423	316L	32	LH
V30745.813	FLIGHTING,1.375,HP-MACH,316,30.5"OAL	1.375	+.0002/-.005	0.500	0.550	0.488	30.5	0.123	N/A	N/A	0.500	316L	32	LH
V30745.814	FLIGHTING,1.375,FP-MACH,316,30.5"OAL	1.375	+.0002/-.005	0.500	0.550	1.375	30.5	0.123	N/A	N/A	0.500	316L	32	LH
V30745.815	FLIGHTING,1.375,HP-MACH,316,26.5"OAL	1.375	+.0002/-.005	0.500	0.870	0.488	26.5	0.123	N/A	N/A	0.500	316L	32	LH
V30745.816	FLIGHTING,1.375,FP-MACH,316,26.5"OAL	1.375	+.0002/-.005	0.500	1.000	1.375	26.5	0.123	N/A	N/A	0.500	316L	32	LH
V30745.817	FLIGHTING,1.375,HP-MACH,316,34.5"OAL	1.375	+.0002/-.005	0.500	0.870	0.488	34.5	0.123	N/A	N/A	0.500	316L	32	LH
V30745.818	FLIGHTING,1.375,FP-MACH,316,34.5"OAL	1.375	+.0002/-.005	0.500	0.870	1.375	34.5	0.123	N/A	N/A	0.500	316L	32	LH
V30745.819	FLIGHTING,1.75,HP-MACH,316,30.5"OAL	1.750	+.0002/-.005	0.750	0.550	0.875	30.5	0.123	N/A	N/A	0.750	316L	32	LH
V30745.820	FLIGHTING,1.75,RP-MACH,316,30.5"OAL	1.750	+.0002/-.005	0.750	0.550	1.750	30.5	0.123	N/A	N/A	0.750	316L	32	LH
V30745.821	FLIGHTING,1.75,HP-MACH,316,26.5"OAL	1.750	+.0002/-.005	0.750	0.870	0.875	26.5	0.123	N/A	N/A	0.750	316L	32	LH
V30745.822	FLIGHTING,1.75,RP-MACH,316,26.5"OAL	1.750	+.0002/-.005	0.750	1.250	1.750	26.5	0.123	N/A	N/A	0.750	316L	32	LH
V30745.823	FLIGHTING,1.75,HP-MACH,316,34.5"OAL	1.750	+.0002/-.005	0.750	0.870	0.875	34.5	0.123	N/A	N/A	0.750	316L	32	LH
V30745.824	FLIGHTING,1.75,RP-MACH,316,34.5"OAL	1.750	+.0002/-.005	0.750	0.870	1.750	34.5	0.123	N/A	N/A	0.750	316L	32	LH
V30745.825	FLIGHTING,2.25,HP-MACH,316,26.5"OAL	2.250	+.0002/-.010	1.000	0.870	1.125	26.5	0.123	N/A	N/A	1.250	316L	32	LH
V30745.826	FLIGHTING,2.25,RP-MACH,316,26.5"OAL	2.250	+.0002/-.010	1.000	0.870	2.250	26.5	0.123	N/A	N/A	1.250	316L	32	LH
V30745.827	FLIGHTING,2.25,HP-MACH,316,34.5"OAL	2.250	+.0002/-.010	1.000	1.180	1.125	34.5	0.123	N/A	N/A	1.250	316L	32	LH
V30745.828	FLIGHTING,2.25,RP-MACH,316,34.5"OAL	2.250	+.0002/-.010	1.000	1.180	2.250	34.5	0.123	N/A	N/A	1.250	316L	32	LH
V30745.829	FLIGHTING,2.25,HP-MACH,316,42.5"OAL	2.250	+.0002/-.010	1.000	1.180	1.125	42.5	0.123	N/A	N/A	1.250	316L	32	LH
V30745.830	FLIGHTING,2.25,RP-MACH,316,42.5"OAL	2.250	+.0002/-.010	1.000	1.180	2.250	42.5	0.123	N/A	N/A	1.250	316L	32	LH
V30745.831	FLIGHTING,2.25,HP-MACH,316,24"OAL	2.250	+.0002/-.010	1.000	1.250	1.125	24.0	0.123	N/A	N/A	1.250	316L	32	LH
V30745.832	FLIGHTING,2.25,FP-MACH,316,24"OAL	2.250	+.0002/-.010	1.000	1.250	2.250	24.0	0.123	N/A	N/A	1.250	316L	32	LH
V30745.833	FLIGHTING,3.00, HP-MACH,316,26.5"OAL	3.000	+.0002/-.030	1.000	0.870	1.500	26.5	0.188	N/A	N/A	1.000	316L	32	LH
V30745.834	FLIGHTING,3.00, FP-MACH,316,34.5"OAL	3.000	+.0002/-.030	1.000	0.870	3.000	34.5	0.188	N/A	N/A	1.000	316L	32	LH
V30745.835	FLIGHTING,3.00, HP-MACH,316,34.5"OAL	3.000	+.0002/-.030	1.000	1.180	1.500	34.5	0.188	N/A	N/A	1.000	316L	32	LH
V30745.836	FLIGHTING,3.00, FP-MACH,316,34.5"OAL	3.000	+.0002/-.030	1.000	1.180	3.000	34.5	0.188	N/A	N/A	1.000	316L	32	LH
V30745.837	FLIGHTING,3.00, HP-MACH,316,42.5"OAL	3.000	+.0002/-.030	1.000	1.180	1.500	42.5	0.188	N/A	N/A	1.000	316L	32	LH
V30745.838	FLIGHTING,3.00, FP-MACH,316,42.5"OAL	3.000	+.0002/-.030	1.000	1.180	3.000	42.5	0.188	N/A	N/A	1.000	316L	32	LH
V30745.839	FLIGHTING,3.50, HP-MACH,316,34.5"OAL	3.500	+.0002/-.030	1.000	1.180	1.750	34.5	0.188	N/A	N/A	1.125	316L	32	LH
V30745.840	FLIGHTING,3.50, FP-MACH,316,34.5"OAL	3.500	+.0002/-.030	1.000	1.180	3.500	34.5	0.188	N/A	N/A	1.125	316L	32	LH
V30745.841	FLIGHTING,3.50, HP-MACH,316,42.5"OAL	3.500	+.0002/-.030	1.000	1.180	1.750	42.5	0.188	N/A	N/A	1.125	316L	32	LH
V30745.842	FLIGHTING,3.50, FP-MACH,316,42.5"OAL	3.500	+.0002/-.030	1.000	1.180	3.500	42.5	0.188	N/A	N/A	1.125	316L	32	LH
V30745.843	FLIGHTING,4.00, HP-MACH,316,34.5"OAL	4.000	+.0002/-.030	1.000	1.180	2.000	34.5	0.188	N/A	N/A	1.373	316L	32	LH
V30745.844	FLIGHTING,4.00, FP-MACH,316,34.5"OAL	4.000	+.0002/-.030	1.000	1.180	4.000	34.5	0.188	N/A	N/A	1.373	316L	32	LH
V30745.845	FLIGHTING,4.00, HP-MACH,316,42.5"OAL	4.000	+.0002/-.030	1.000	1.180	2.000	42.5	0.188	N/A	N/A	1.373	316L	32	LH
V30745.846	FLIGHTING,4.00, FP-MACH,316,42.5"OAL	4.000	+.0002/-.030	1.000	1.180	4.000	42.5	0.188	N/A	N/A	1.373	316L	32	LH



```
DIA=.2500
ZCRR=-.1333-.0163-.005
ZCOR=.1333+.017+.0163

P0001
( **** ROUGH MILL HELIX PASS **** )
G0 X20. Z0. M9
G50 S2000
NT6AA T050505
M110 (C-AXIS ON)
SB=2537 M13 C0. (CLOCKWISE M TOOL ROTATION) (400-500 SFM)
G0 Z0.0+ZCRR (STARTING Z POSITION)
X1.75 (CLEAR X)
G138 (Y-AXIS ON)
M15 (SPINDLE DIRECTION POSITIVE)
G0 G19 Y-1.0 (CALCULATE BASED ON WORK PIECE DIAMETER)
G1 Y-.2125 F16. (FEED TO NEAR CENTER DETERMINED BY INSERT DEPTH)
G1 G94 X=DIA (SET X DEPTH HERE) F16. (CONTACT IN X) (.050 DOC)
P0002
G1 G94 C180.00 Z-.6875+ZCRR M15 F80.
P0003
C359.999 Z-1.3750+ZCRR
P0004
C180.000 Z-2.0625+ZCRR
P0005
C359.999 Z-2.7500+ZCRR
P0006
C180.000 Z-3.4375+ZCRR
P0007
C359.999 Z-4.1250+ZCRR
P0008
C180.000 Z-4.8125+ZCRR
P0009
C359.999 Z-5.5000+ZCRR
P0010
C180.000 Z-6.1875+ZCRR
P0011
C359.999 Z-6.8750+ZCRR
P0012
C180.000 Z-7.5625+ZCRR
P0013
C359.999 Z-8.2500+ZCRR
P0014
C180.000 Z-8.9375+ZCRR
P0015
C359.999 Z-9.6250+ZCRR
P0016
C180.000 Z-10.3125+ZCRR
P0017
C359.999 Z-11.0000+ZCRR
P0018
C180.000 Z-11.6875+ZCRR
P0019
C359.999 Z-12.3750+ZCRR
P0020
ZFED=80.
CFED=120.
FFAC=0.070

P0001 (B TURRET OPERATION)
NT5A (X.6375)
(ROUGH AND FINISH MILL FLIGHTINGS)
M810 (NEEDED)
P0002
G29 PW=45 (TORQUE LIMIT ON)
VLMON[64]=0(=32 FOR W AXIS) (LOAD MONITOR ON)
G1 G94 W-.68 F=[ZFED*FFAC] M808 (NEEDED)
P0003
G1 W-1.36
P0004
G1 W-2.05
P0005
G1 W-2.74
P0006
G1 W-3.42
P0007
G1 W-4.11
P0008
G1 W-4.80
P0009
G1 W-5.49
P0010
G1 W-6.17
P0011
G1 W-6.86
P0012
G1 W-7.55
P0013
G1 W-8.24
P0014
G1W-8.92
P0015
G1 W-9.61
P0016
G1 W-10.30
P0017
G1 W-10.99
P0018
G1 W-11.67
P0019
G1 W-12.36
P0020
G1 W-13.05
P0021
G1 W-13.74
P0022
G1 W-14.42
P0023
G1 W-14.42+.4763 F=[ZFED*FFAC]
P0024
G1 W-13.74+.4763
VTLIN[1]=35
VTLFN[1]=1
VTLL[1]=3.0000
VTLD[1]=1.0000
M121
N1 G0 X50 Z50
G50 S2000
NT1 T050505
M110 (C-AXIS ON)
SB=6000 M13 C0
G0 Z10.0
X8.1
G138 G0 G19 Y-.50
G1 G94 X2.5F165.0 (CONTACT IN X)
Y-.350 C90
C0 M15
CALL OMIL1
GOTO NEND
Y-.350 C90 M15
C0 M15
C91
G0 X4.5 Y-0.350
C0
Z-1.9
G1 G94 X3.9 F165.0
Y-.350 C90 M15
C0 M15
C91
G0 X4.5 Y-0.350 (CLEAR WORK PEICE)
NEND
G136 M12 (CANCEL Y AXIS)
G0 X50 Z50 M109 (EVACUATE CUTTING TOOL)
M02 (PROGRAM END)
OMIL1 (MILL TURN MACRO ACROSS Z)
ZSTR=10.0 (SEE ALSO ABOVE PROGRAM Z START POSTION)
ZEND=-2.0
DOC=.900 (CANNOT EXCEED MILL DIAMETER)
ZPOS=ZSTR-DOC
IF [ZPOS LE ZEND] NFIN
NLOOP
G1 G94 C359.999 Z=ZPOS M15 F165.0
ZPOS=ZPOS-DOC
IF [ZPOS LE ZEND] NFIN
C0
GOTO NLOOP
NFIN
C0
G1 G95 C359.999 Z=ZEND M15
G0 X4.5 (CLEAR WORK PIECE)
Y0
M12
G136
```

More on Innovative Programming

- OCHECKA / OCHECKB Sub Programs
  - Check machine conditions prior to cycle start
- Avert Crashes (Poka-yoke)

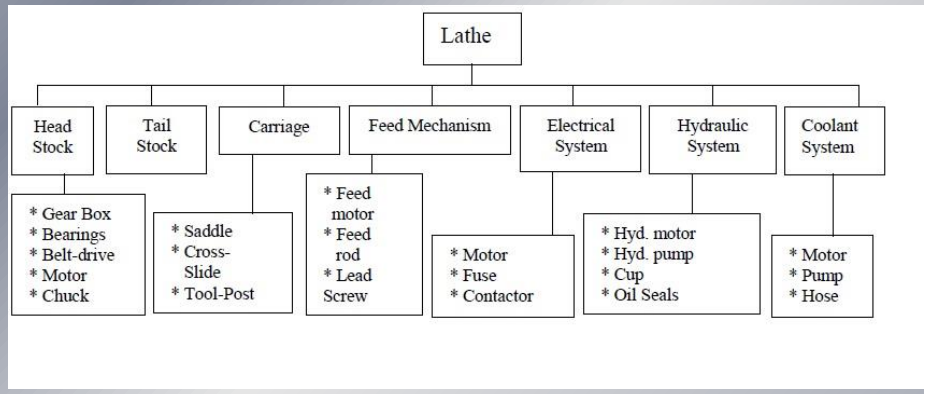
```
OCHKA
IF[VORD[0016]EQ 1]NRTS (IF MACHINE LOCK ON)
IF[VTOFZ[2]EQ 0]NCK0
VUACM[1]='T-A2 NOT AT Z0.0'
VDOUT[992]=1
NCK0 IF[VORD[0015]EQ 0]NCK1
VUACM[1]='DRY RUN ON'
VDOUT[992]=1
NCK1(IF[VORD[0014]EQ 0]NCK2
VUACM[1]='BLOCK DELETE ON'
VDOUT[992]=1)
NCK2 IF[VORD[0022]EQ 1]NCK4
VUACM[1]='SPINDLE OVERIDE'
VDOUT[992]=1
NCK4 IF[VORD[0031]EQ 1]NCK5
VUACM[1]='COOLANT OFF'
VDOUT[992]=1
NCK5 IF[VORD[011A]EQ 1]NCK6
VUACM[1]='R-SPNDL OVERRIDE'
VDOUT[992]=1
NCK6 IF[VRSTT NE 0]NCK7 (IF RESTART)
NCK  IF[VORD[0011]EQ 0]NCK7
VUACM[1]='A INDIVIDUAL ON'
VDOUT[992]=1
NCK7 IF[VORD[001C]EQ 1]NCK8
VUACM[1]='LOAD MONITOR OFF'
VDOUT[992]=1
NCK8 IF[VORD[0110]EQ 1]NCK9
VUACM[1]='MA OVERRIDE'
VDOUT[992]=1
NCK9 IF[VORD[0106]EQ 1]NCK10
VUACM[1]='MB OVERRIDE'
VDOUT[992]=1
NCK10 IF[VORD[0143]EQ 1]NCK11
VUACM[1]='SYSTEM LINK OFF'
VDOUT[992]=1
NCK11 IF[VRSTT NE 0]NCK12 (IF RESTART JUMP)
IF[VORD[0013]EQ 1]NCK12 (SINGLE BLOCK)
IF[VORD[0023]EQ 1]NCK12
VUACM[1]='FEEDRATE NOT 100'
VDOUT[992]=1
NCK12 IF[VRSTT EQ 0]NRTS (IF NOT RESTART JUMP)
NCKR1 IF[[VIRD[0030]+VIRD[0031]+VIRD[0032]]EQ 0]NCKR2
VUACM[1]='FEEDRATE TOO HI'
VDOUT[992]=1
NCKR2 IF[VORD[0013]EQ 1]NRTS
VUACM[1]='SINGLE BLK OFF'
VDOUT[992]=1
NRTS RTS
OCHKB
IF[VORD[0016]EQ 1]NRTS
IF[VTOFZ[2]EQ 0]NCK1
VUACM[1]='T-B2 NOT AT Z0.0'
VDOUT[992]=1
NCK1 IF[VRSTT NE 0]NRTS (IF RESTART)
NCK13 IF[VORD[0012]EQ 0]NRTS
VUACM[1]='B INDIVIDUAL ON'
VDOUT[992]=1
NRTS RTS
OCHK1 (WITHOUT BARFEEDER)
IF[VORD[0016]EQ 1]NRTS (IF MACHINE LOCK ON)
IF[VORD[0015]EQ 0]NCK0
VUACM[1]='DRY RUN ON'
VDOUT[992]=1
NCK0(IF[VORD[0014]EQ 0]NCK2
VUACM[1]='BLOCK DELETE ON'
VDOUT[992]=1)
NCK2 IF[VRSTT NE 0]NCK3 (IF RESTART)
NCK00 IF[[VIRD[0030]+VIRD[0031]+VIRD[0032]]EQ 0]NCK3
NCK  IF[VORD[0023]EQ 1]NCK3
VUACM[1]='FEEDRATE NOT 100'
VDOUT[992]=1
NCK3 IF[VORD[0022]EQ 1]NCK4
VUACM[1]='SPINDLE OVERIDE'
VDOUT[992]=1
NCK4 IF[VORD[0031]EQ 1]NCK5
VUACM[1]='COOLANT OFF'
VDOUT[992]=1
NCK5 IF[VORD[011A]EQ 1]NCK6
VUACM[1]='R-SPNDL OVERRIDE'
VDOUT[992]=1
NCK6 IF[VRSTT NE 0]NCK7 (IF RESTART)
NCK  IF[VORD[0011]EQ 0]NCK7
VUACM[1]='A INDIVIDUAL ON'
VDOUT[992]=1
NCK7 IF[VORD[001C]EQ 1]NCK8
VUACM[1]='LOAD MONITOR OFF'
VDOUT[992]=1
NCK8 IF[VORD[0110]EQ 1]NCK9
VUACM[1]='MA OVERRIDE'
VDOUT[992]=1
NCK9 IF[VORD[0106]EQ 1]NCK11
VUACM[1]='MB OVERRIDE'
VDOUT[992]=1
NCK10 IF[VORD[0143]EQ 0]NCK11
VUACM[1]='SYSTEM LINK ON‘
```

Innovative Programming

- Scaling Sizes or Floating Positions
- Engraving Letters
- Added Adjustability, Finer Adjustability
  - Infinite Adjustability, over time or pc count
- Variable Speeds and Feeds
- Repetitive Processing
  - Canned Cycles
  - Multiple Parts Per Chuck

Innovation Resulting from Failure

- Stainless Steel
  - The Effects of Chromium Discovered
  - Surface Footage
- Manufacturing Systems failures
  - Failure Modes & Wearables
  - Variation in all forms



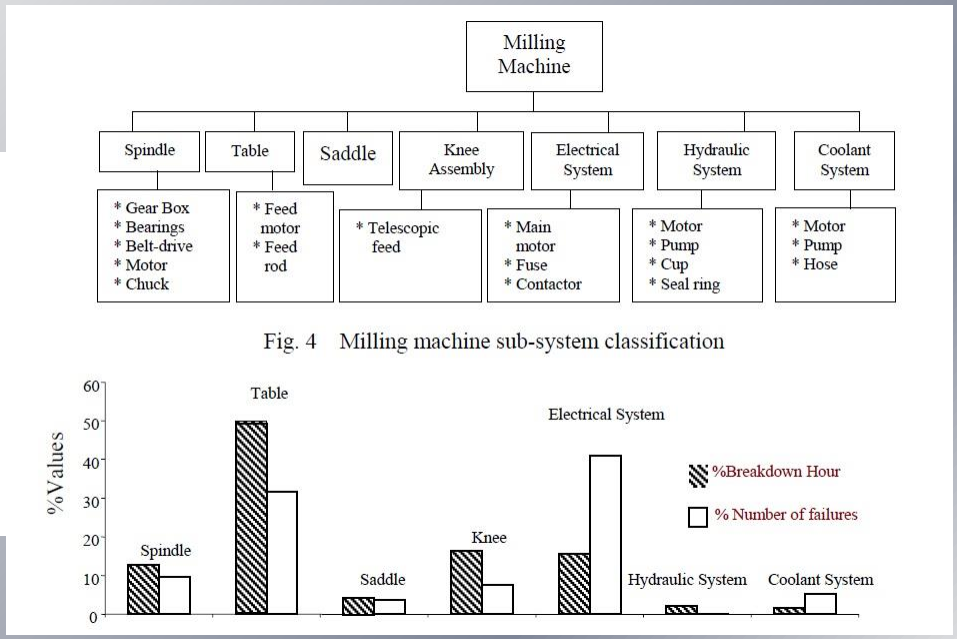
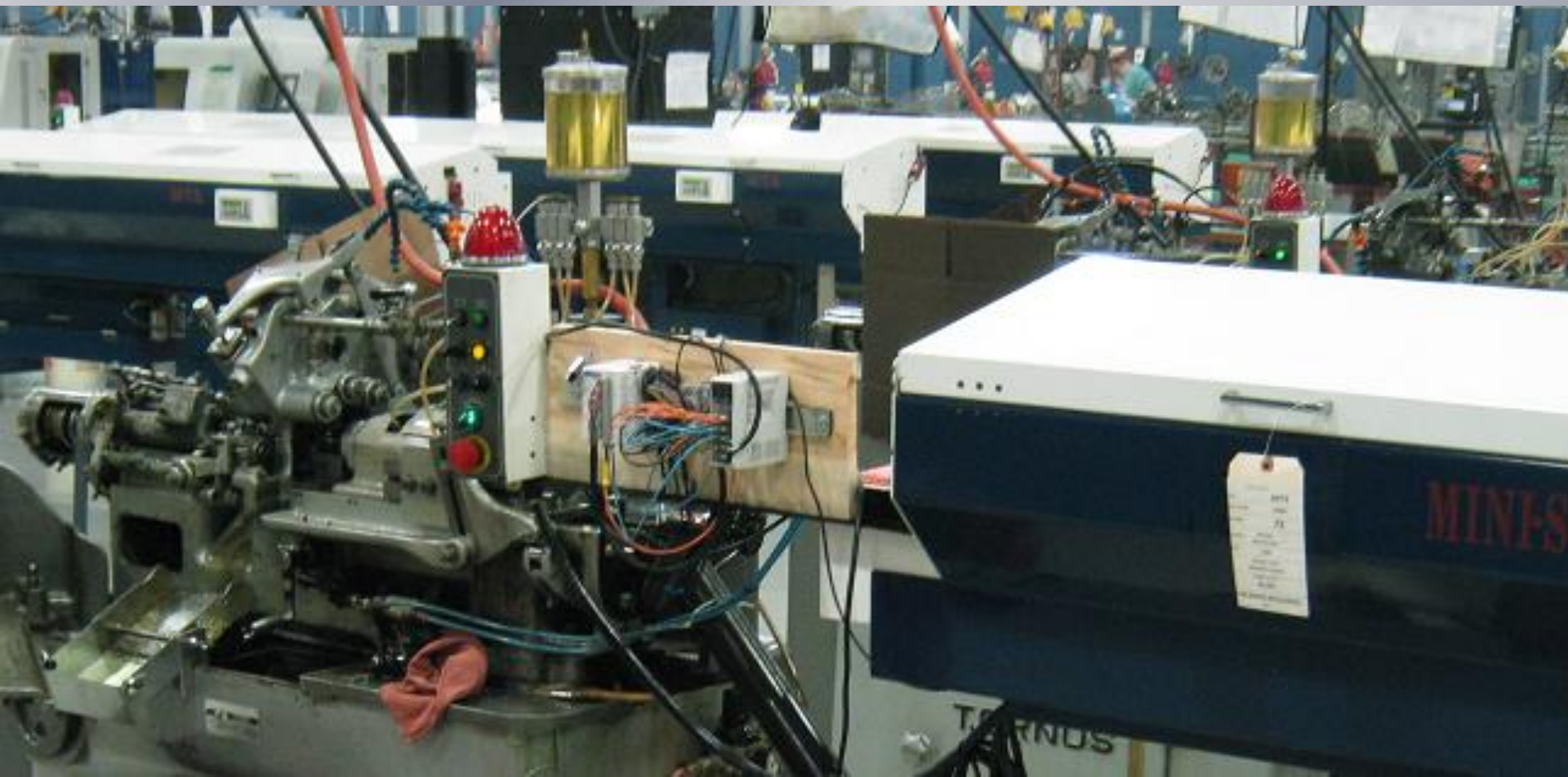


Fig. 4 Milling machine sub-system classification

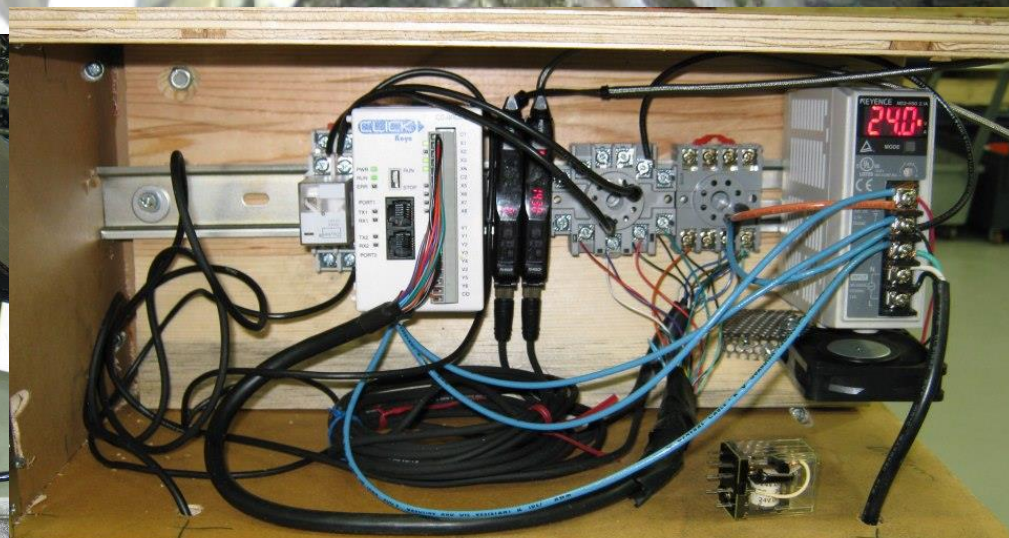
Autonomation

- By Definition: Stopping a machine automatically or without intervention when a defective part (symptom) has been created or observed.
- PREVENT CONTAMINATION OF CONFORMING WITH NONCONFORMING PRODUCT.
- Build you Autonomation device for premature stopping upon system failure

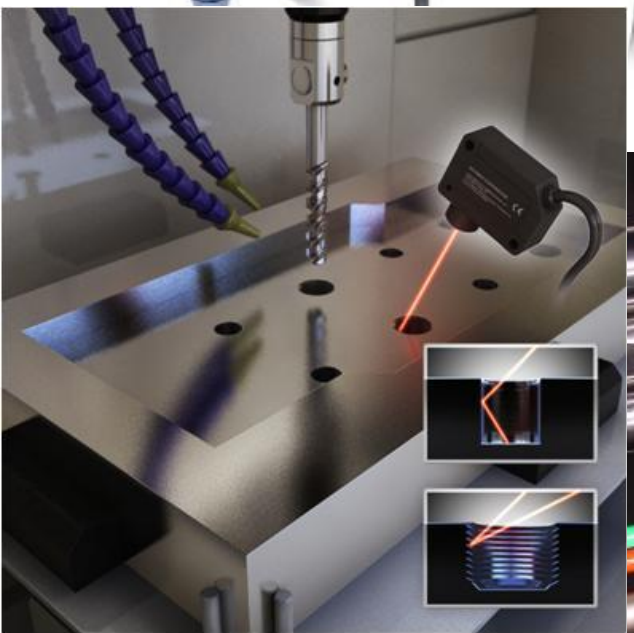
Process Failure: Broken Taps
Design for Customer Requirement
Corrective Action



TORNOS

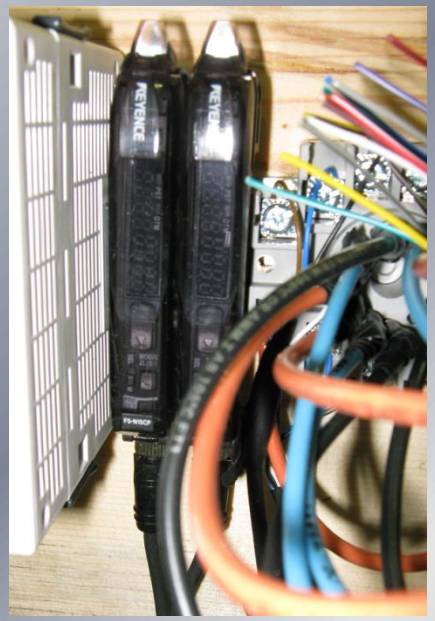

240

Sensor Technology

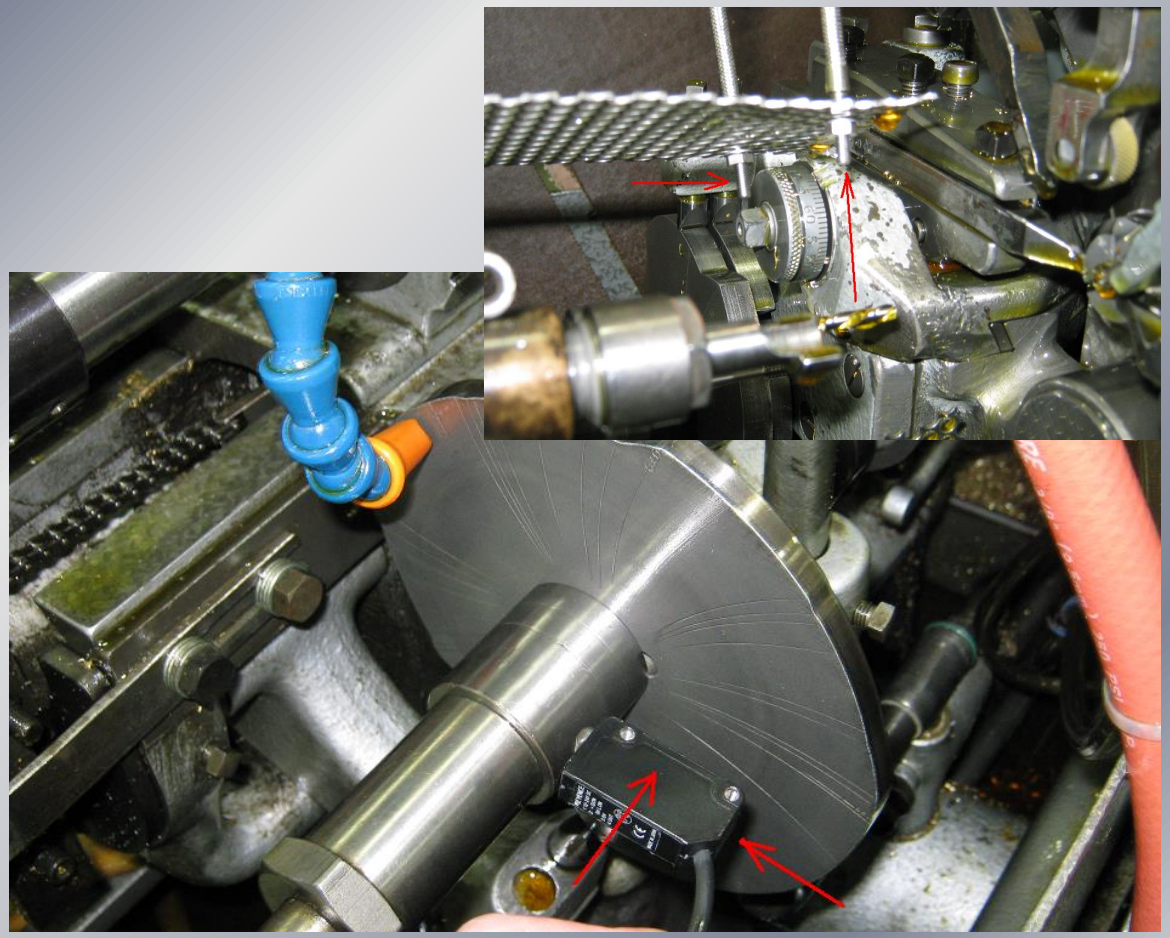


Sensor Technology

- Fiber Optic Sensors
- PNP Type
- Amplifier
- Fiber Cable and Eye



Fiber Optic Eyes Record Reflectivity of tooling in order to sense tool presence

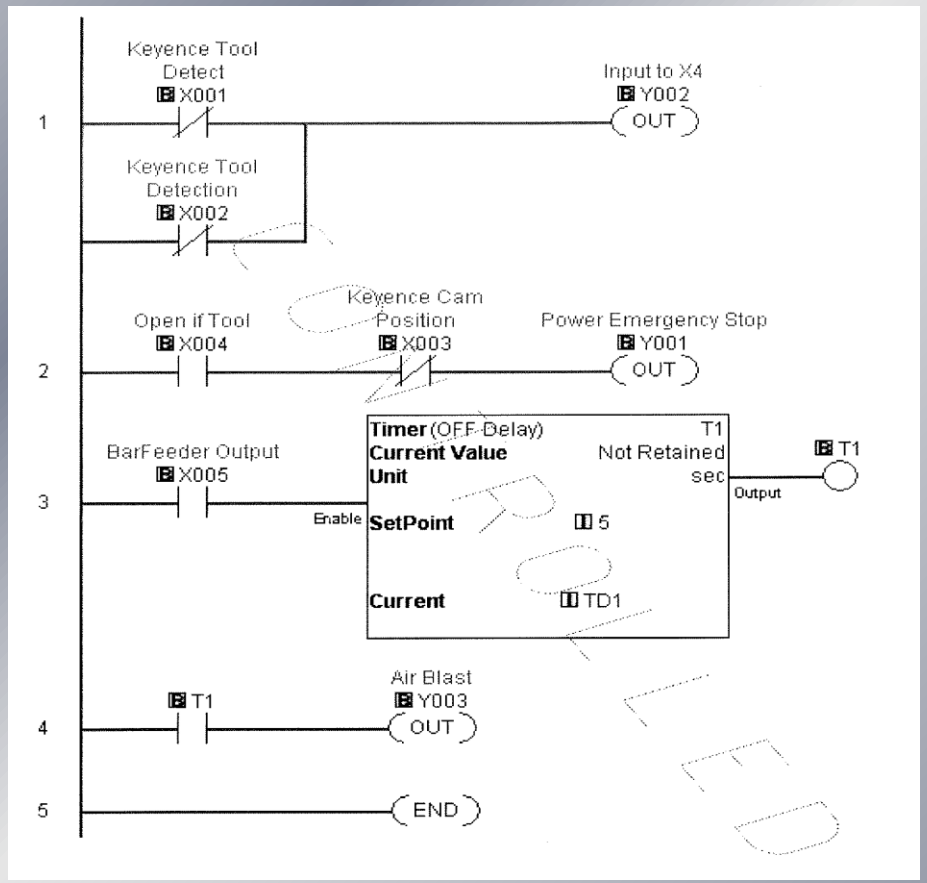


This sensor Counts Cam Rotations, It also specifies when the Fiber Optic Sensors should Sense Tool Presence

MECHANISMS CONDITION TO LOGIC
LOGIC BACK TO MECHANISMS CONTROL

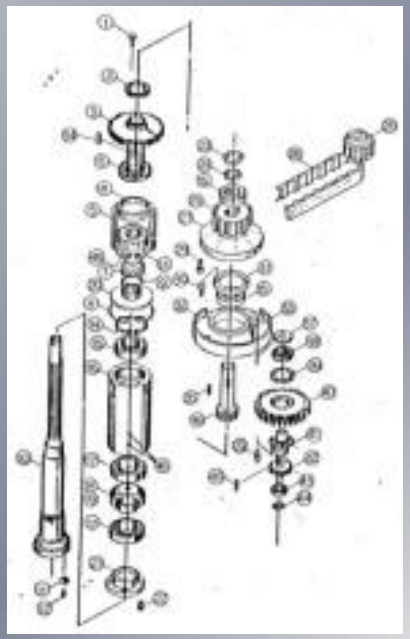
Logic

- Ladder Logic: a written method to document the construction of relay racks.
- Evolved into a programming language

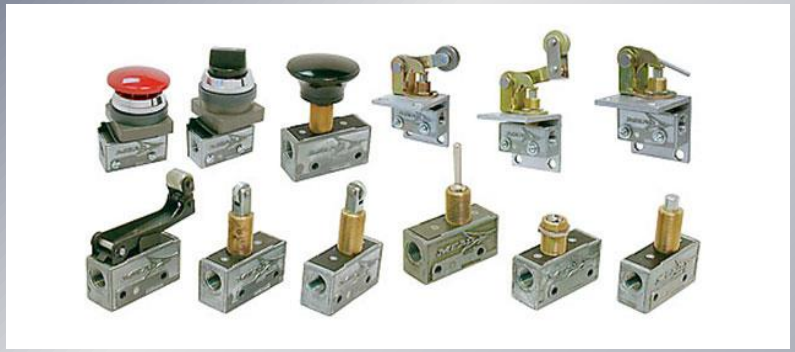


Automatic, Spindle Stop

- Stop Spindle Attachment allows for the automatic screw machine to preform a secondary task while the spindle is stopped and then restart after completion of the operation
- Cross Drilling
- Face and Side Milling
- Off Center Drilling, Milling, Slotting



How Does it Work?

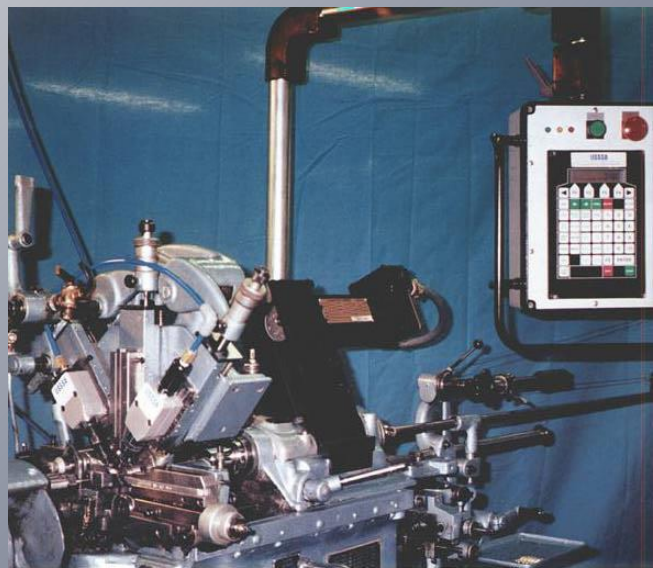


- The system is operated pneumatically, and requires only 80-90 PSI. A cam driven valve sends air to the drive release mechanism. This does not stop the motor or flywheel, but successfully removes driving force from the spindle. Then, without drive to the spindle, a brake is applied, stopping the rod and spindle.

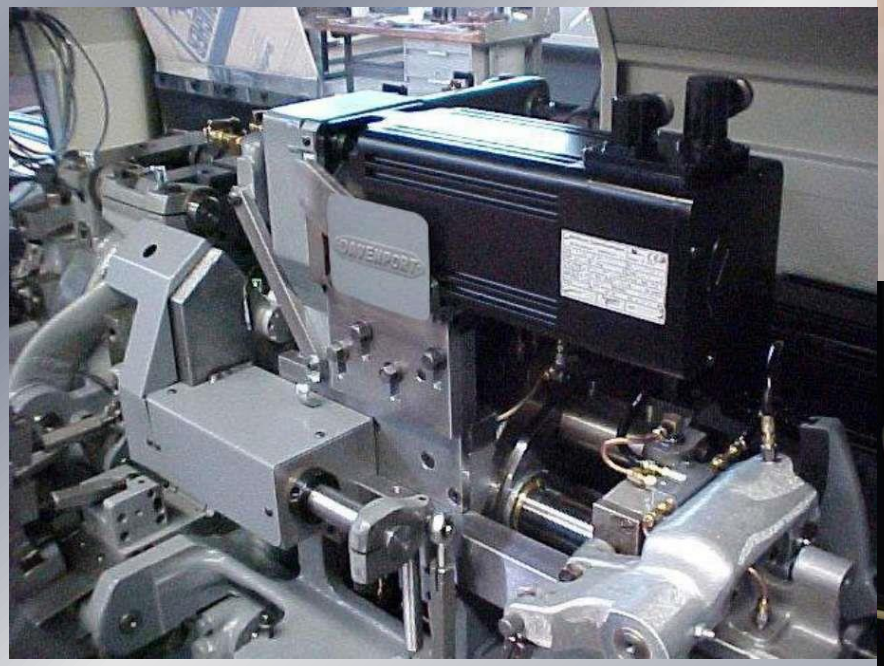
  Because the system is operated from a cam on the main cam shaft, you can stop, hold and restart the spindle at any moment you choose by simply designing the cam to suit your needs as you would in any other tooling operation. When the cam releases the valve, the process occurs in a reverse order, restoring the spindle to operating speed.

C Axis Control for the Automatic

- Purpose: Provide control of spindle speed, direction and indexing. Provides precision orientation of slotting, milling, drilling.
- Eliminate or Reduce Secondary Operation and inherent quality defects incurred from extra handling, chucking, and misalignment
- Ease loading of shaped stock



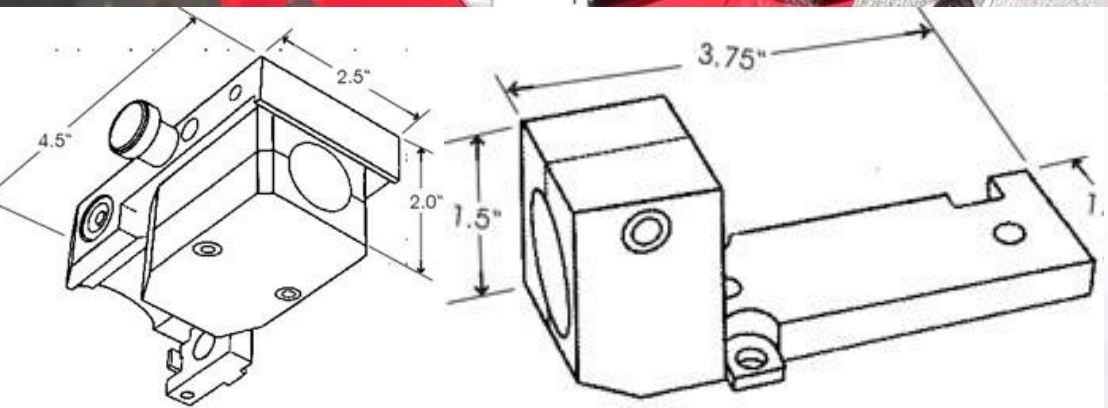
- Several RPM's or Indexes are programmed into the NC device.
- Preprogrammed sequences and fail safes
- RS-232 port interfaces the computer and the control
- Logic operates the installed AC Servo motor
- 12 Programmable I/O ports allow for start up of driven tools
- 0-10,000 RPM CW & CCW
- Index Accuracy to 0.1 Degree

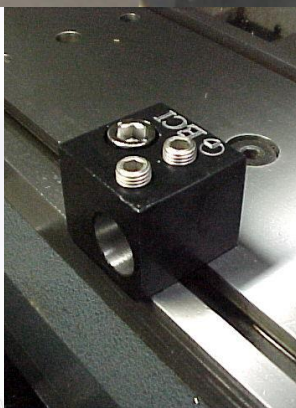


High Frequency Spindles

- Mounted Spindles solve the SFM vs. Small Tool Diameter Incongruity

Innovative Mounting Solutions





Automation

- By Definition: Automatic Control, is the use of various control systems for operating equipment with minimal or reduced human intervention
- Purpose- to save labor, energy and materials or to improve quality, accuracy and/or precision
- Advantages / Disadvantages

OKUMA
ROBUSTURN
LFS10M-2SP

OKUMA

Robotics

- Machine Tending
- Palletizing
- Auto Loading
- Logistics
- Inspection
- Deburring
- Cleaning
- Welding
- Assembly
- Painting
- Packaging

More on Robotics and Automation

<u>Pros vs. Cons of Automation</u>

ROI for the contract manufacturer
Increasing Wages
Lack of skilled labor
Flexibility
Integration
Ease of use

ReThink Robotics

The manufacturing world is changing. And so are its technology requirements. An industry that once looked to automation to drive volume production is now seeking to gain an edge in flexibility, as labor rates rise and availability falls, while consumer demands constantly change. When it comes to manufacturing trends, you might even say that Flexible is the new Fast

Emerging Technologies aimed at Flexibility

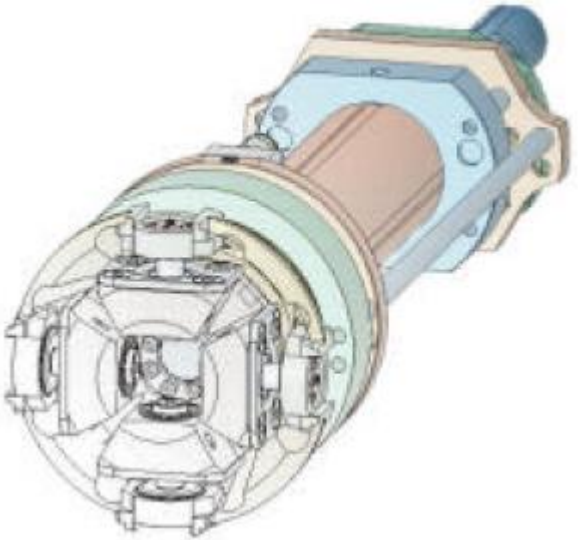
- Tool Changing
- Vision & Orientation of part handling
- Simplified programming
- Machine Tool Integration
- RFID tool and pallet Identification

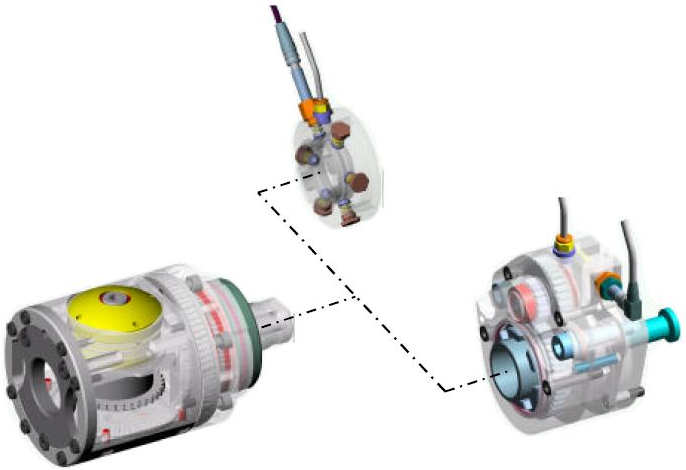
Automation and Lean Misconception

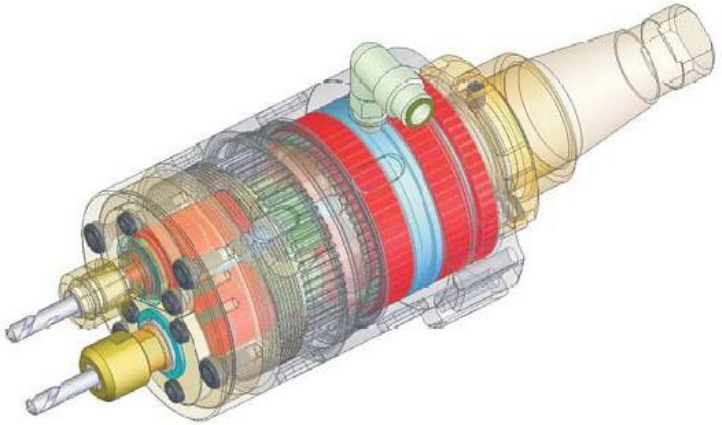
- Common misperceptions about lean manufacturing and automation systems lead many manufacturing managers to dismiss the use of automation in a lean setting.
- Confusion over lean manufacturing principles often results in a knee-jerk dismissal of automation
- There are a lot of misinterpretation and misconceptions about what is lean, and it stems from the misinterpretation of what is waste and what is value-added.

Innovating for Efficiency

- Simultaneous attachments
  - Multiple Cross Drilling
  - Slot Milling
  - Eccentric Drilling
- Eccentric Turning
- Longitudinal Profile Generation





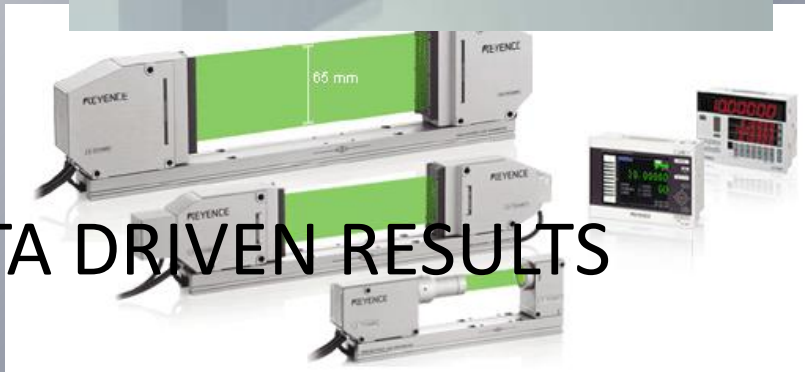


Safety Innovations

- Cage-less Automation
- Safety Light Curtain
- Reduce the need for Guards

Innovative Process Monitoring

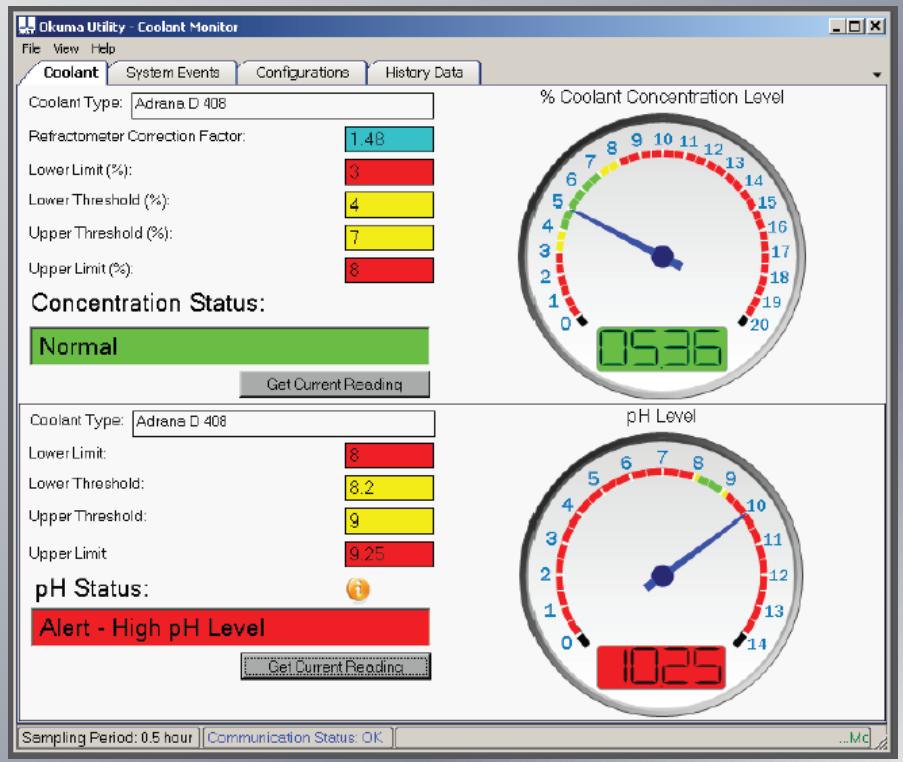
- In-Process Gauging
  - Size of Feature
  - Vibration
  - Strain / Deformation
  - Temperature
  - Force / Acceleration
  - Acoustics
  - Power Consumption



FEEDBACK IS CRITICAL FOR DATA DRIVEN RESULTS

Innovative Process Monitoring

- Coolant Level, Concentration, and Ph Monitoring
  - Displayed on Phone or Device
  - Displayed on Machine
  - Alert System



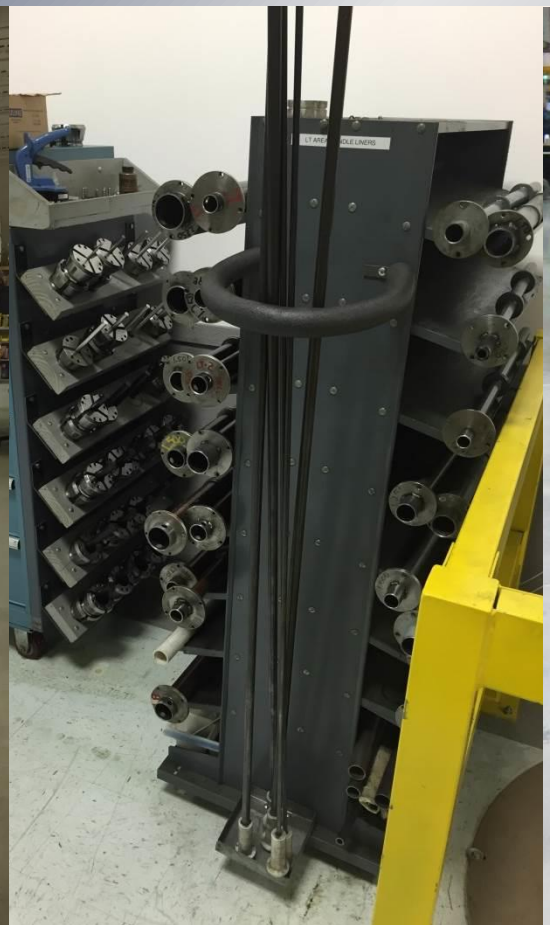
Innovative Process Monitoring

- Machine Alert System (Think OSP App)
- The Machine Alert System allows user to assign machine alarms to be sent to user by email, text message, and dial to a mobile phone

- RFID Tool Management
- RFID code tags are installed on each tool holder, which contains information on the tool (T#, geometry, life, etc.). The system connects directly to your Presetters collecting and storing Tool Offsets during presetting. Tool-ID also integrates directly to your CNC equipment, automatically registering offset information as tools are loaded into the ATC. These features greatly reduce setup times and ensuring data integrity.

What is needed to Achieve an Innovation?

Homegrown Innovations that Utilize Waste



Conclusion

- Change is Inevitable
- Exploration, Observation, and Questioning are the only means to gain Insight
- Effective Solutions Gain a Competitive Edge
- Company Wide Effort / Culture

Do your current business practices/principles aid in, or prevent, innovative thinking?

PMPA
PRECISION MACHINED PRODUCTS ASSOCIATION
Tools You Can Use