AUTODESK. UNIVERSITY

Why use Multi-Tasking Machines: Done in One

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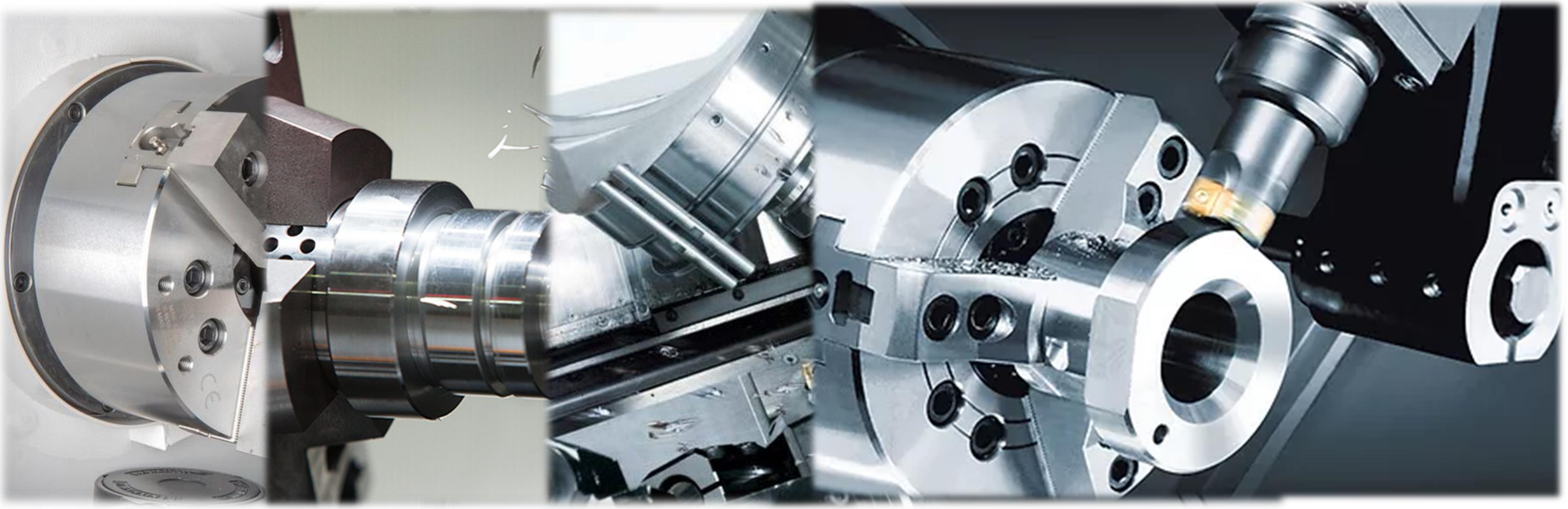
Mazak Corporation

Oldest and largest metal chip cutting machine tool builder.

- **Established in 1919**
- **Building Machine Tools in Florence KY since 1974**
- **North American Headquarters and Manufacturing Campus covers over 800,00 ft²**
- **In 1995 the Agility Forum honors Mazak for having the “Best Agile Practice” in manufacturing. Mazak receives “The Philip B. Crosby Award” for global competitiveness.**

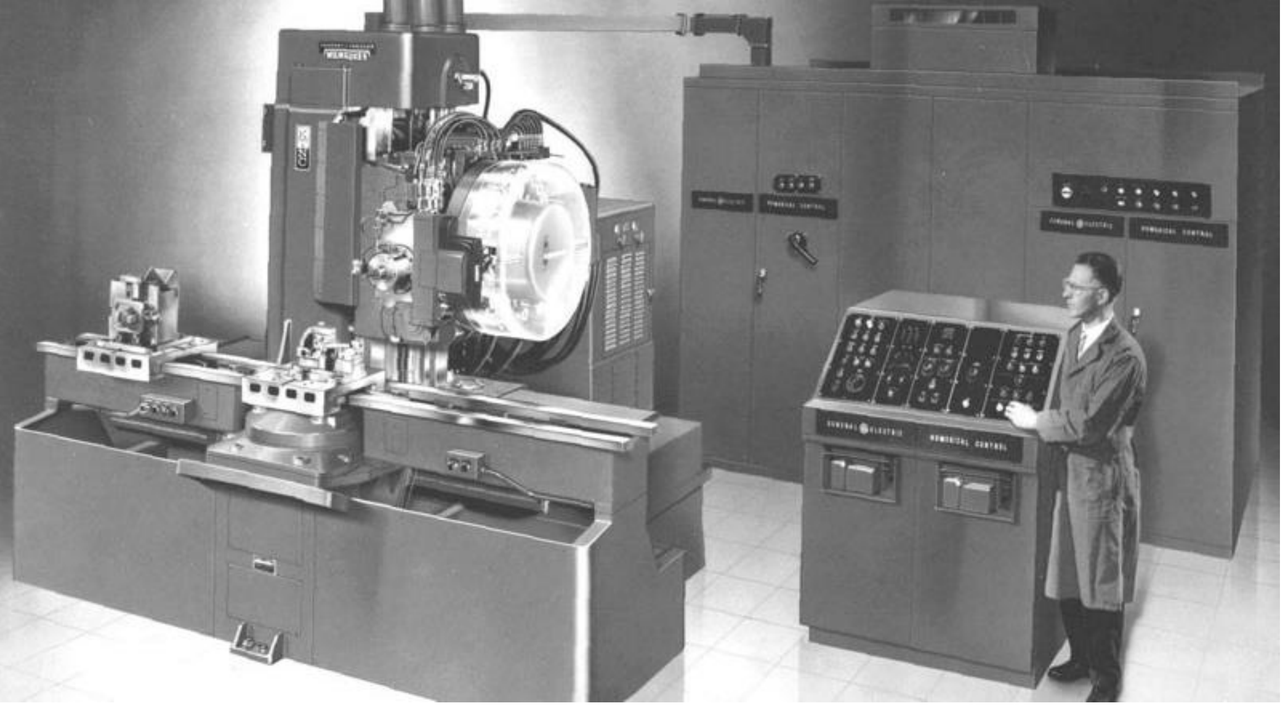


Multitasking (Mill/Turn) Machines

Multitasking is combining several processes from different machines into one machine platform

Back in Time

To understand Multitasking lets cover a quick bit of history



1952 Cincinnati Milacron Hydrotel

Richard Kegg, in collaboration with MIT, developed the first CNC milling machine: the Cincinnati Milacron Hydrotel.

Punched Paper

Early machines used Punched paper technology to drive the machine.

More familiar CNC

As technology moved into the 1960s and 1970s, a more recognizable form of a CNC machine started taking shape.

- **Grew in popularity**
  - Ultra precise results
  - Large quantities across many applications
- **New issues came up**
  - Parts waiting for open spindles
  - Parts traveled to far
  - Scrap
  - Smaller lot sizes

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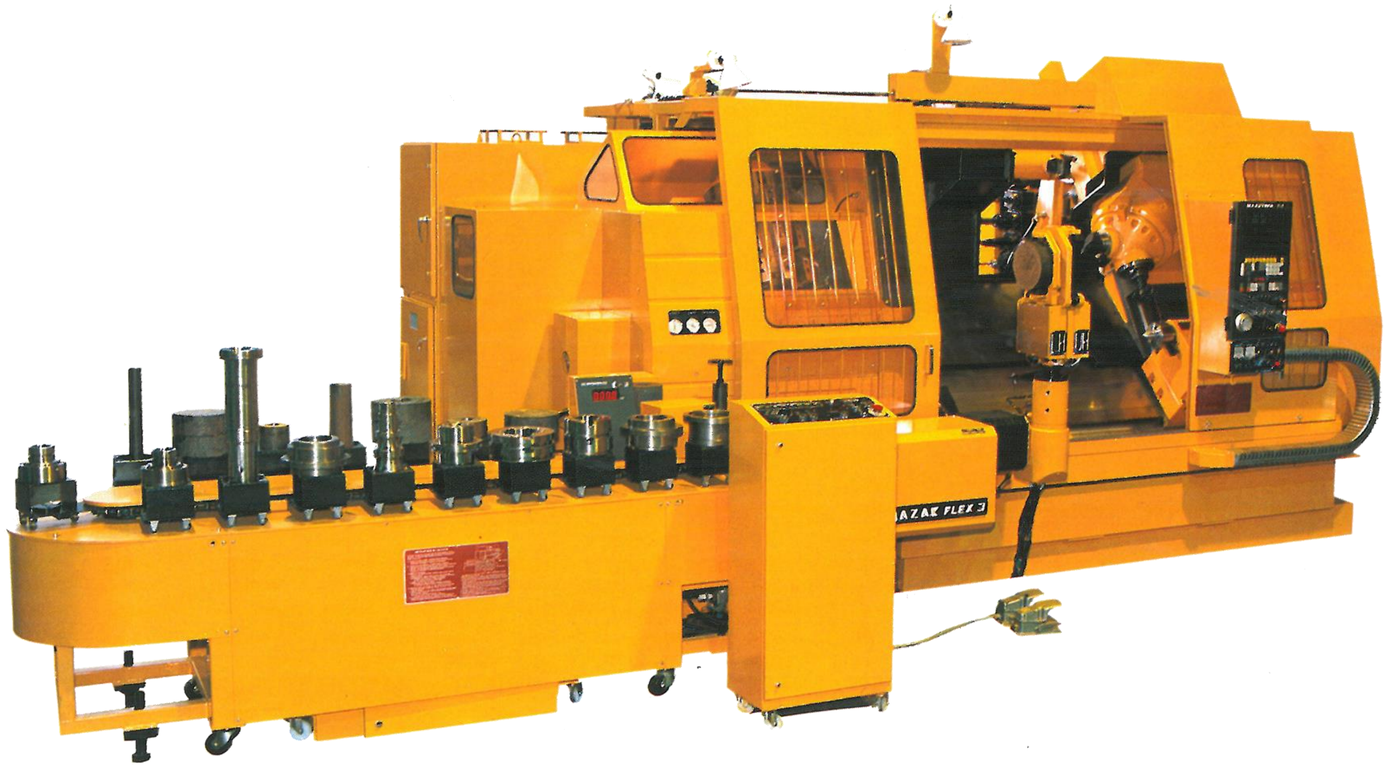


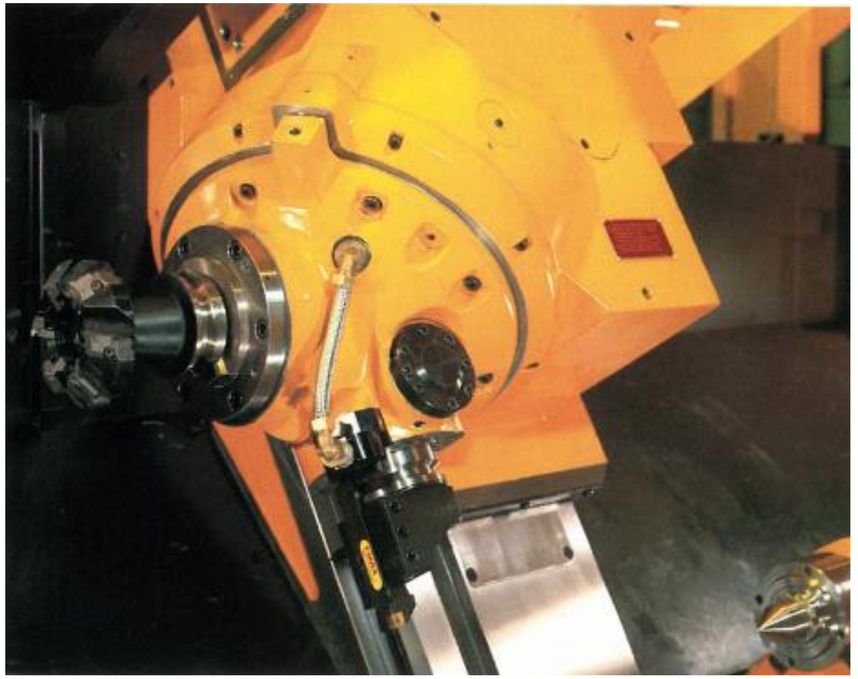
First True Multitasking Lathe

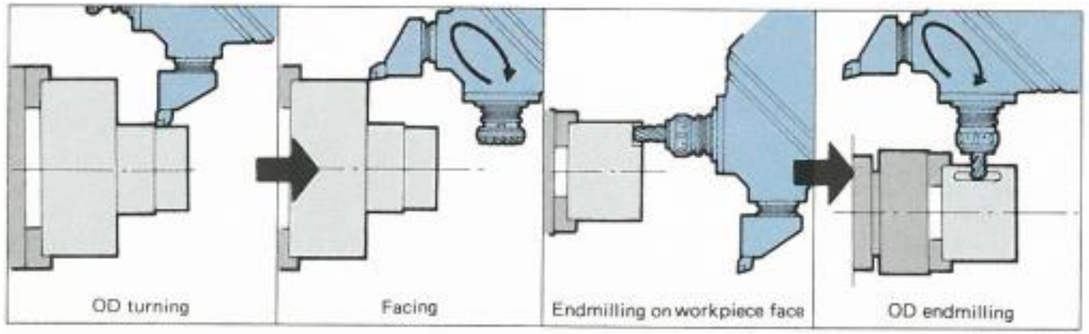
In 1983, Mazak Corporation was the first to commercially introduce the first multitasking machine.

A New Mill/Turn World

Introduction of a machine with both turning and milling ability.

- **The unique indexable head design would allow the milling or the turning tool to cut in both the vertical and horizontal environment.**





Today

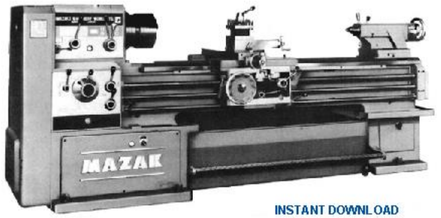
Multitasking machine tool technology are bringing shops to a much higher level of productivity than ever before.

- **Shops can be more competitive**
  - Higher complexity
  - Single Set Up
  - Less human intervention

One machine producing higher quality parts previously made using two or 3 different machines

Development of Multitasking Machines

MANUAL LATHE



CNC LATHE

MULTITASKING LATHE

MULTITASKING MACHINE

Why Multitasking

CONSOLIDATION OF PROCESSES

A part has many operations like turning and milling, the multitasking machine can put all these in one setup.

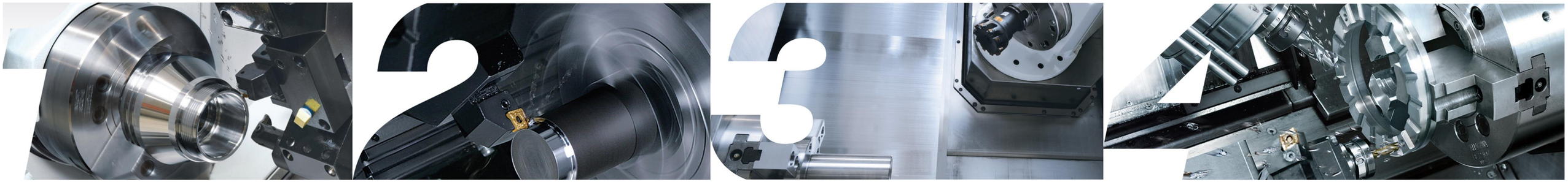
REDUCE TAKT TIME

With Multitasking the part doesn’t have to move from machine to machine. Therefore, the setup time will be drastically reduced which results in overall Takt time reduction.

REDUCE WIP

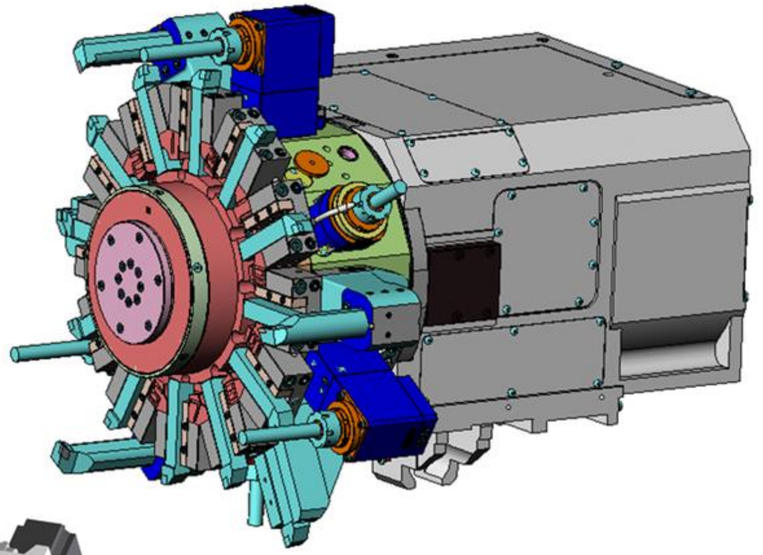
Can perform many operations in one footprint, eliminating the need to move the workpiece through the shop.

Levels of Multitasking

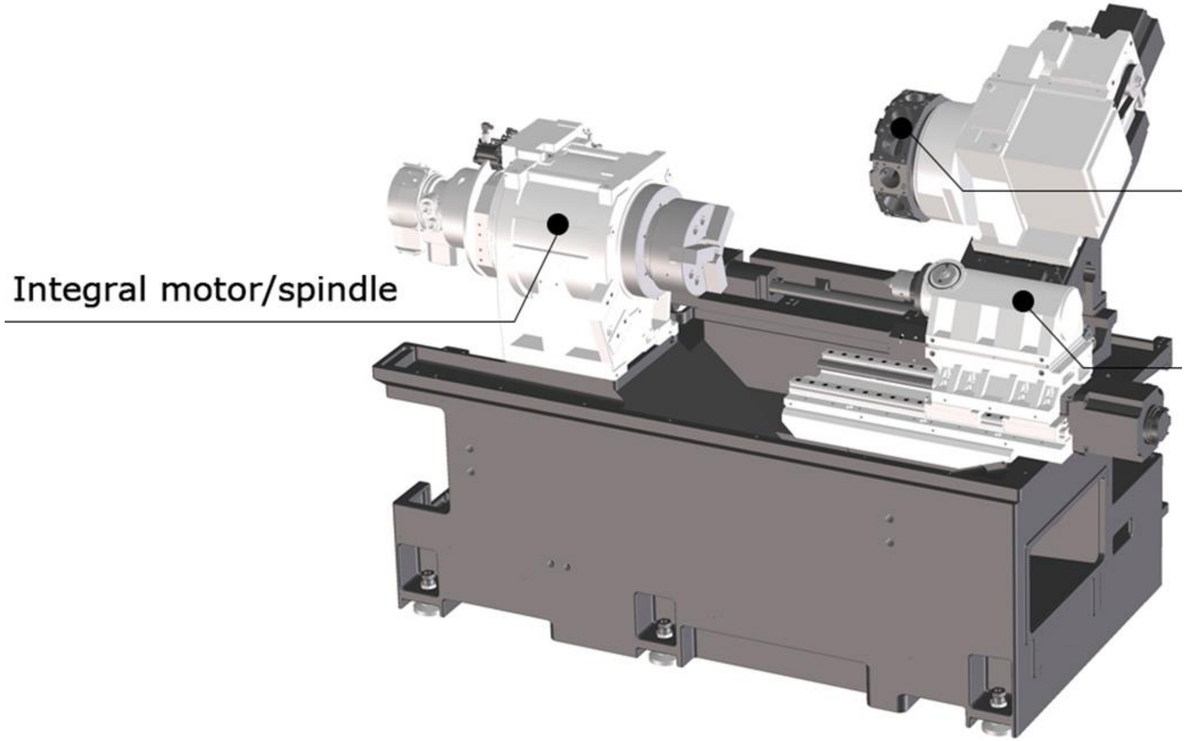


To assist you in determining the right level of Multi-Tasking technology for your facility, 4 distinct Levels of Multi-Tasking have been developed and can be applied to your specific part machining needs.

Level 1

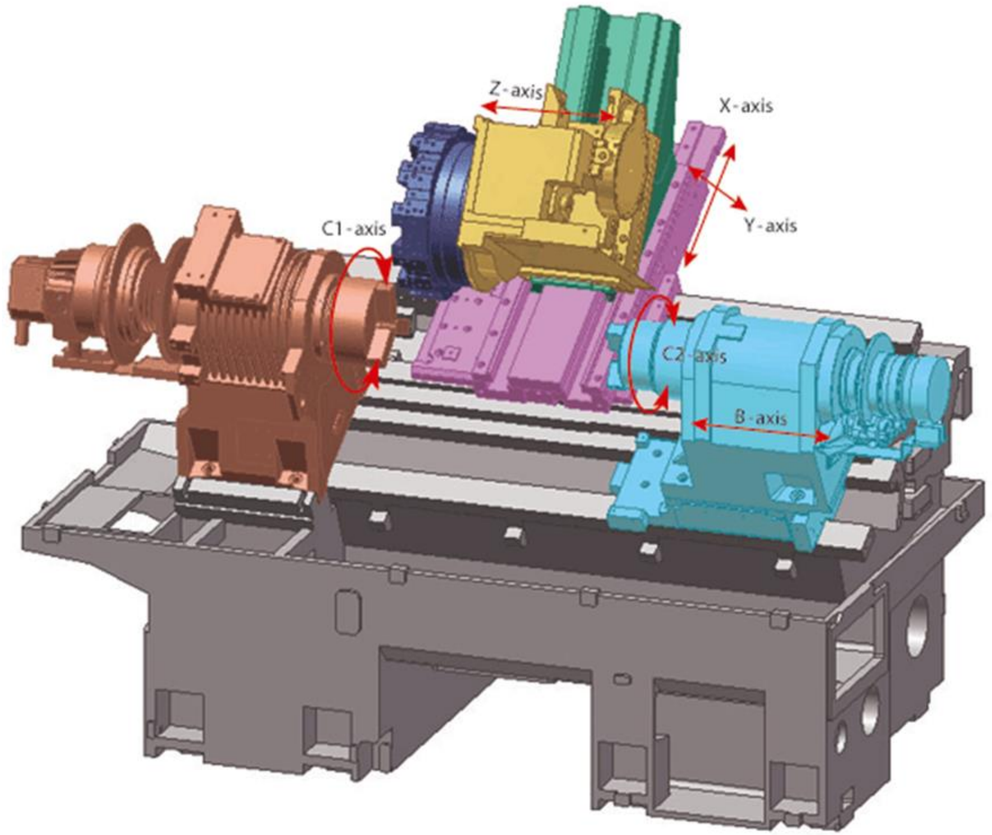


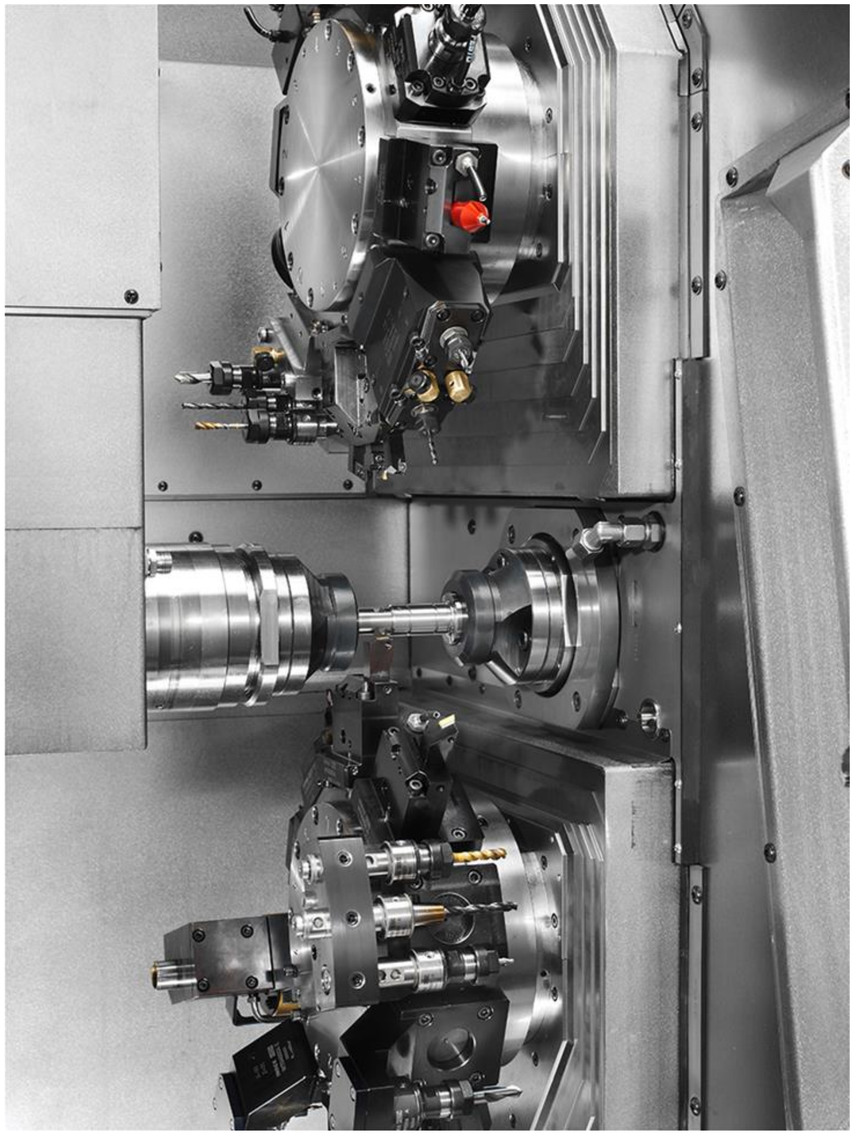
- **Level 1.**
  - Single Turning Spindle.
  - Drum Turret
  - Rotating Tool Capability



Level 2

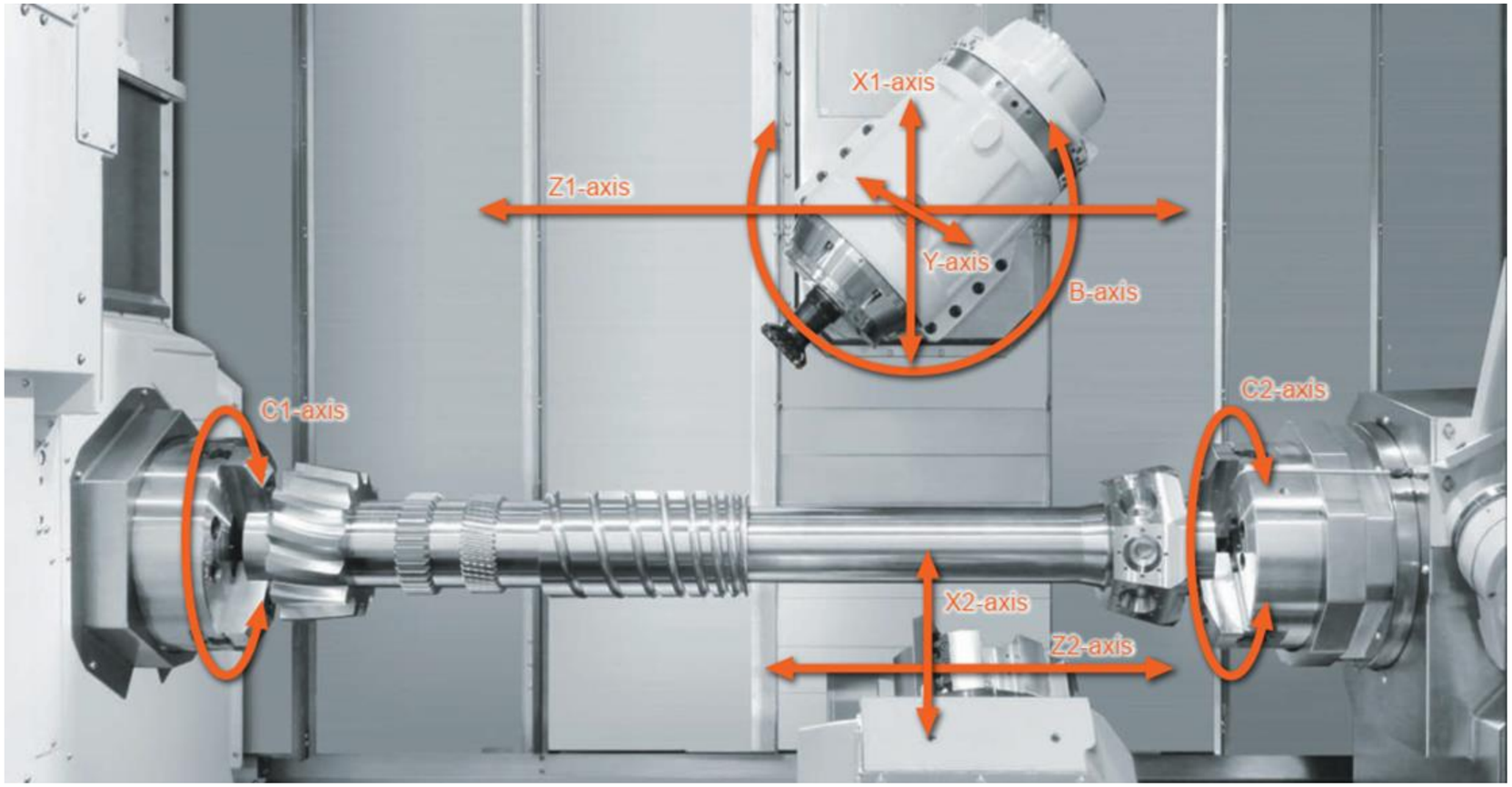
- **Level 2.**
  - Virtual Y Axis Ability.
  - Addition of 2nd Spindle.
  - Addition of 2nd Turret.





Level 3

- **Level 3.**
  - Milling Headstock.
  - Full Y axis.
  - Indexing B axis.
  - Large capacity tool Magazine.



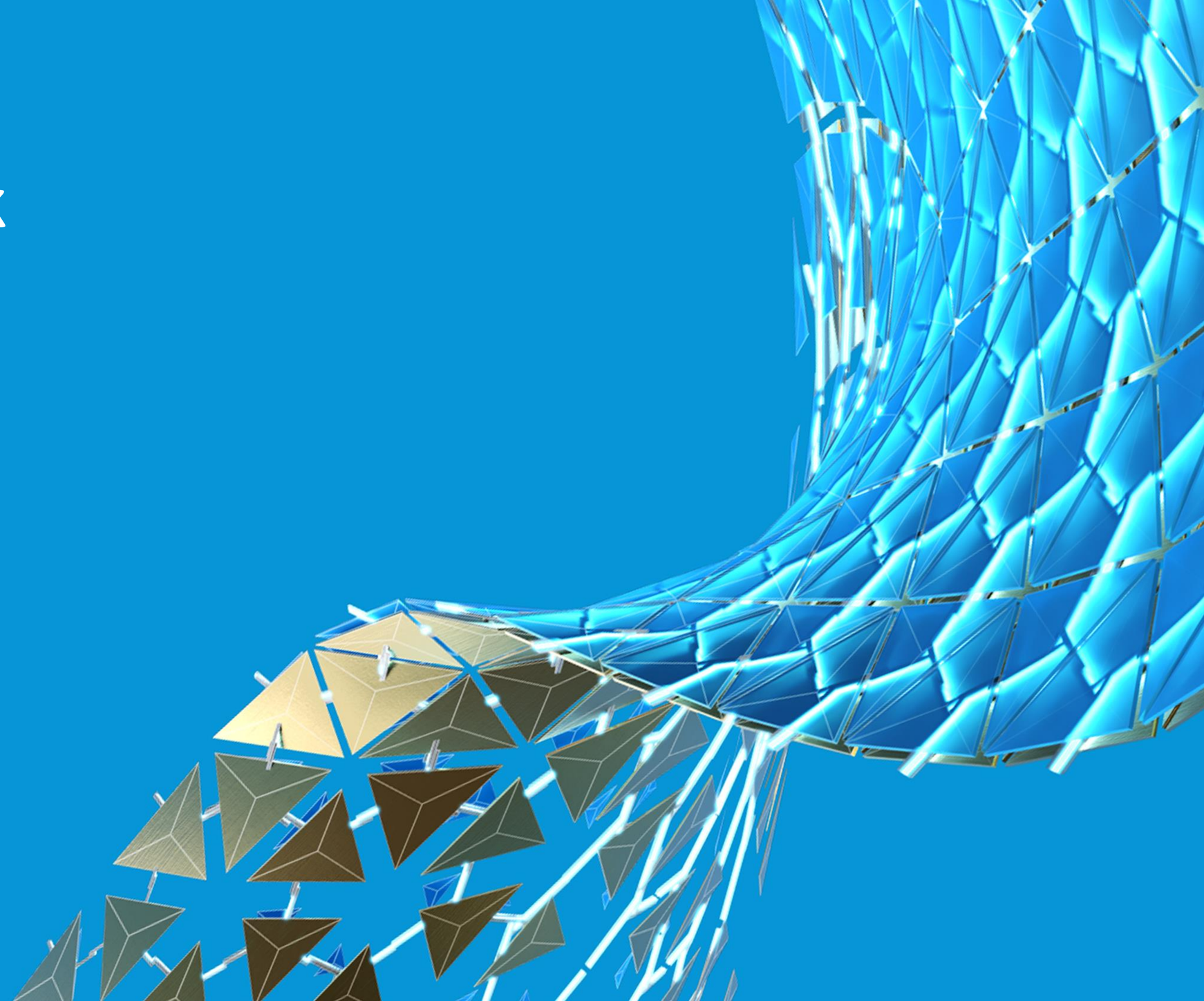
Level 4

- **Level 4.**
  - Full B axis.
  - Full 5 axis control capability.
  - Automation.

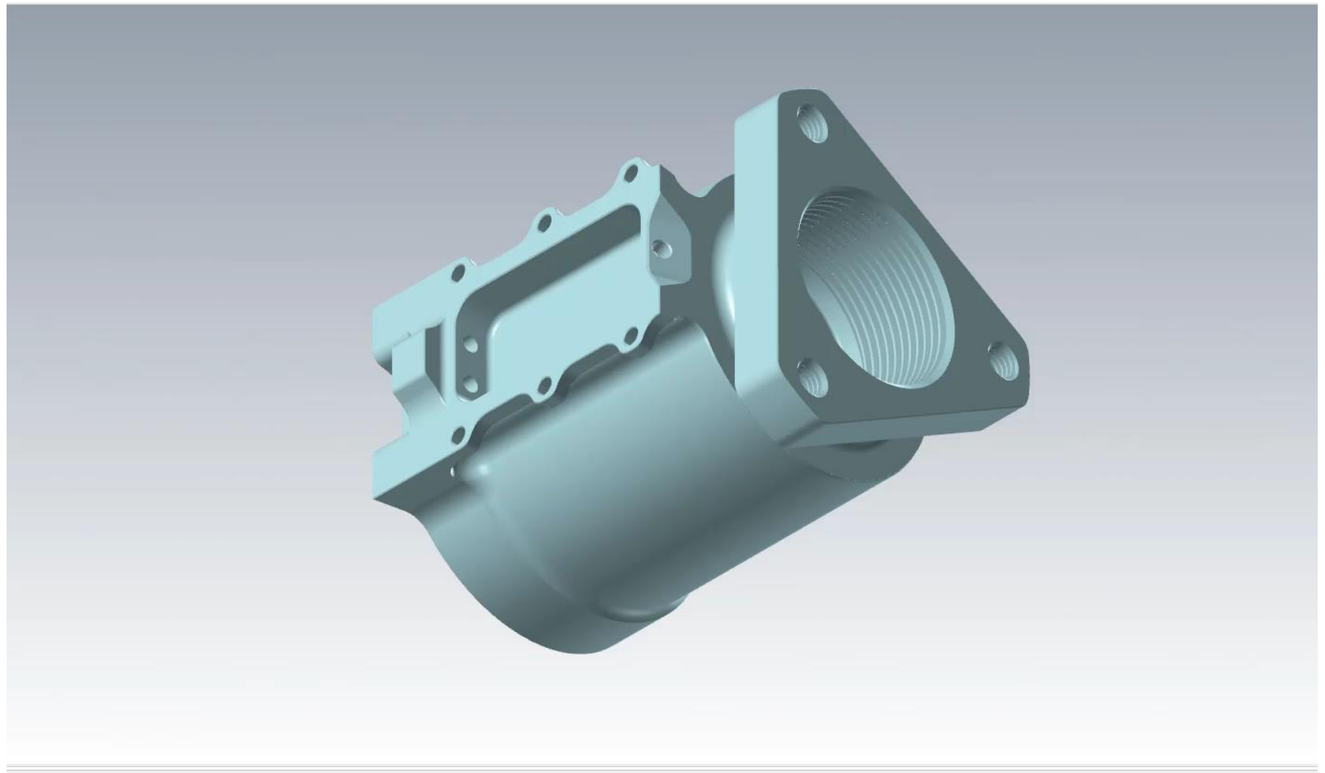
What level is best for you

Shops should not undervalue the advantages of having one on the shop floor. For shops that both turn and mill parts, it’s time to start looking into multitasking machines.

Section Break

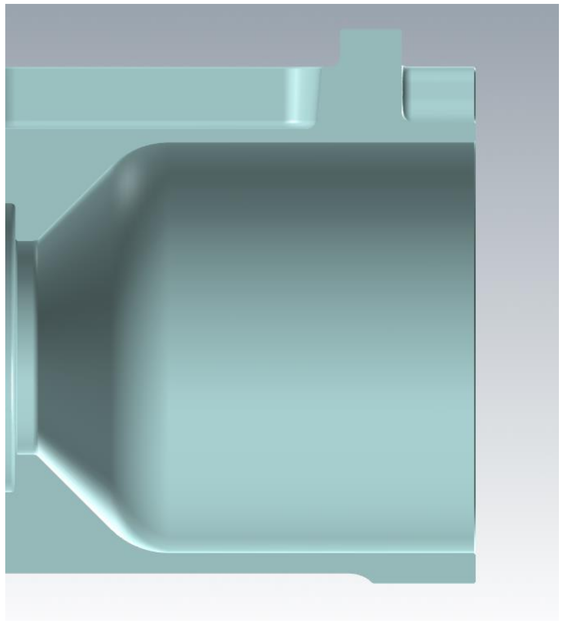


Example



Typical Aerospace Fuse Housing

Bills Machine Shop Lathe Department

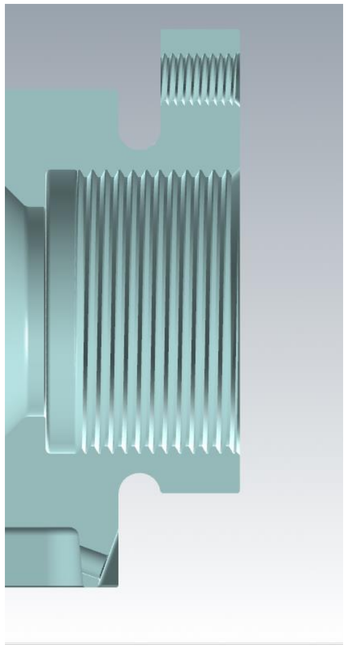


LATHE MACHINE 1

Face Front

Drill Center Hole

Internal Bore



LATHE MACHINE 2

Face Front

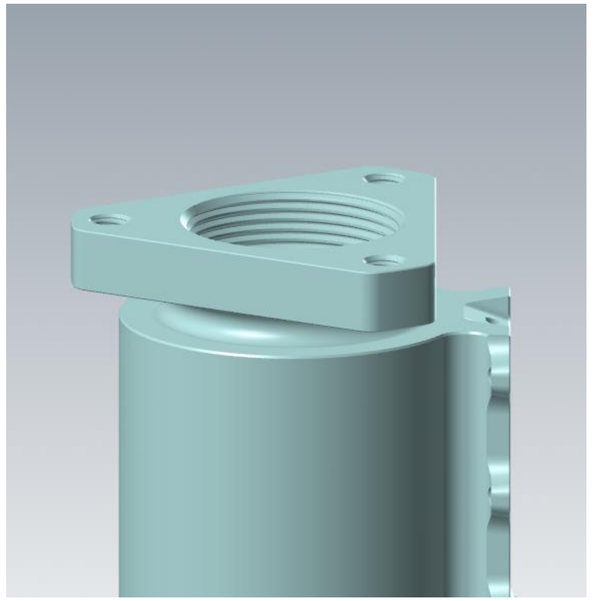
Turn OD radius Grove

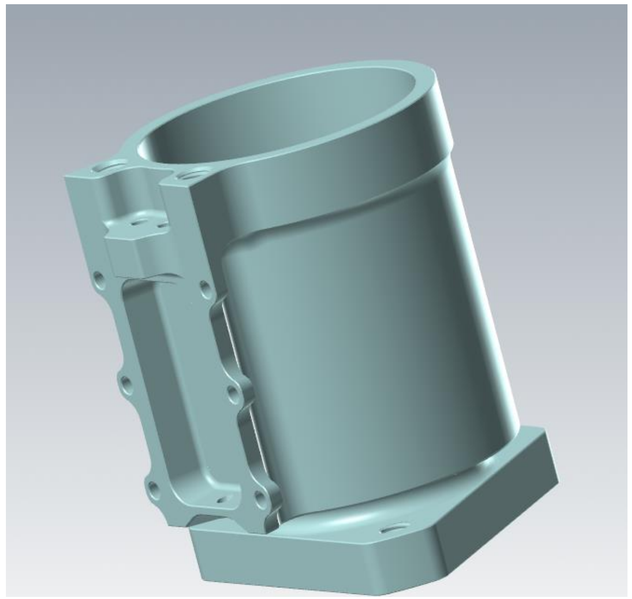
Drill Center Hole

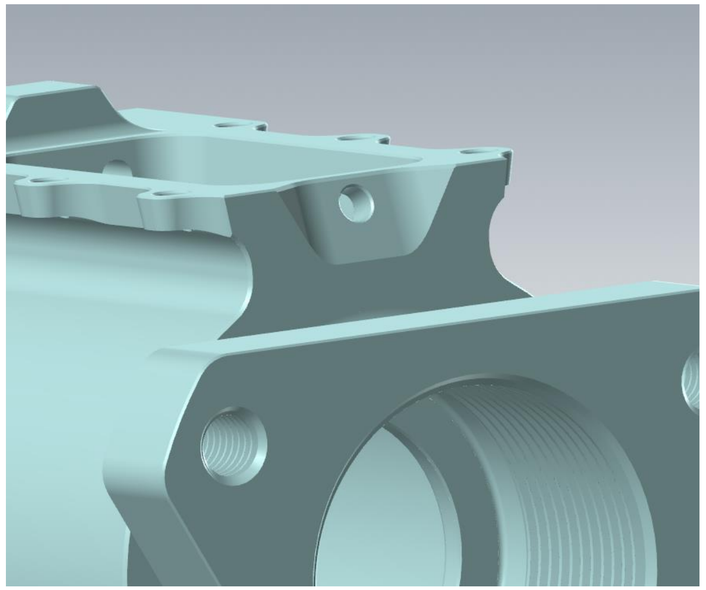
Internal Bore

Thread ID

Bills Machine Shop Mill Department







MILLING MACHINE 1

Mill Triangular Shape

Drill and Tap 3 Holes

MILLING MACHINE 2

Mil Contour Face

Drill and Tap 2 Holes

Drill and Ream 2 Holes

Index Part

Machine Cylinder

Machine Pocket Area

MILLING MACHINE 3

Machine Angle Flat

Machine Angle Hole

Completed Part

Part has been completed and is ready to go to the customer.

Data

The total overview to run the part through the Machine shop.

- **5 total machines**
  - 2 lathes
  - 3 milling machines
- **Costs**
  - Direct
  - Indirect
  - Number of employees required
- **Cycle Times**
  - Cutting Cycle time per Machine
  - Load and unload time

Cell / Line Machines

Cell Machines

Machine	LoadTime	UnLoadTime	DirectCost	NumEmployee	InDirectCost	CycleTime
1	1	1	40	1	85	30
2	7	2	50	0	20	13
3	10	2	25	1	100	20
4	10	2	40	1	100	150
5	1	1	25	1	80	5

Data Using Mazak Multitasking Calculator.

Total Time

The time to run the part through the Machine Shop.

- **1,366 total hours**
  - Set Up Time for 5 machines
  - Load/ Unload time for 5 machines
  - Total cutting Cycle Time
  - 1366 reflects longest single machine cycle time

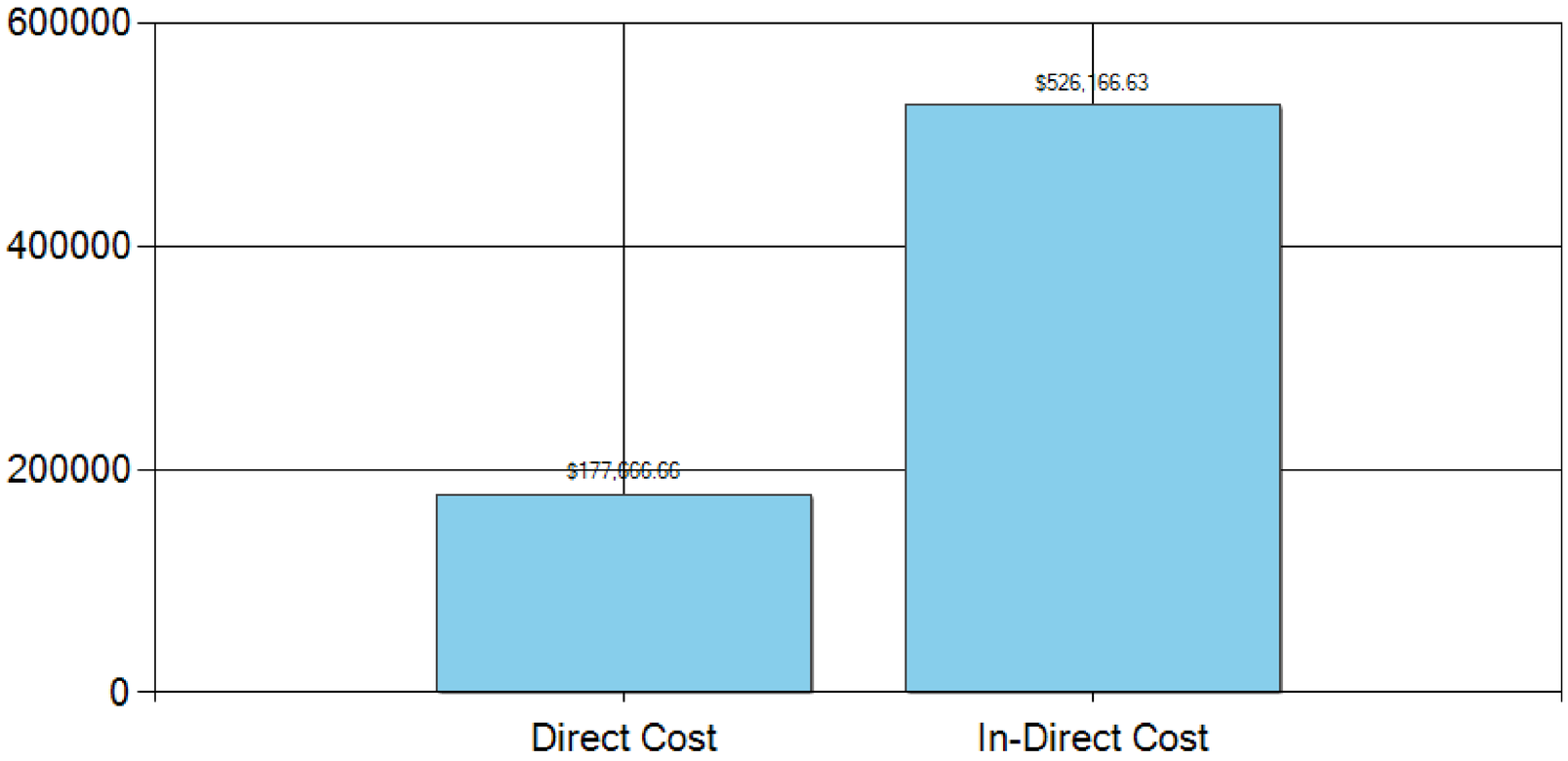
Total SetUp Time	16.67	Hours
Total Load Time	241.67	Hours
Total UnLoad Time	66.67	Hours
Total In Cycle Time	1,816.67	Hours
Time to complete Scheduled Job	**1,366.67**	Hours

8.5 months to run the complete 500-part job.

Costs

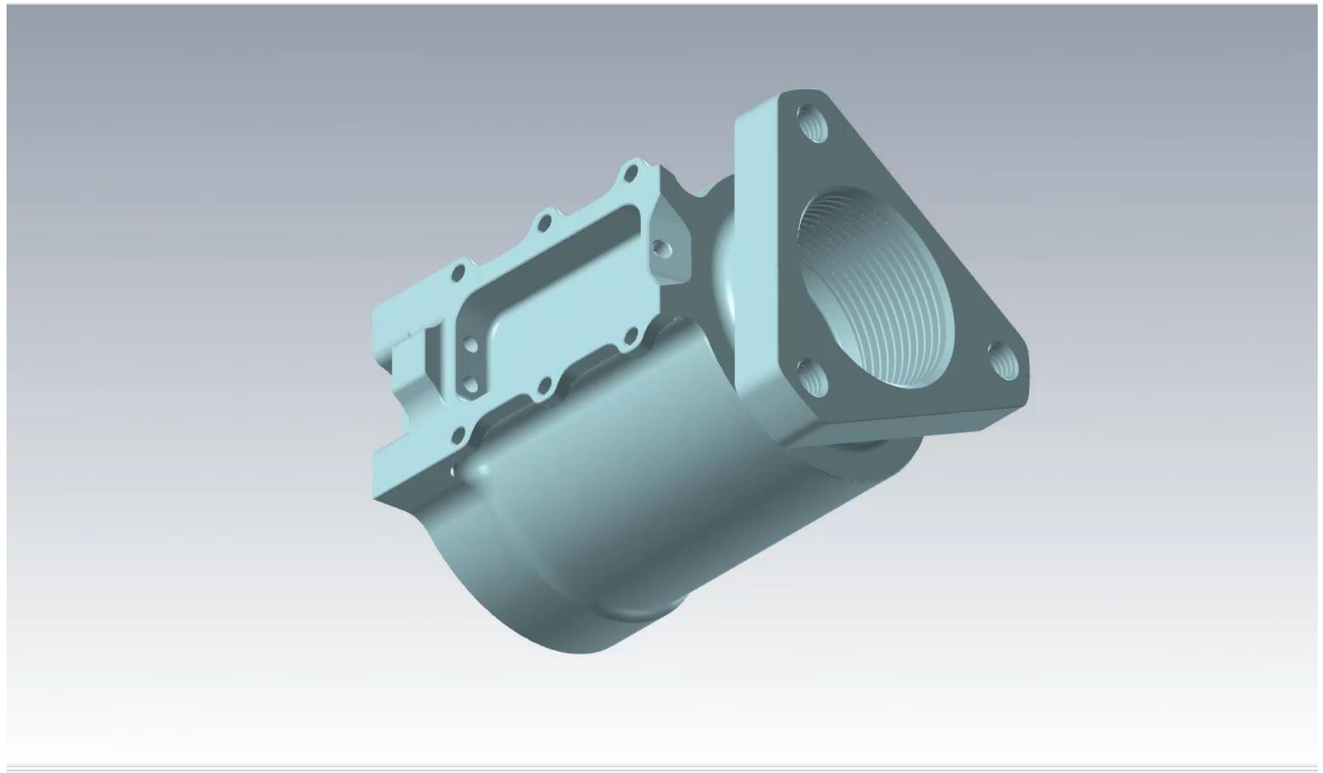
The cost to run the part through the Machine Shop.

- **Direct Costs**
  - Material
  - Tooling
  - Manufacturing Supplies
- **Indirect Cost**
  - Electricity
  - Labor
  - Rent
- **Job yielded $1,092.00 profit per part**
  - (Direct + Indirect)/# of Pieces

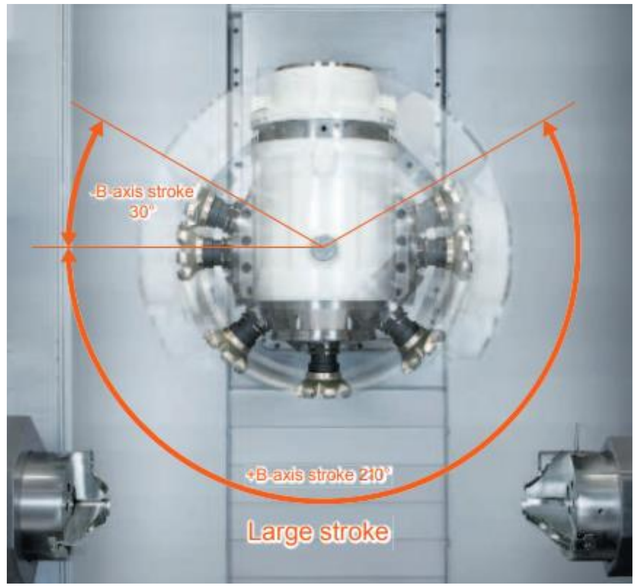


$703,832.00 to run the complete job of 500 pieces.

Frank’s Done-in-One Machine Shop



Typical Aerospace Fuse Housing



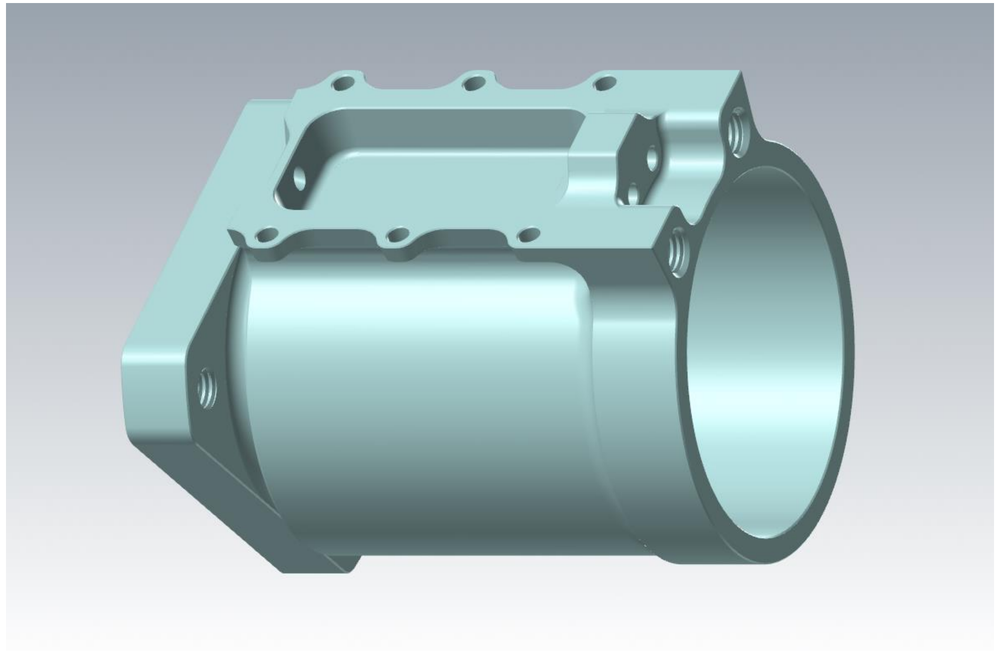
General Specifics

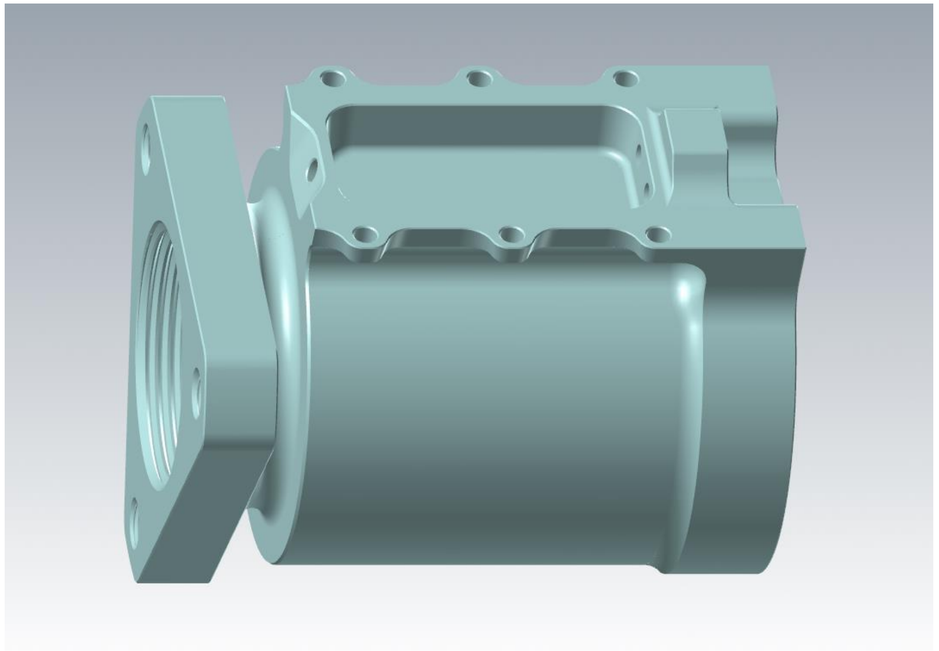
- All powerful aspects of 2 Turning Centers.
- Full C axis on both spindles.
- Lower Turret adds flexibility and productivity.

Full Milling Spindle

- Comparable milling spindle
- Full indexable B axis

Frank’s Done-in-One Machine Shop





MULTITASKING MACHINE 1 HEAD 1

- Face Front
- Machine all ID work
- Machine Face Contour
- Machine Outside Cylinder
- Machine Fuse Pocket

Automatic Transfer

MULTITASKING MACHINE 1 HEAD 2

- Face Rear
- Turn OD radius Grove
- Machine all ID work
- Machine Face Triangle
- Machine compound angle feature

Franks Done-in-One Machine Shop

Slug is loaded once in first spindle. Part is automatically transferred to the second spindle.

Data

The total overview to run the part through the Machine shop.

- **1 Multitasking Machine**

- **Costs**
  - Direct
  - Indirect
  - Number of employees required
- **Cycle Times**
  - Cutting Cycle time per Machine
  - Load and unload time

Multitasking Machines						
Machine	LoadTime	UnLoadTime	DirectCost	NumEmployee	InDirectCost	CycleTime
1	2	1	85	1	100	90

Data Using Mazak Multitasking Calculator.

Total Time

The time to run the part through the Machine Shop.

- **776 total hours**
  - Set Up Time for 1 machine
  - Load/ Unload time for 1 machine
  - Total cutting Cycle Time

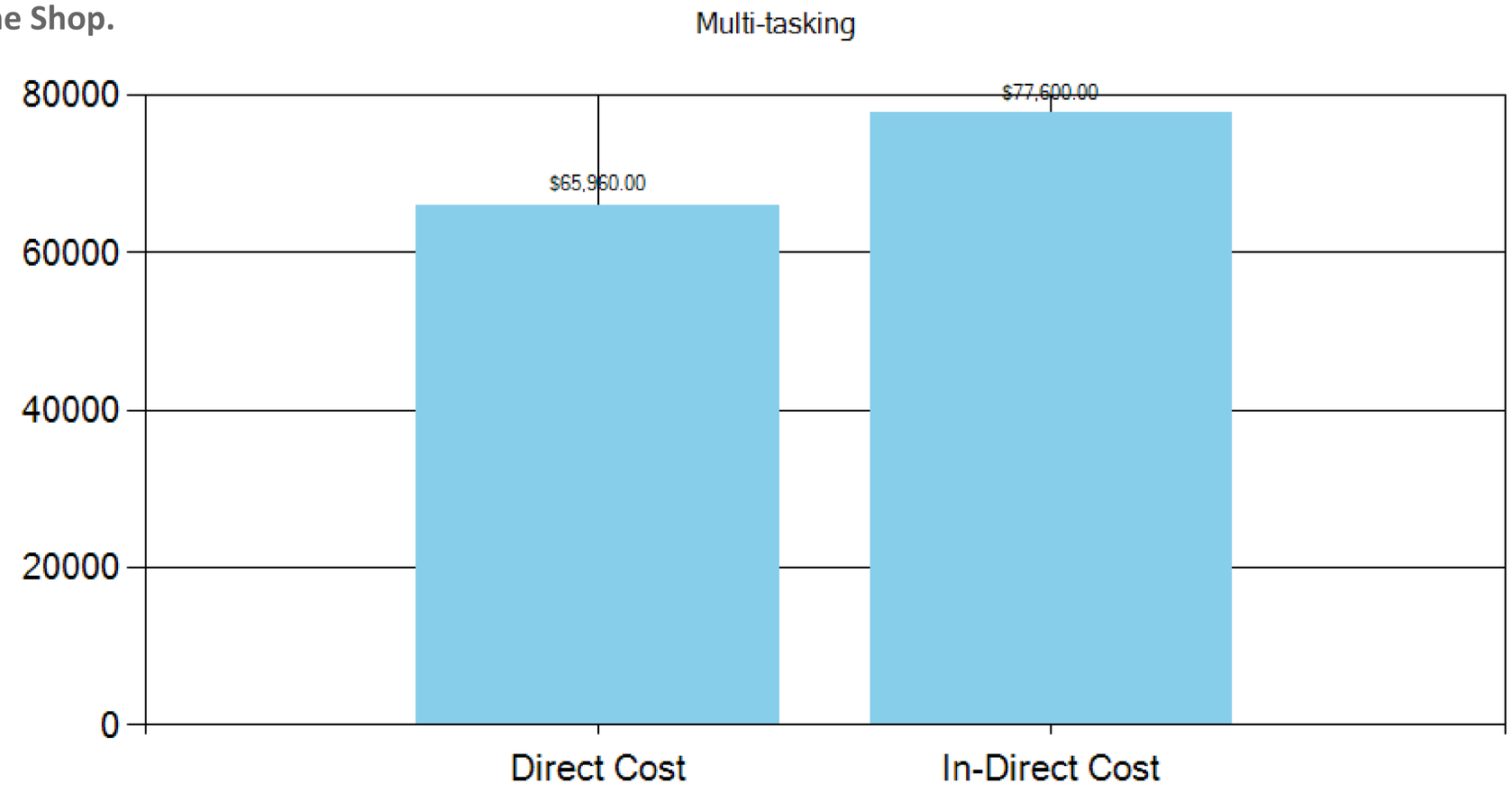
Total SetUp Time	1	Hours
Total Load Time	16.67	Hours
Total UnLoad Time	8.33	Hours
Total In Cycle Time	750	Hours
Time to complete Scheduled Job	**776**	Hours

4.8 months to run the complete 500-part job.

Costs

The cost to run the part through the Machine Shop.

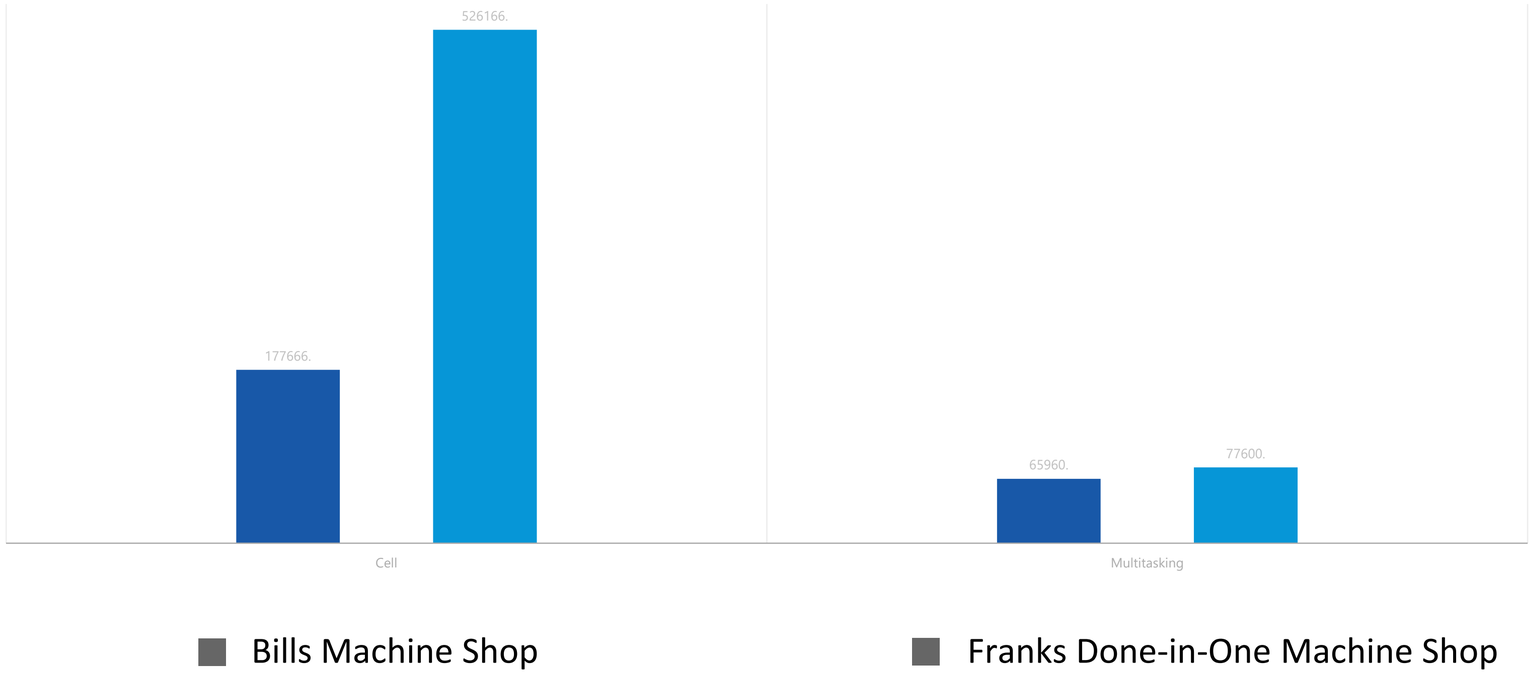
- **Direct Costs**
  - Material
  - Tooling
  - Manufacturing Supplies
- **Indirect Cost**
  - Electricity
  - Labor
  - Rent
- **Job yielded $2,212.00 profit per part**
  - (Direct + Indirect)/# of Pieces
    - $287.12 cost per part



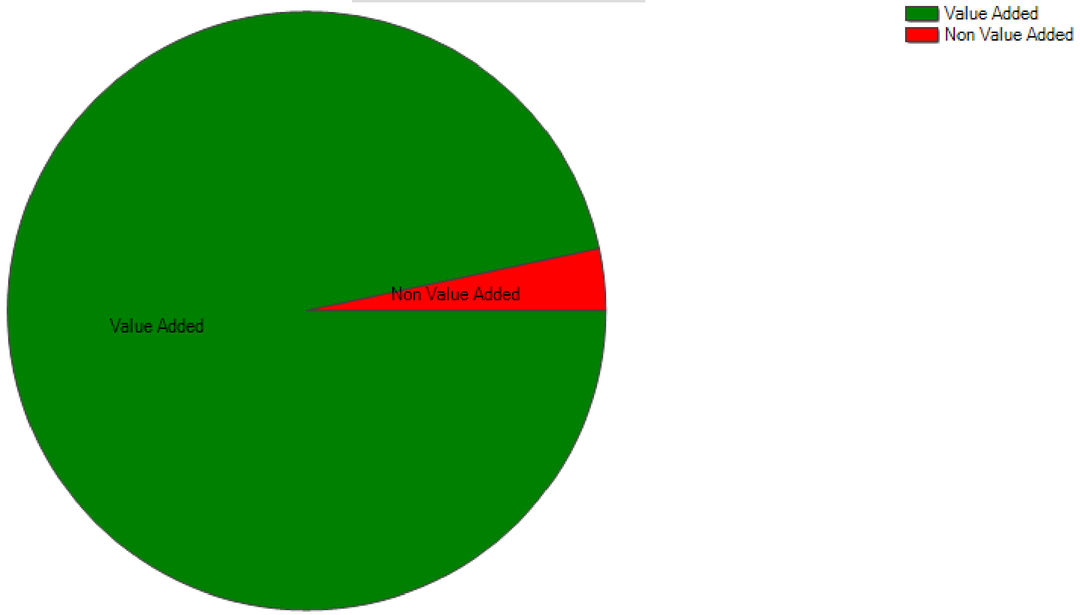
$143,560.00 to run the complete job of 500 pieces.

Total Costs

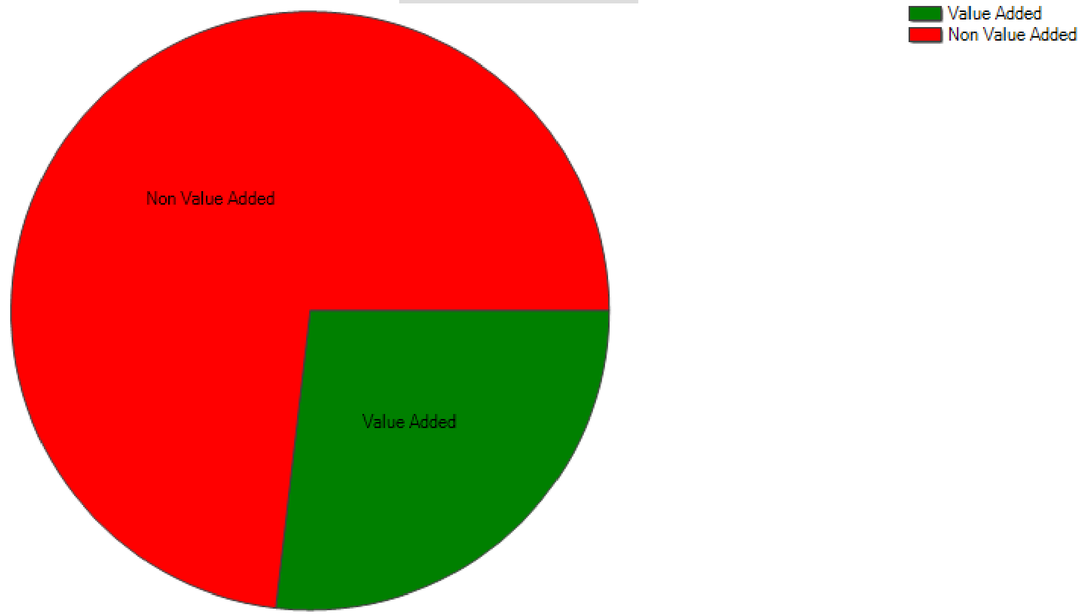
Chart showing Direct and Indirect cost comparison between shops



Frank's Shop

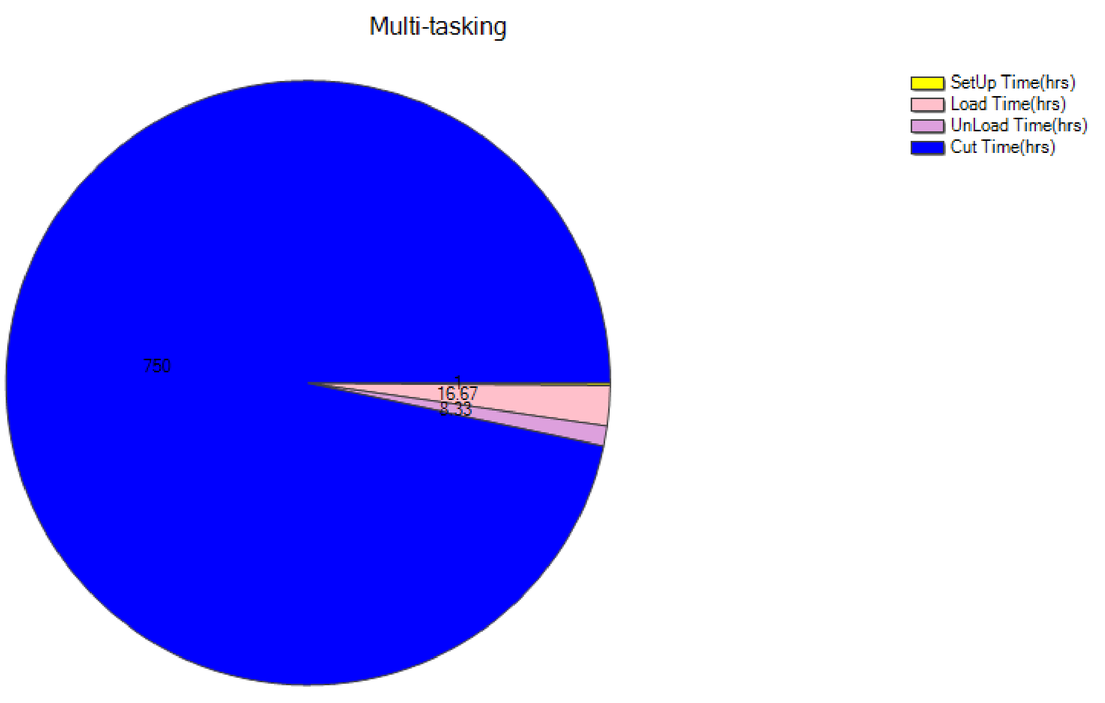


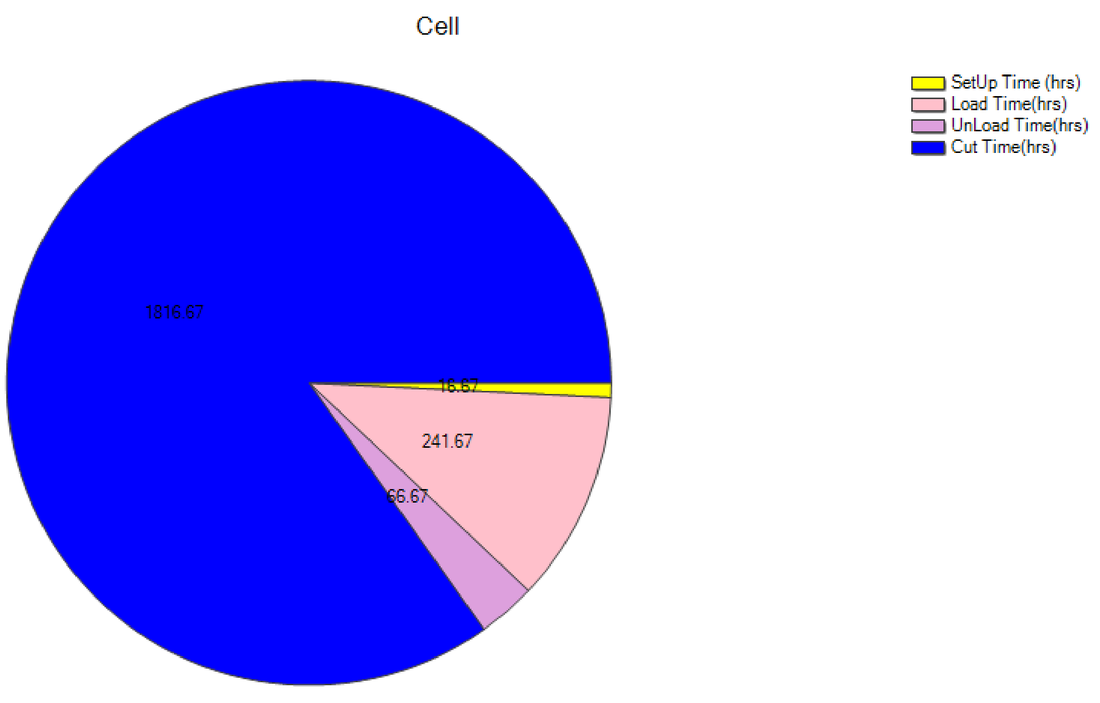
Bill's Shop



Value Added vs Non-Value Added

Non-value-added time or activity in a production or manufacturing process is any **time** spent on a step in that process that **adds** nothing to the finished product. This is in opposition to **value-added** activity, which **adds** some **value** that a customer will pay for with the finished product.



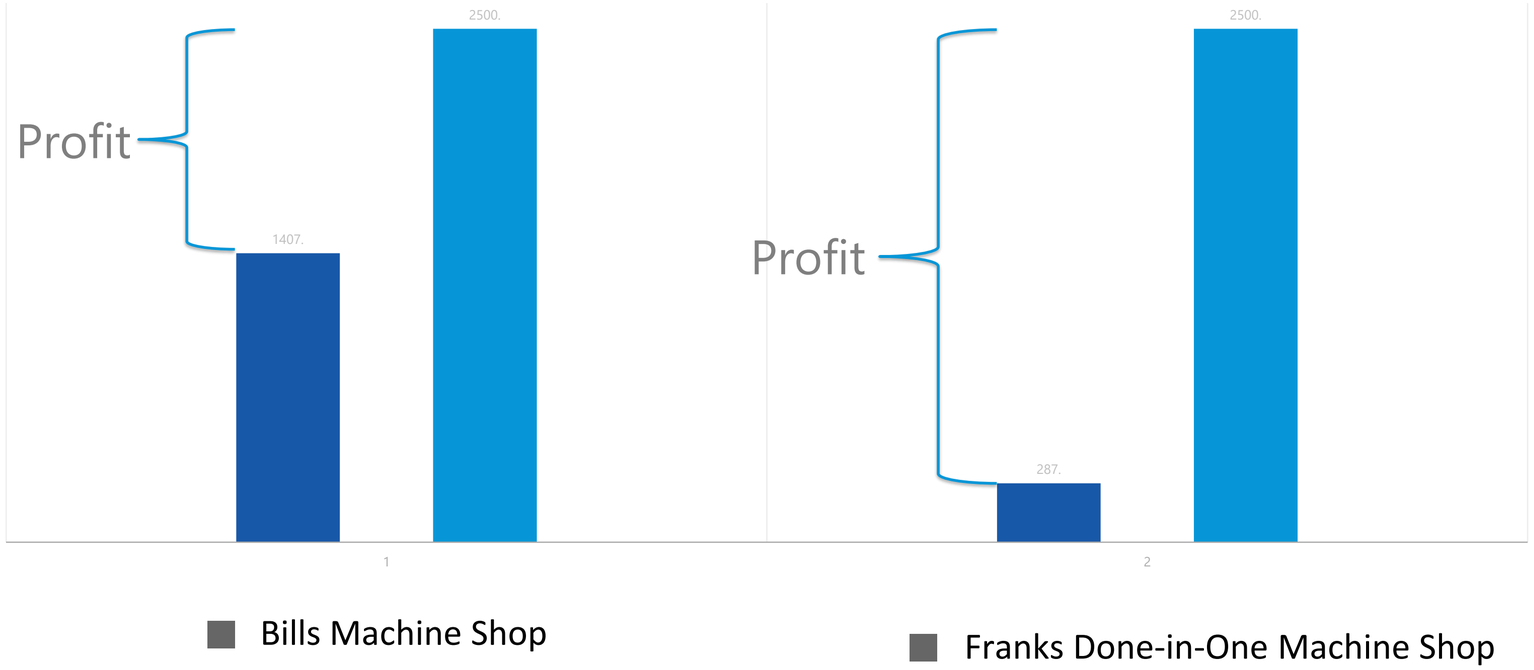


Break Down of Time

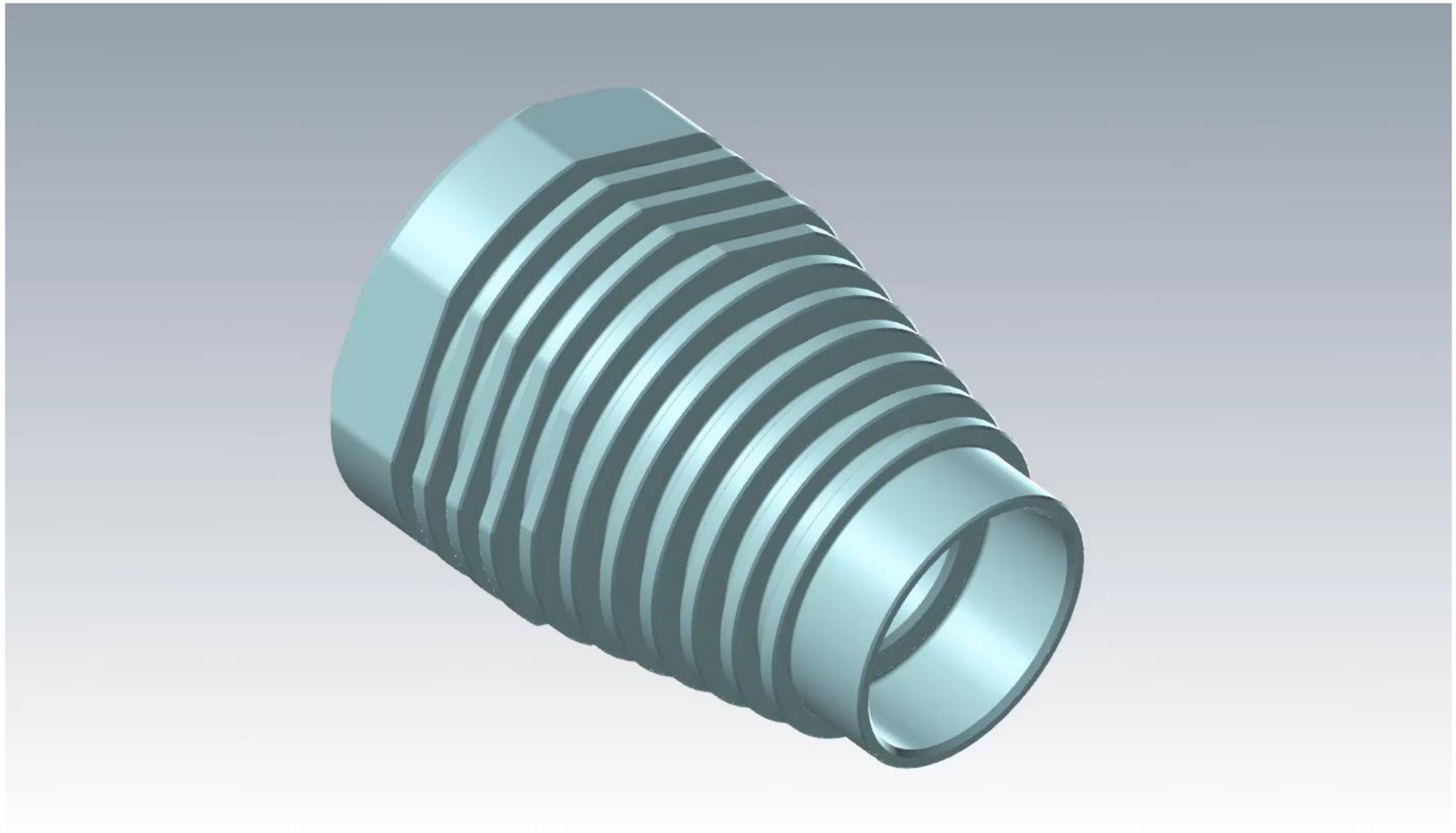
Large difference in actual cutting time Value Added time.

Profit

Chart showing Profit versus cost per part comparison

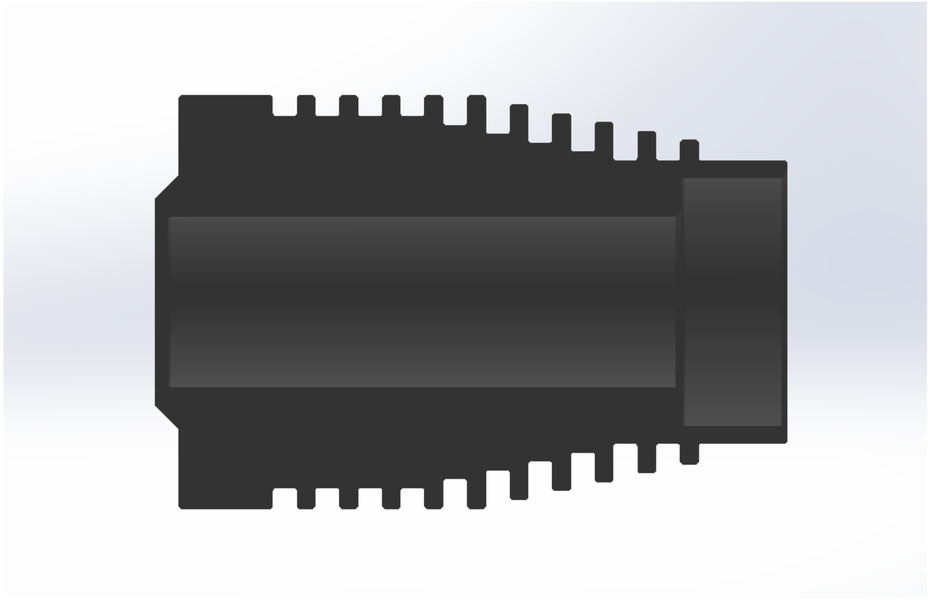


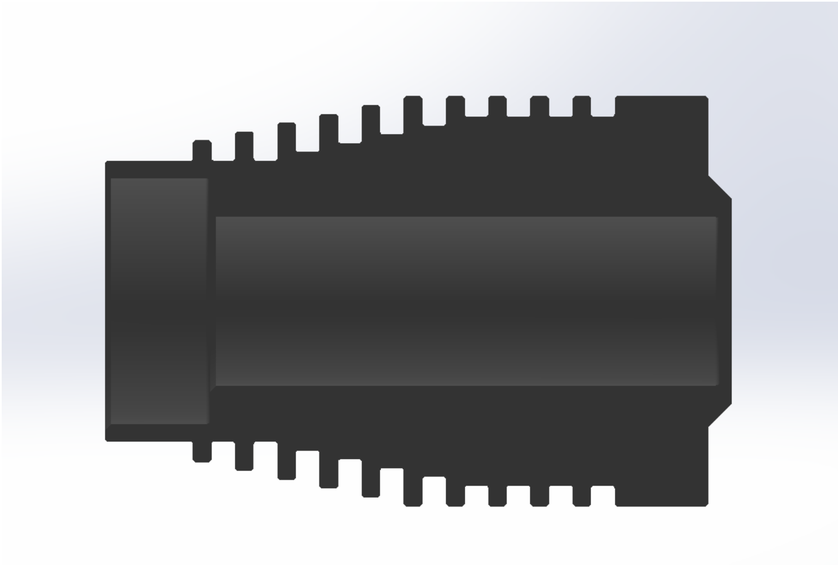
Different Example



Typical Turned Part

Machine Shop Lathe Department





LATHE MACHINE 1

Face Front

Drill Center Hole

Internal Bore

Turn Outside Diameters Complete

Machine Multiple Grooves on Outside

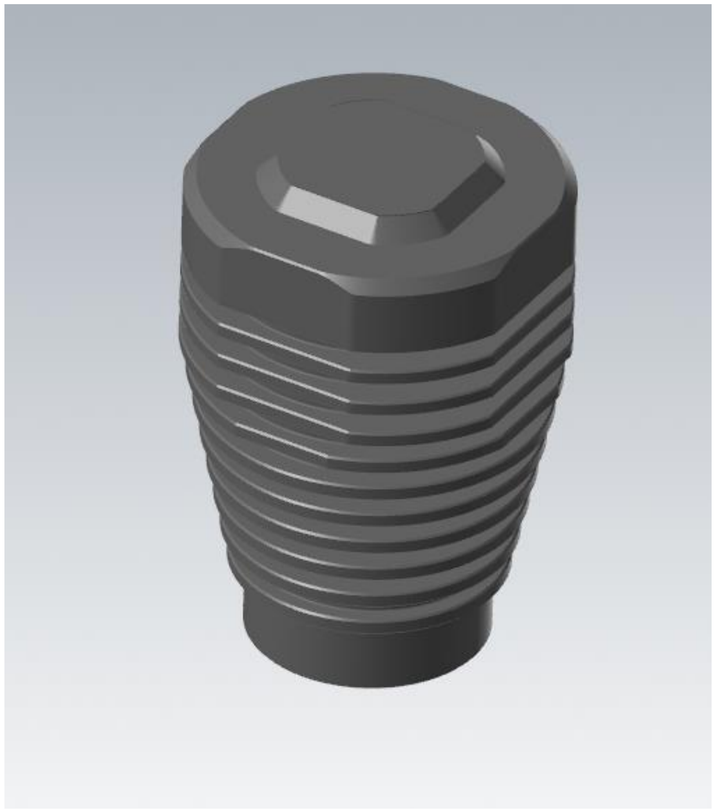
LATHE MACHINE 2

Face Front

Turn Small Face Diameter

Chamfer Major Diameter

Machine Shop Mill Department



MILLING MACHINE 1

Mill Flats On Outside

Mill Taper Wall Feature on Face

Completed Part

Part has been completed and is ready to go to the customer.

Data

The total overview to run the part through the Machine shop.

- **3 total machines**
  - 2 lathes
  - 1 milling machines
- **Costs**
  - Direct
  - Indirect
  - Number of employees required
- **Cycle Times**
  - Cutting Cycle time per Machine
  - Load and unload time

Cell Machines						
Machine	LoadTime	UnLoadTime	DirectCost	NumEmployee	InDirectCost	CycleTime
1	0.2	1	20	1	45	2
2	0.2	1	20	0	45	2
3	1	1	20	1	100	1

Data Using Mazak Multitasking Calculator.

Total Time

The time to run the part through the Machine Shop.

- **62.33 total hours**
  - Set Up Time for 3 machines
  - Load/ Unload time for 3 machines
  - Total cutting Cycle Time

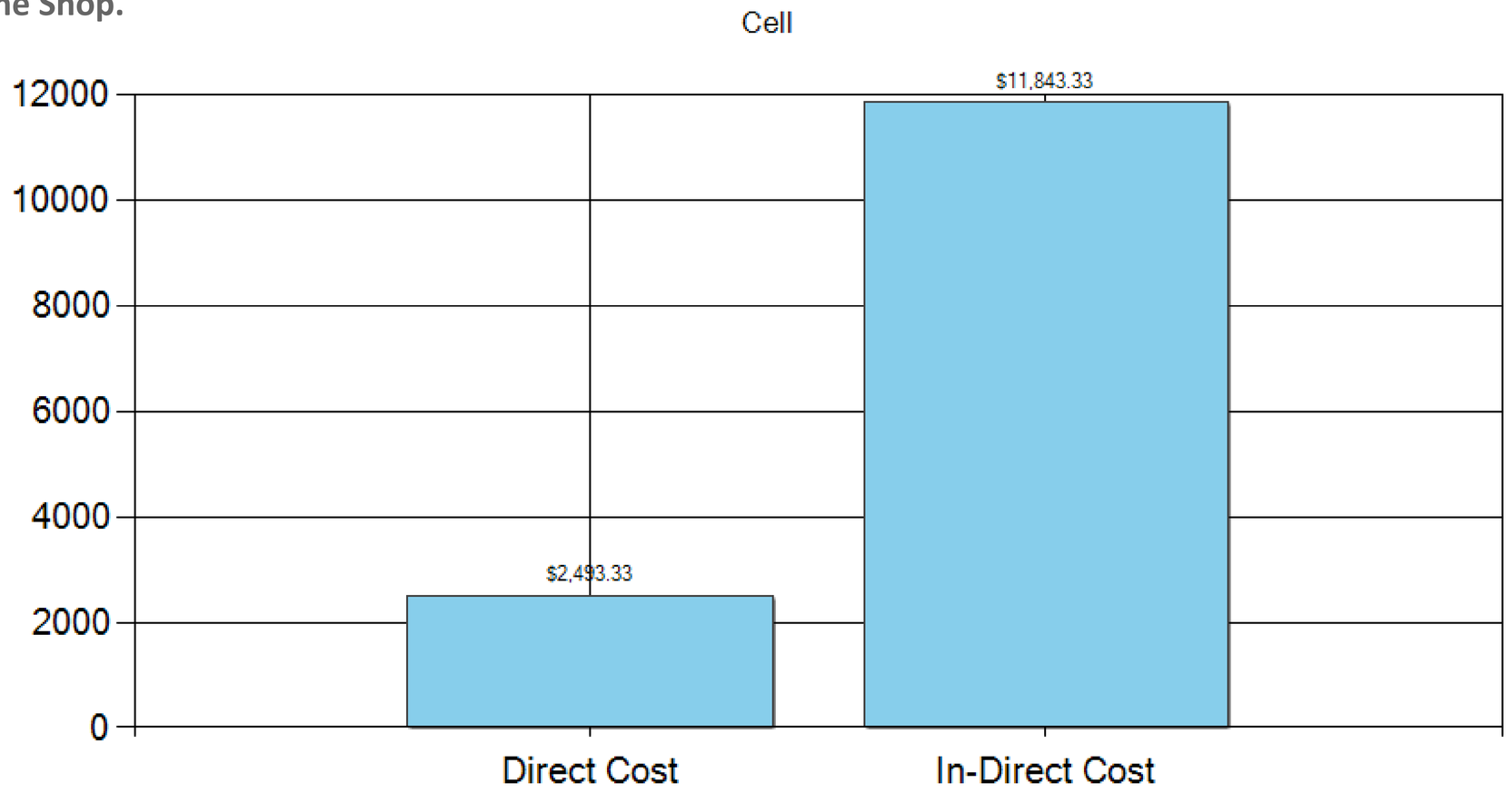
Total SetUp Time	9	Hours
Total Load Time	23.33	Hours
Total UnLoad Time	50	Hours
Total In Cycle Time	83.33	Hours
Time to complete Scheduled Job	**62.33**	Hours

7.8 days to run the complete 1000-part job.

Costs

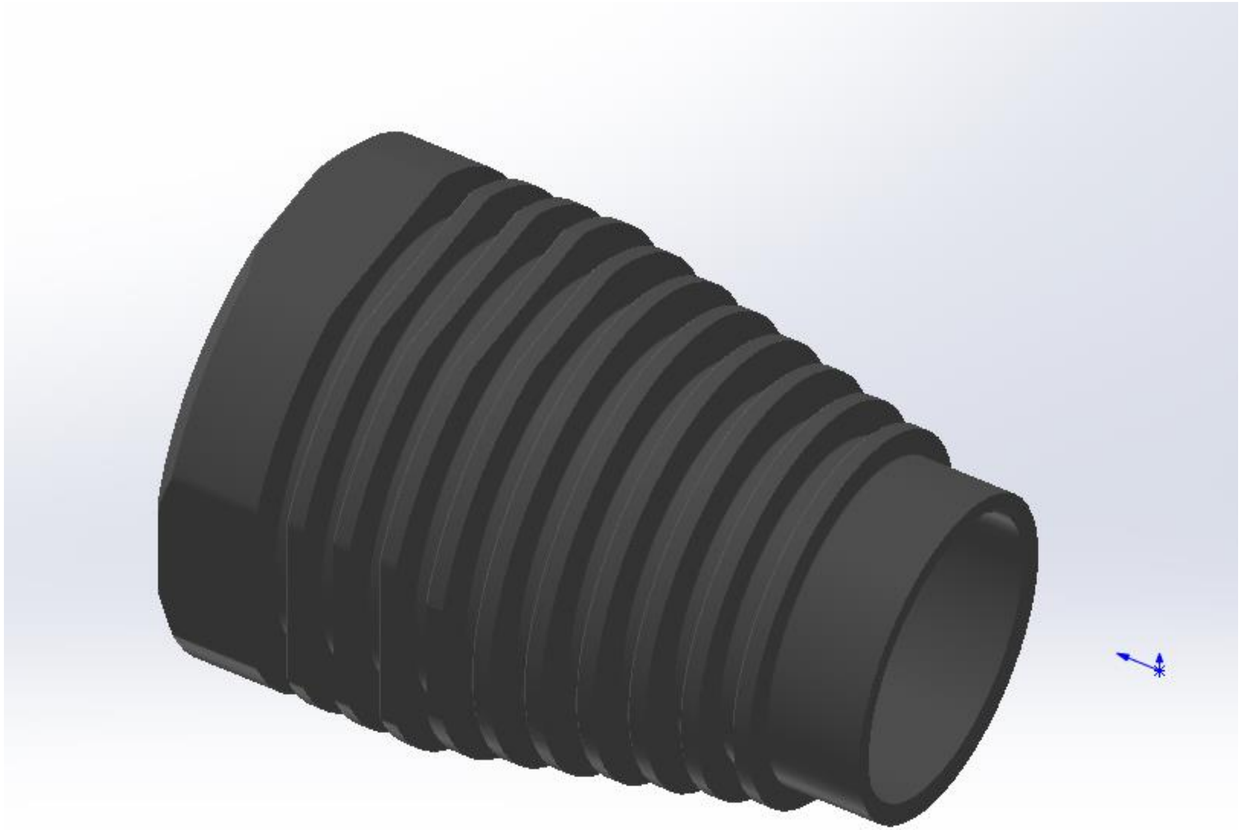
The cost to run the part through the Machine Shop.

- **Direct Costs**
  - Material
  - Tooling
  - Manufacturing Supplies
- **Indirect Cost**
  - Electricity
  - Labor
  - Rent
- **Job yielded $60.66 profit per part**
  - (Direct + Indirect)/# of Pieces
  - $14.34 cost per part

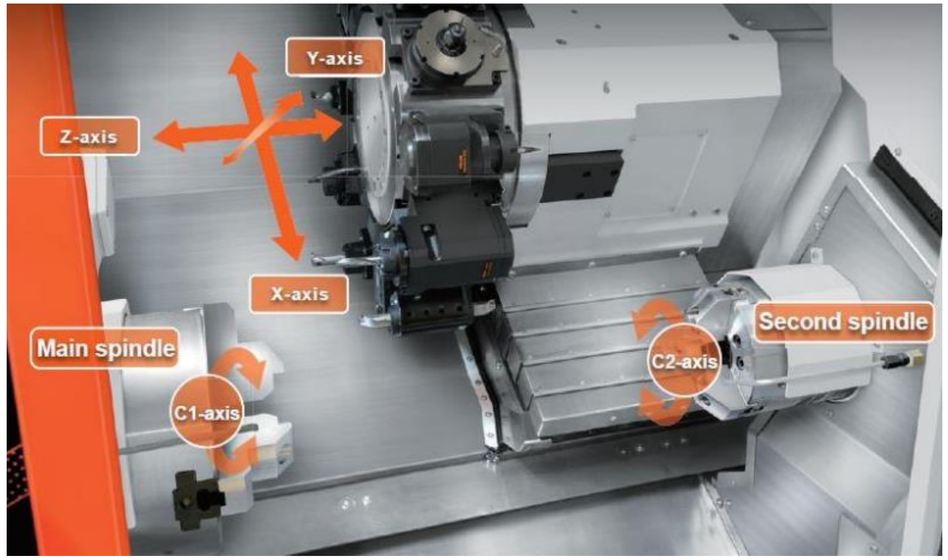


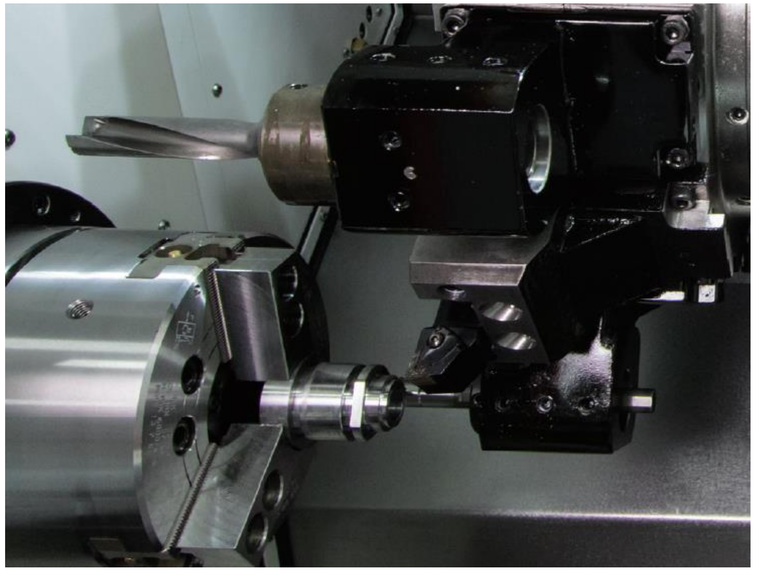
$14,336.00 to run the complete job of 1000 pieces.

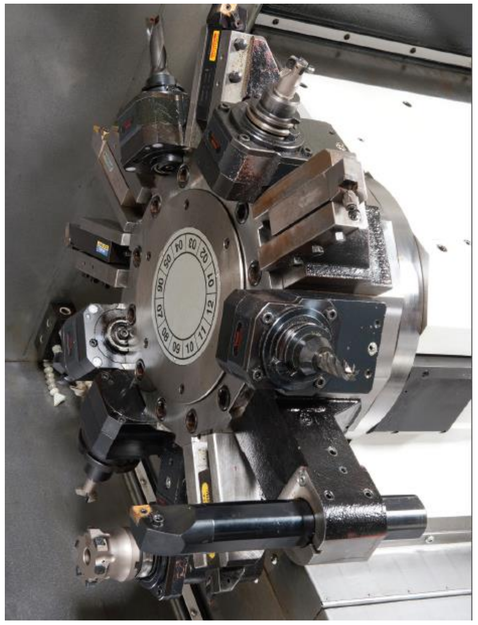
Part 2



Typical Turned Part







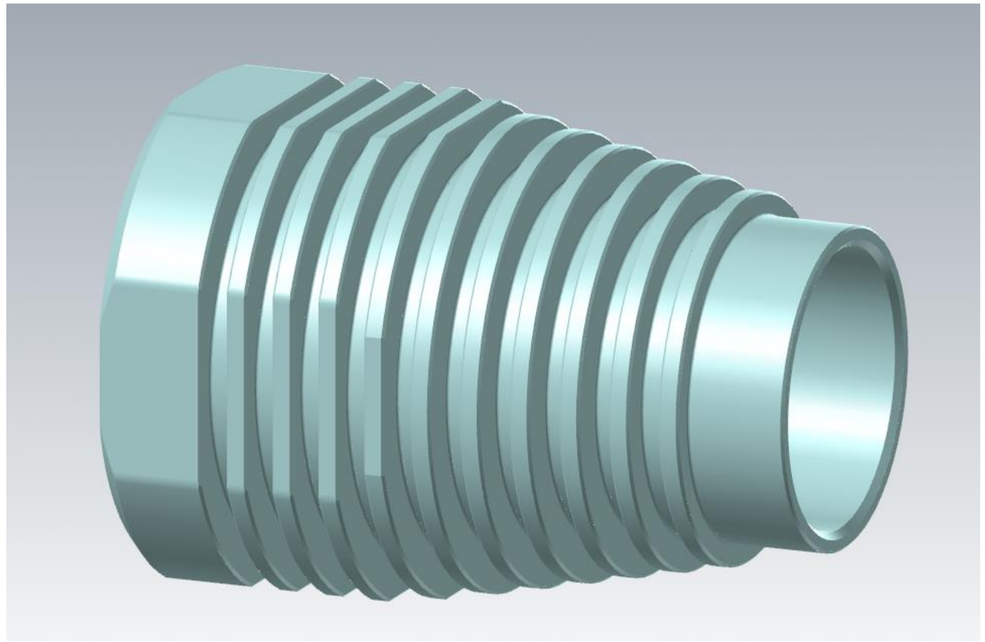
General Specifics

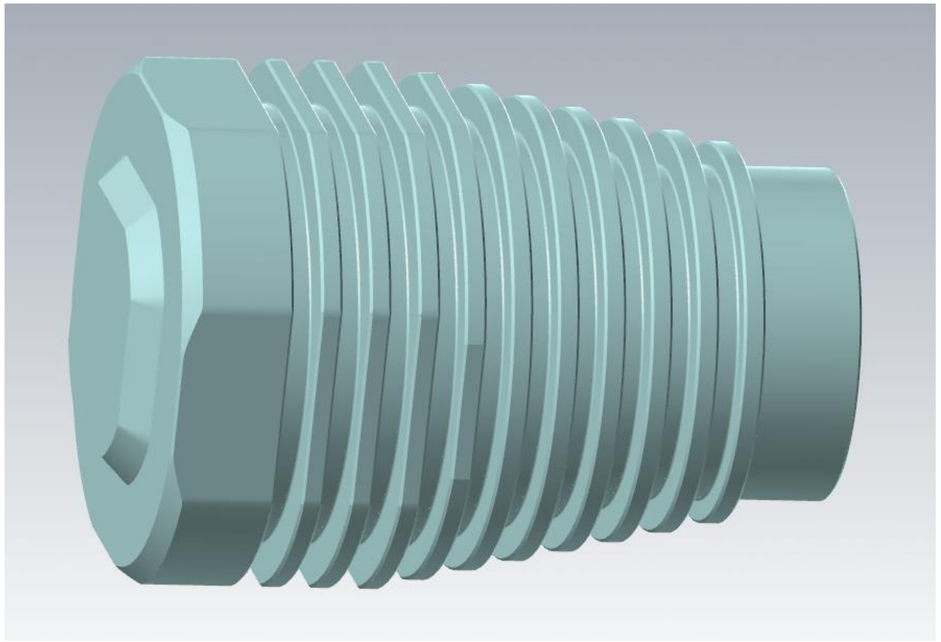
- 2 turning spindles.
- Virtual Y axis

Single Turret

- 12 stations
- Full indexable B axis
- Live tools on turret

Frank’s Done-in-One Machine Shop





MULTITASKING MACHINE 1 HEAD 1

- Face Front
- Machine all ID work
- Machine Face Contour
- Machine Outside Cylinder
- Machine Fuse Pocket

Automatic Transfer

MULTITASKING MACHINE 1 HEAD 2

- Face Rear
- Turn OD radius Grove
- Machine all ID work
- Machine Face Triangle
- Machine compound angle feature

Frank’s Done-in-One Machine Shop

Typical Turned Part

2nd Part Data

The total overview to run the part through the Machine shop.

- **1 Multitasking Machine**

- **Costs**
  - Direct
  - Indirect
  - Number of employees required
- **Cycle Times**
  - Cutting Cycle time per Machine
  - Load and unload time

Multitasking Machines						
Machine	LoadTime	UnLoadTime	DirectCost	NumEmployee	InDirectCost	CycleTime
1	0.2	0	30	1	60	3

Data Using Mazak Multitasking Calculator.

2nd Part Total Time

The time to run the part through the Machine Shop.

- **121 total hours**
  - Set Up Time for 1 machine
  - Load/ Unload time for 1 machine
  - Total cutting Cycle Time

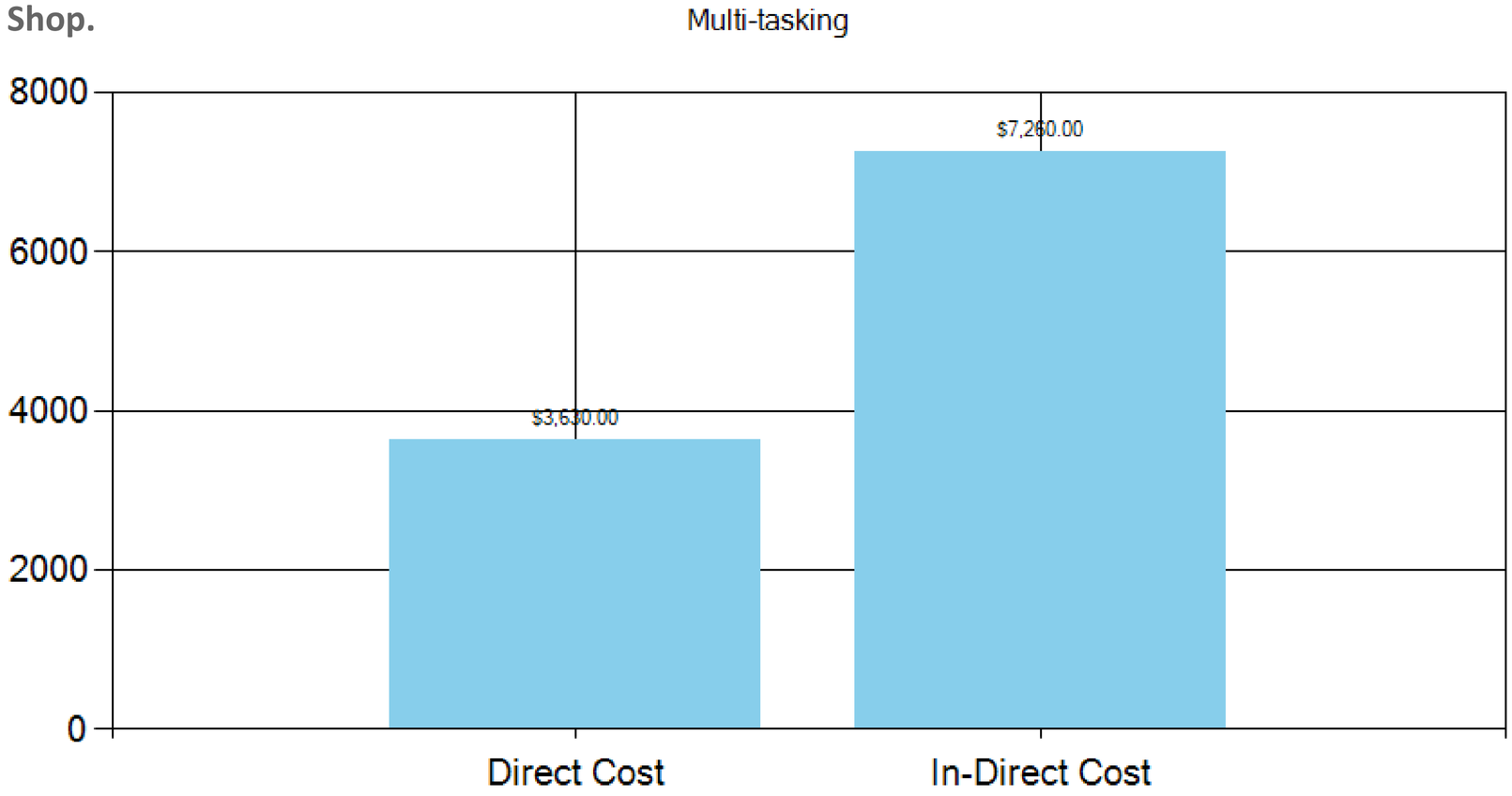
Total SetUp Time	1 Hours
Total Load Time	3.33 Hours
Total UnLoad Time	0 Hours
Total In Cycle Time	116.67 Hours
Time to complete Scheduled Job	**121** Hours

15.1 days to run the complete 1000-part job.

Costs

The cost to run the part through the Machine Shop.

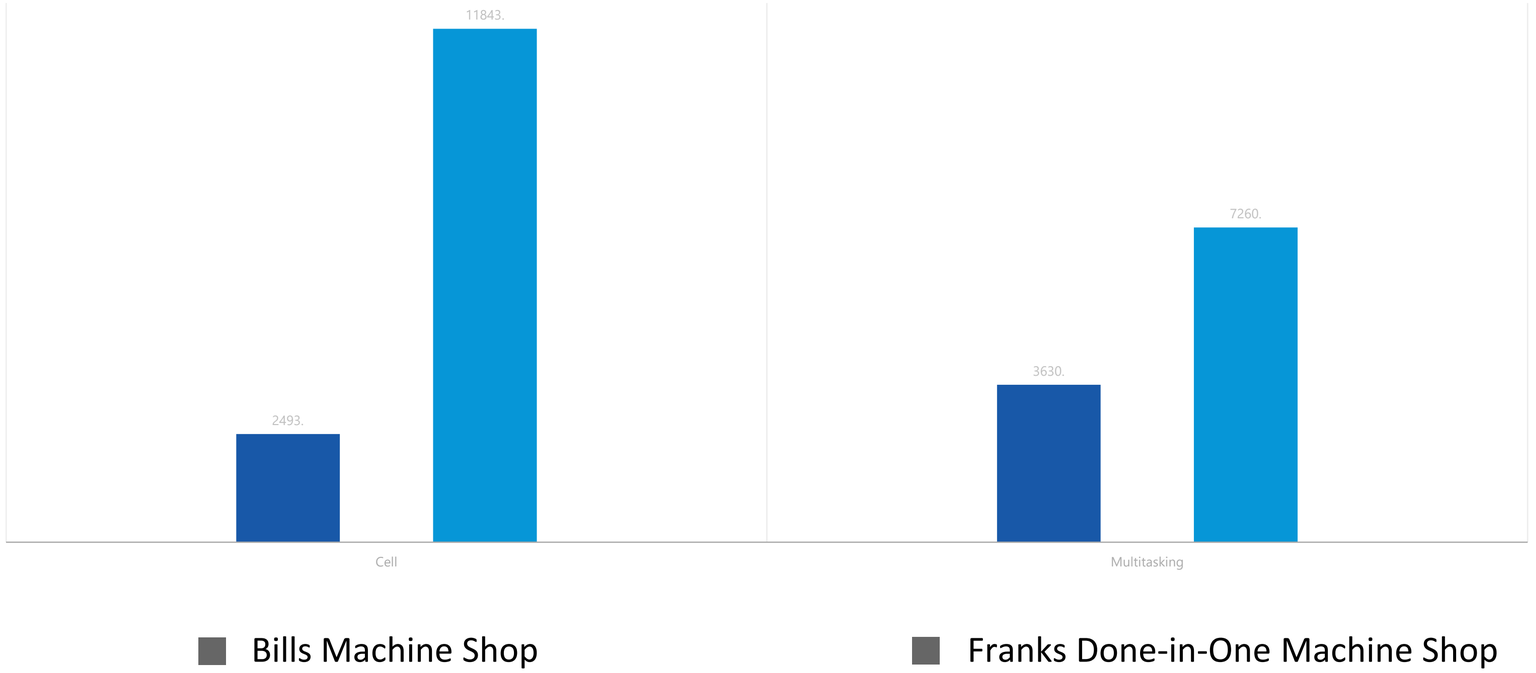
- **Direct Costs**
  - Material
  - Tooling
  - Manufacturing Supplies
- **Indirect Cost**
  - Electricity
  - Labor
  - Rent
- **Job yielded $64.11 profit per part**
  - (Direct + Indirect)/# of Pieces
    - $10.89 cost per part



$10,890.00 to run the complete job of 1000 pieces.

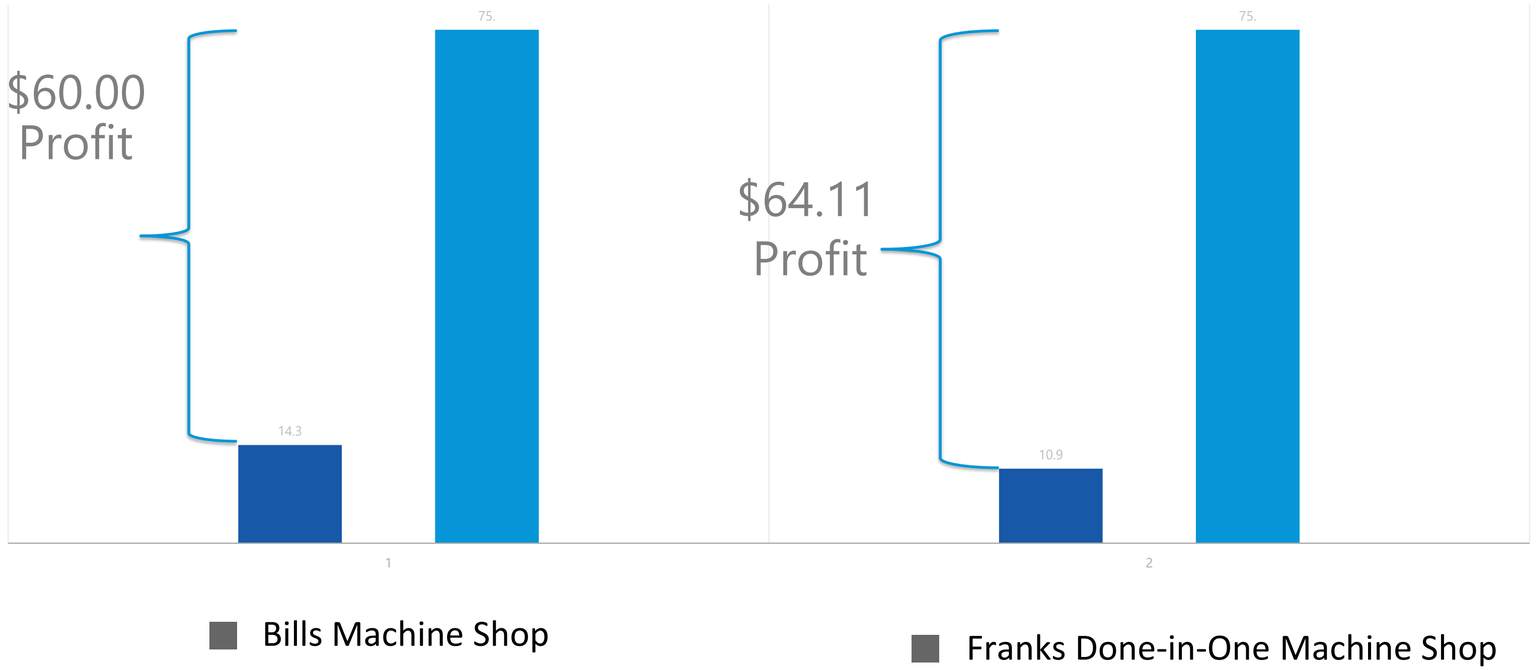
Total Costs

Chart showing Direct and Indirect cost comparison between shops



Profit

Chart showing Profit versus cost per part comparison

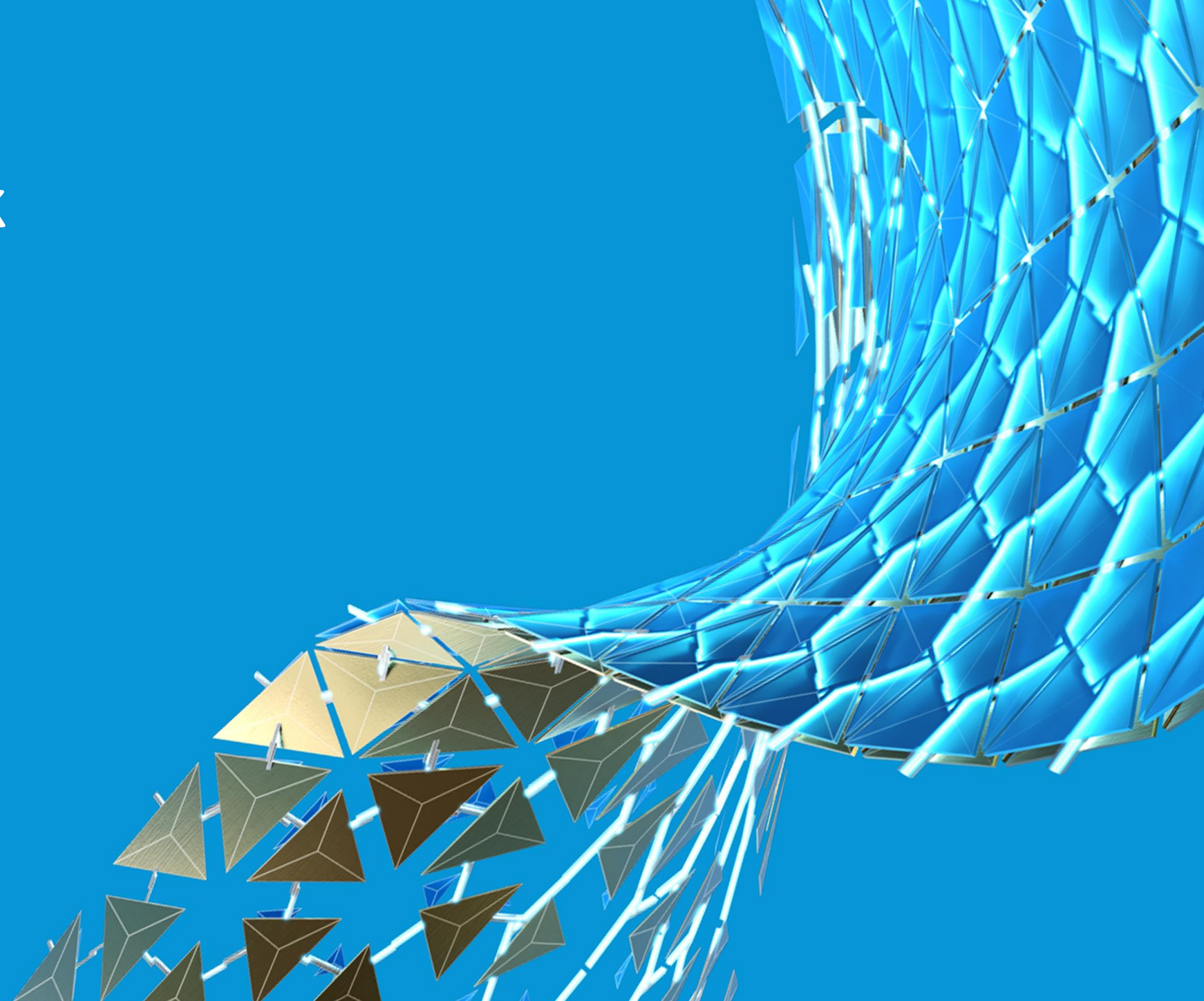


Review

The increase in part quality, the increase in machine efficiency, and the reduction in WIP all yield more profit per job.

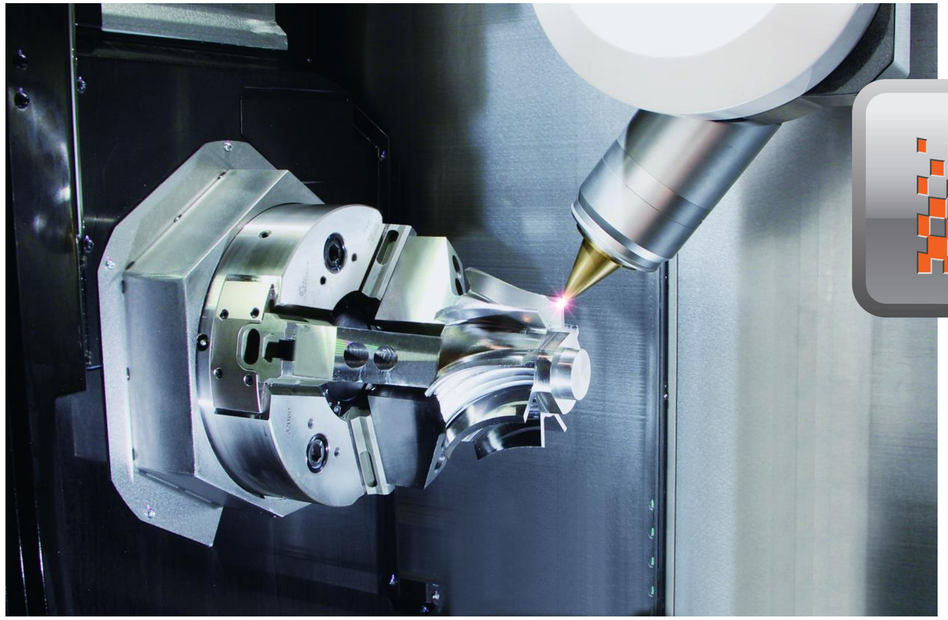
The ability to produce parts of the highest complexity in a single setup, limiting human intervention and saving substantial time provides even small shops a cost-effective solution to competing in today’s challenging manufacturing environment.

Section Break

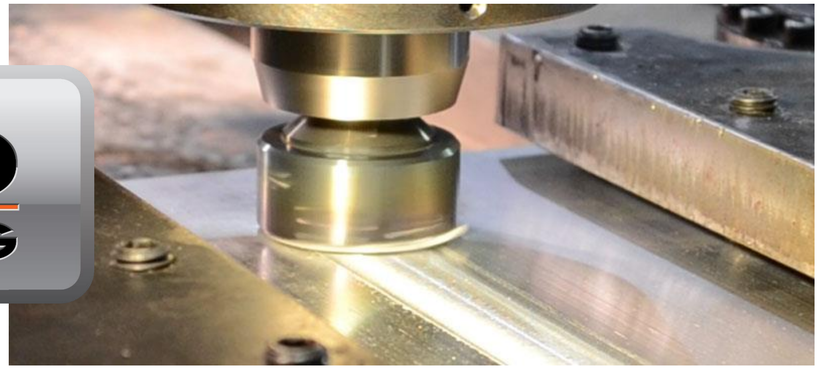


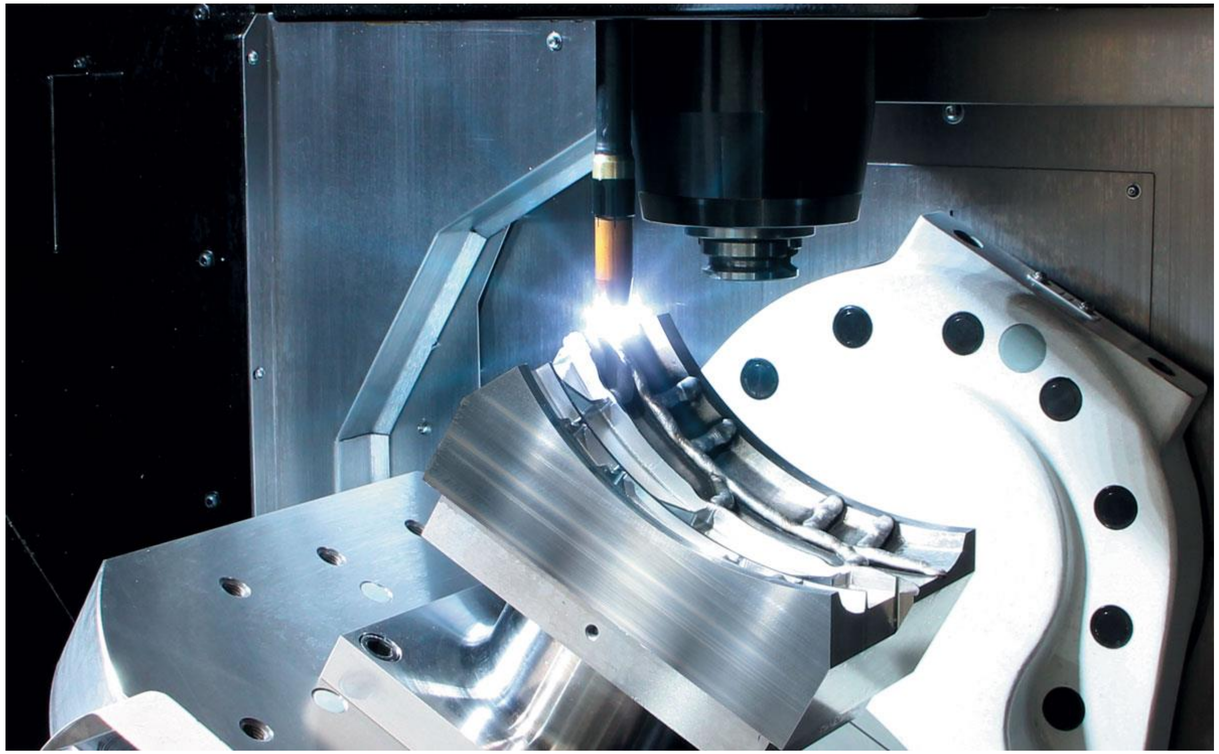
Future of Multitasking
Photo credit goes here

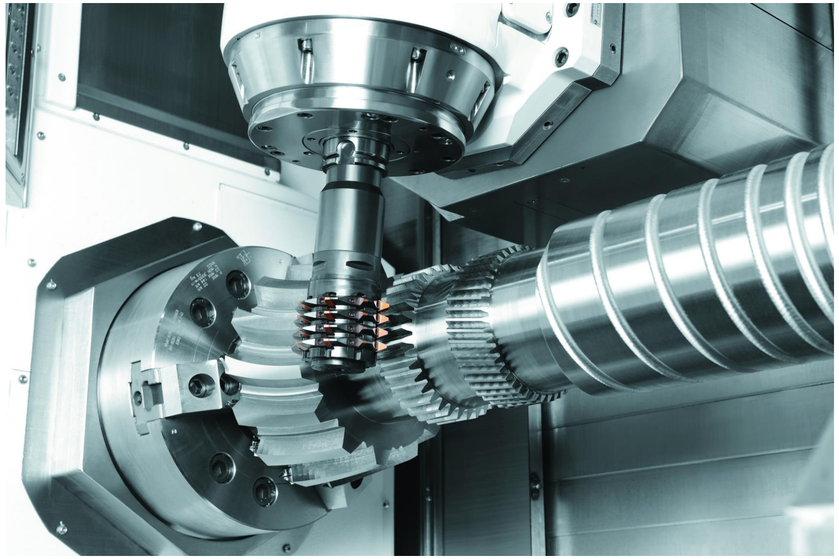
Future of Multitasking



HYBRID MULTI-TASKING







Hybrid Multitasking

GEAR MANUFACTURING

Multi-Tasking machines enable you to maximize your investment by machining gears in single setups.

FRICTION STIR WELDING

The FSW process uses a solid-state combination of frictional heat with forging pressure to create lighter-weight parts and pure, clean joints.

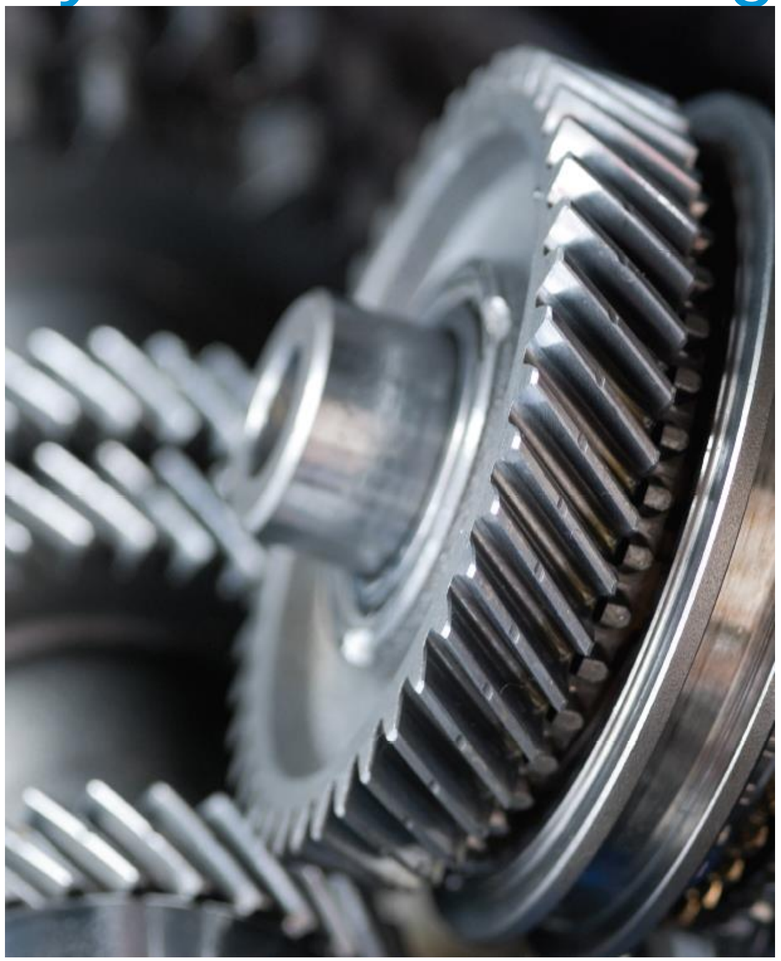
LASER METAL DEPOSITION

The additive capabilities of these machines allow users to easily generate near-net-shape component features and then quickly complete them via high-precision finish machining operations.

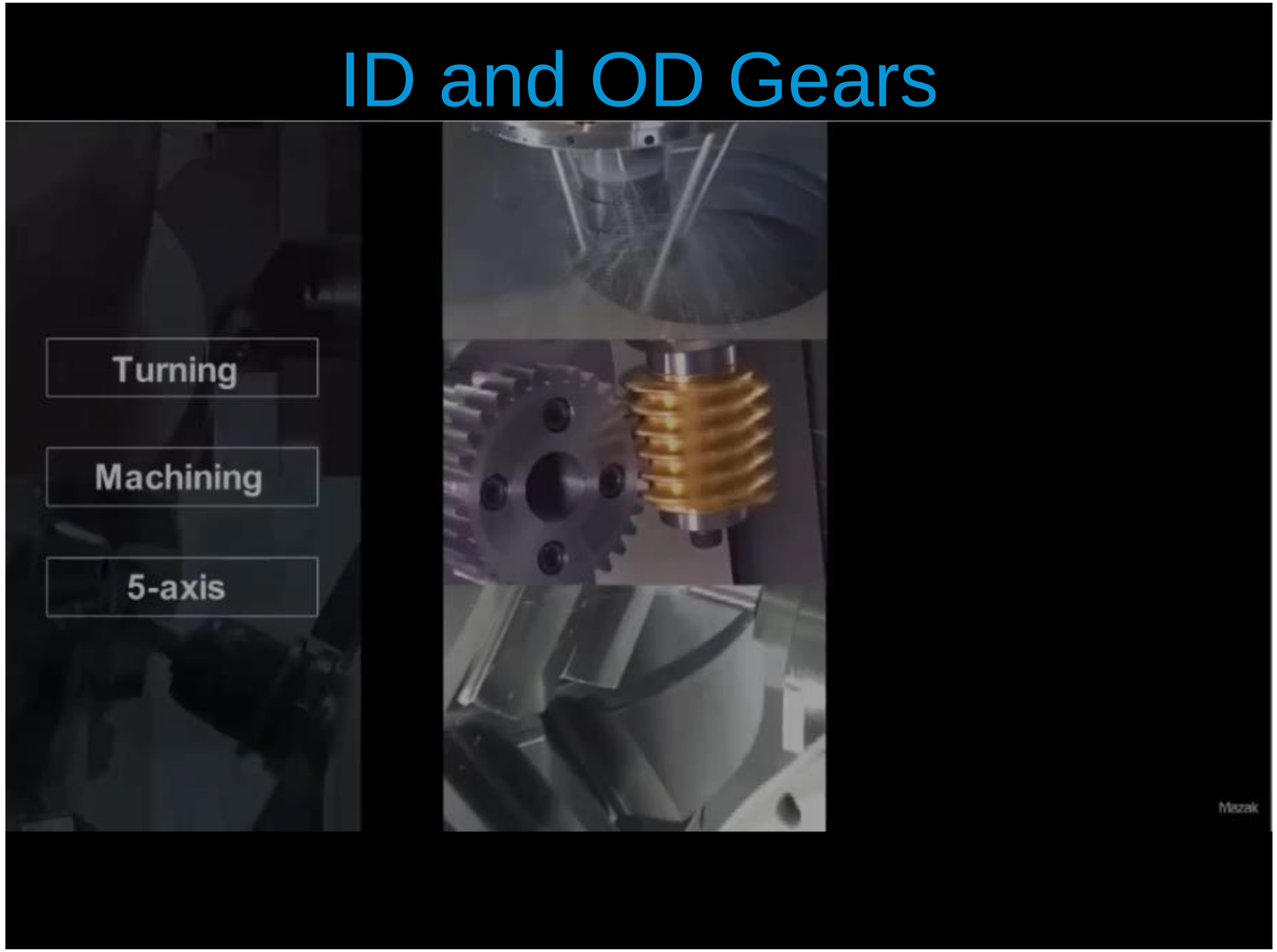
HOT WIRE DEPOSITION

This high-speed additive solution offers programmable welding automation through wire arc AM

Hybrid Gear Cutting

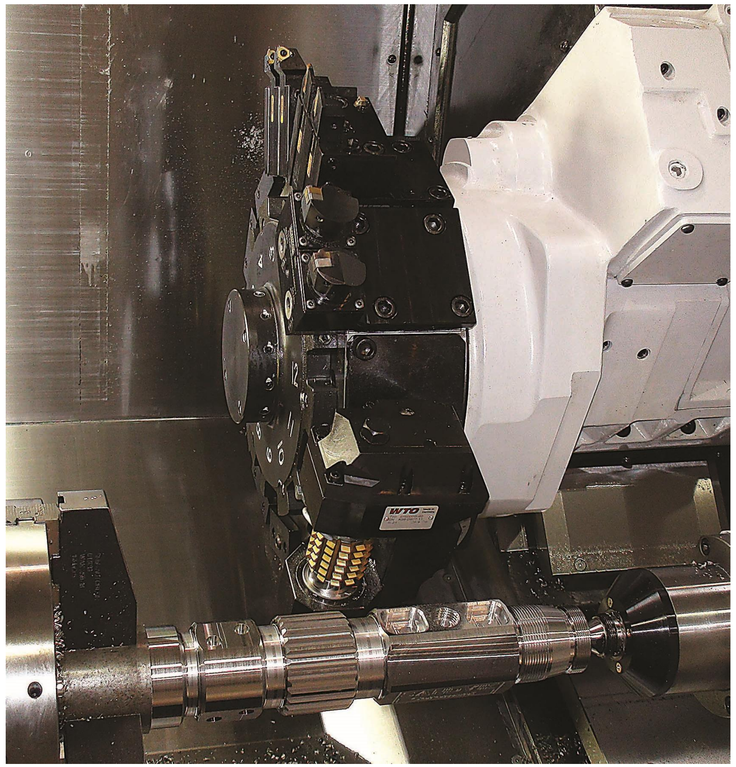


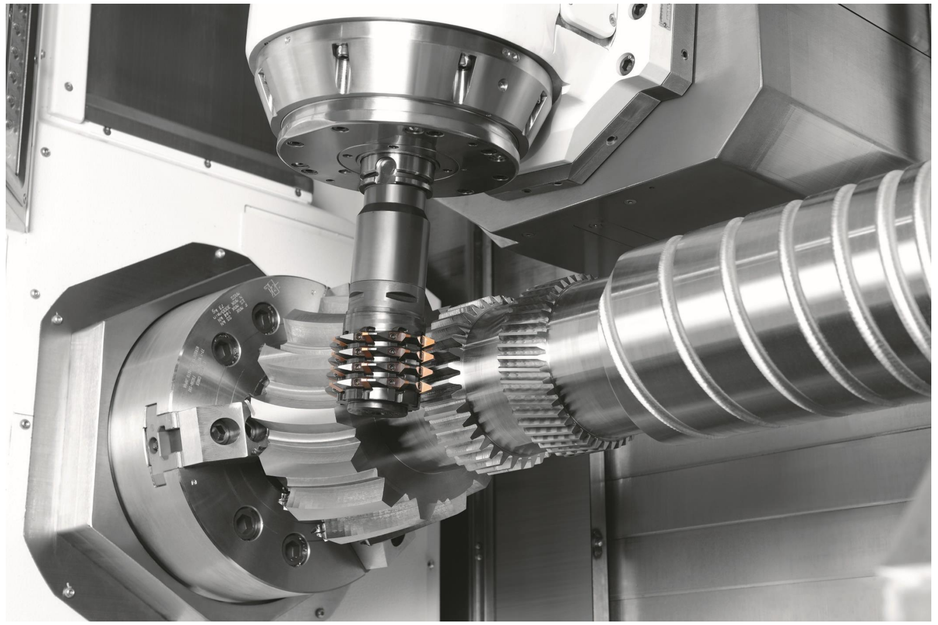
Gear Cutting on Multitasking Machines



Hybrid Gear cutting is a viable processing alternative for low-to medium-volume production.

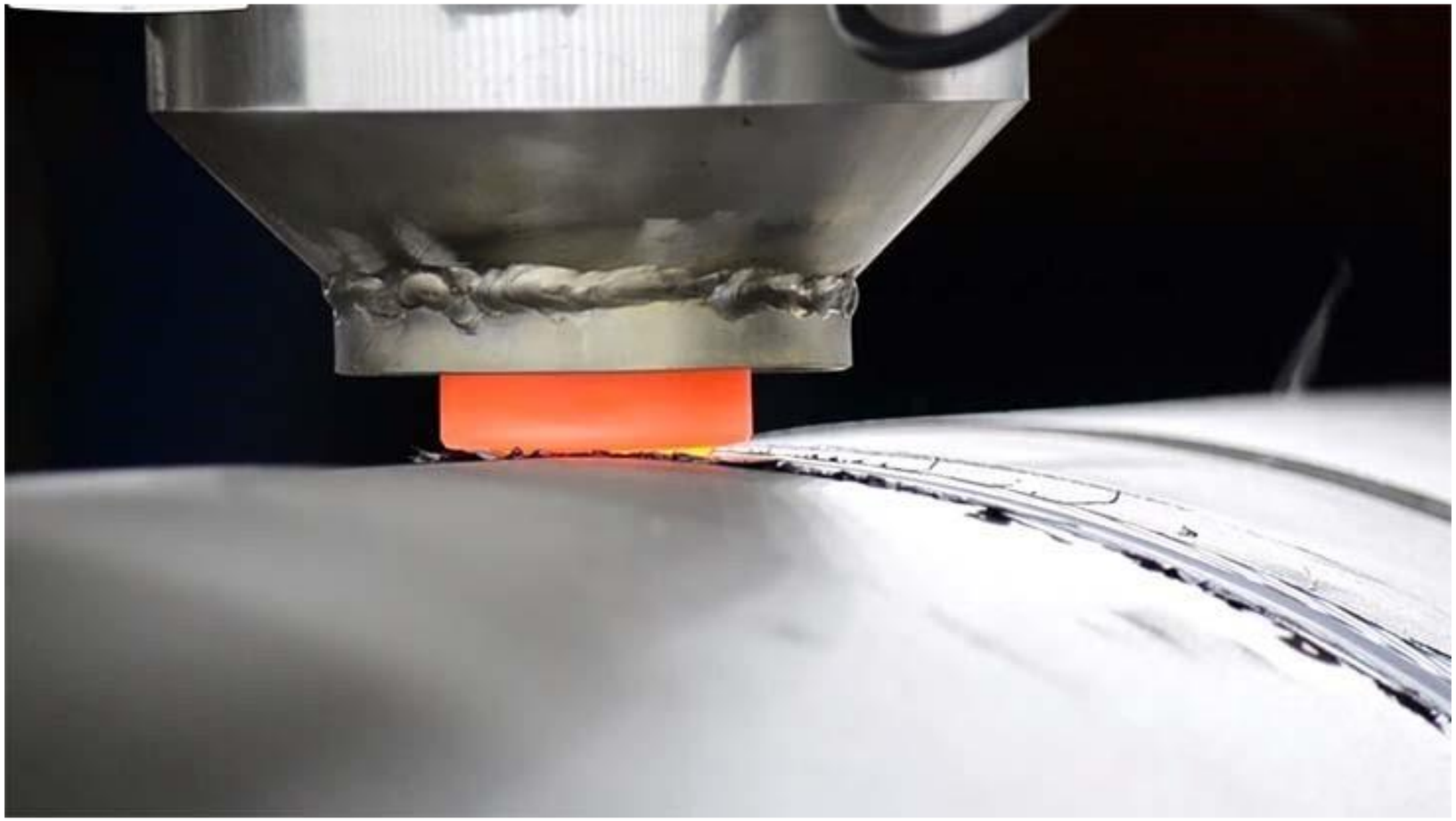
Total Flexibility





Unlike high-volume dedicated gear cutting machines, multitasking machines provide the flexibility to perform other part operations

Hybrid Friction Stir Welding

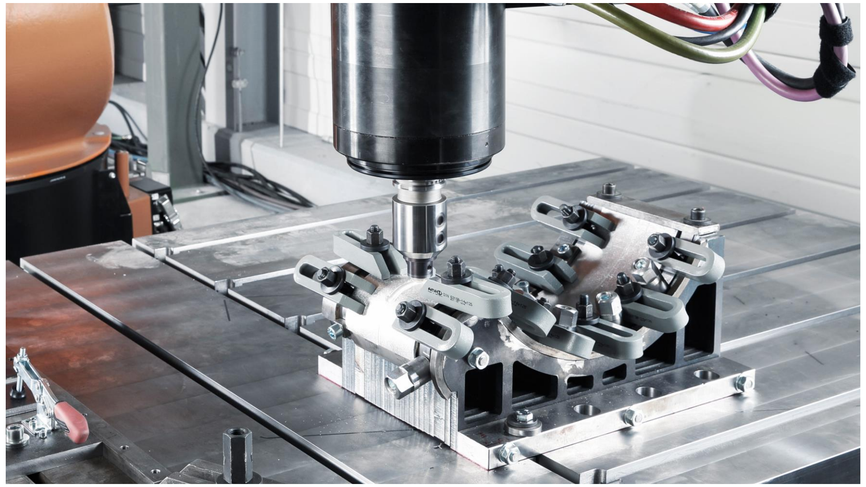


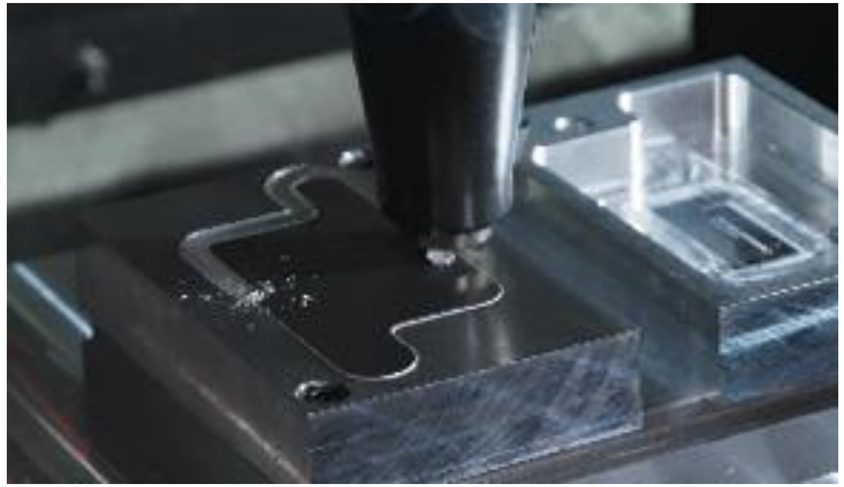
Frictional heat and forging pressure creates full-penetration, defect-free welded joints.

Use of Friction

Uses frictional heat to create full-penetration, defect-free welded joints.

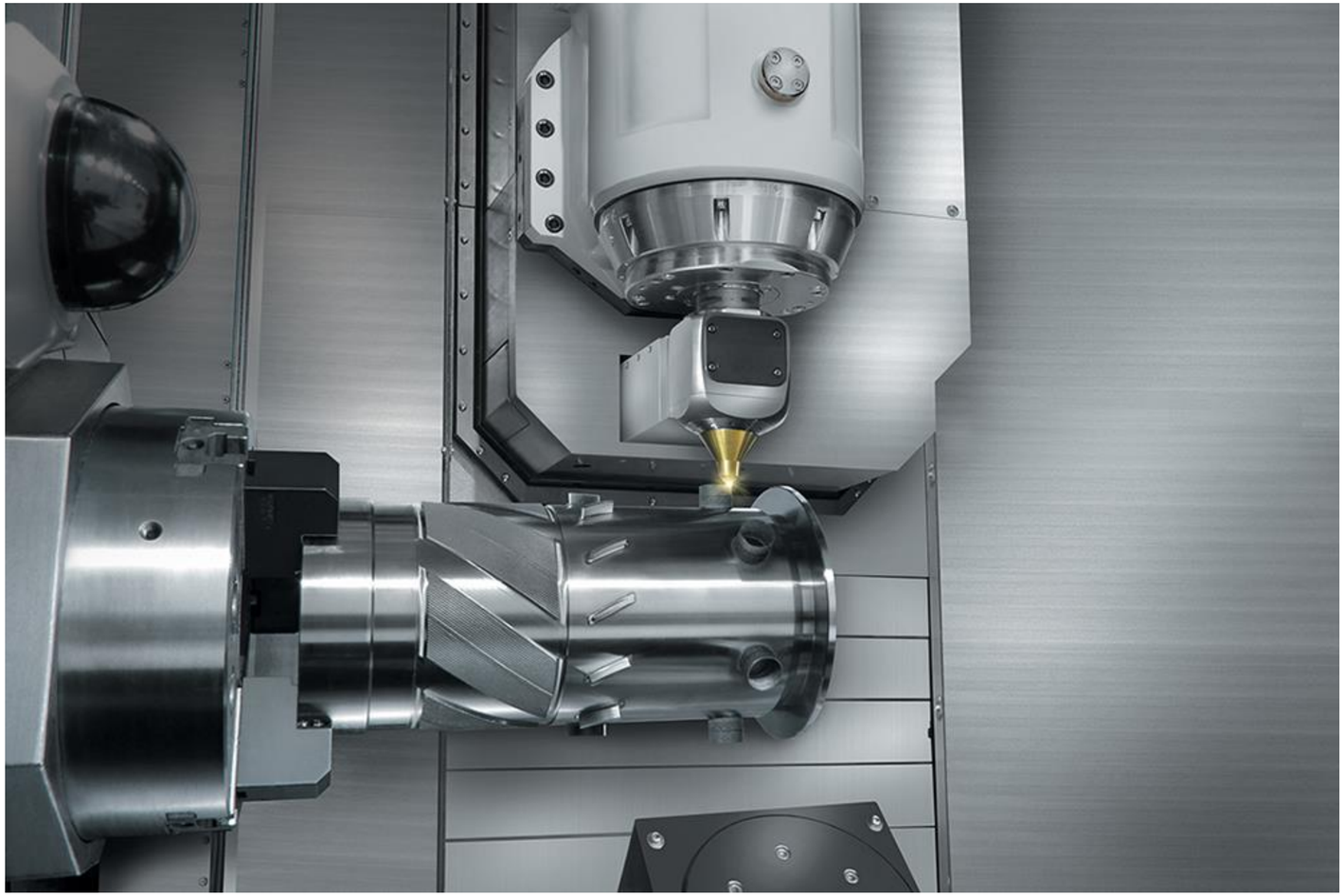
Total Flexibility





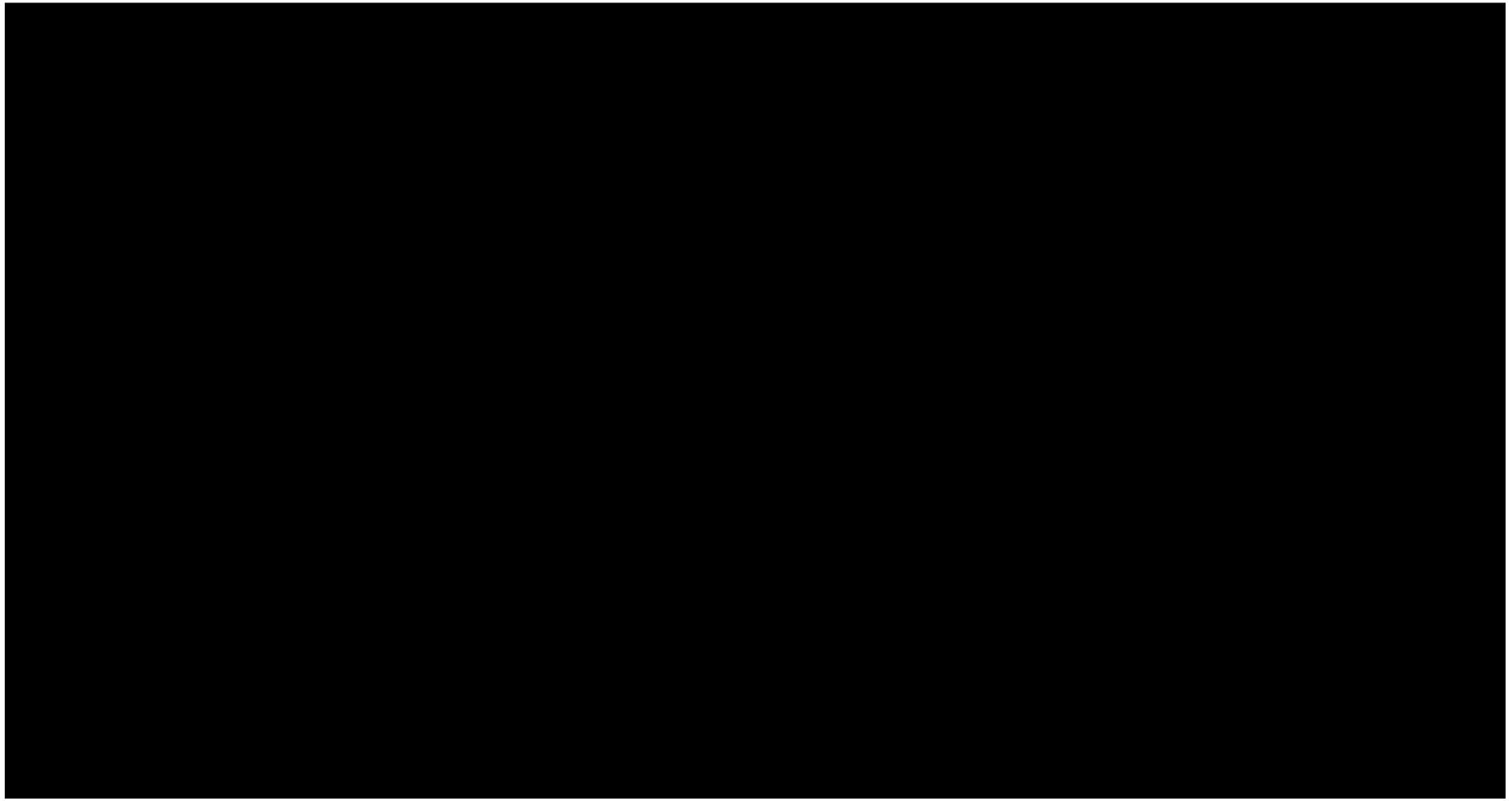
Unlike high-volume dedicated gear cutting machines, multitasking machines provide the flexibility to perform other part operations

Hybrid Additive Manufacturing



Frictional heat and forging pressure creates full-penetration, defect-free welded joints.

Laser Metal Deposition



Laser metal deposition uses one high-power laser to melt powder as it’s sprayed from a nozzle.

Total Flexibility

A near net shape workpiece normally requires a casting to be produced. With additive Multitasking manufacturing technology, the casting process is not necessary for considerably reduced production time.

Conclusion

Overall, multitasking machines are a huge benefit to your shop if you're looking for an efficient and accurate way to produce high mix, low to mid-volume parts as well as specialty and customized parts.

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About the speaker

Rudy Canchola CMTSE

In his 29 years with Mazak Corporation, Rudy has led the Customer Support Team, the Regional Sales and Marketing Team and the Regional Manufacturing Engineering Team. He has worked with hundreds of customers over the years in many countries implementing a variety of Multitasking equipment. He specializes in assisting customers in reducing operating costs. He has successfully implemented large automated multitasking equipment at companies such as Caterpillar Solar Turbines, Senior Aerospace Ketema, Flowserve, Boeing Aircraft Company, Blue Origin, and Callaway Golf to name a few.