DN Solutions
Die & Mold Solution
Reference

ver. EN 220826 SU

INTRO

Two kinds of story will be spoken at this section,
It include the future and optimal solutions in aerospace industry

FUTURE

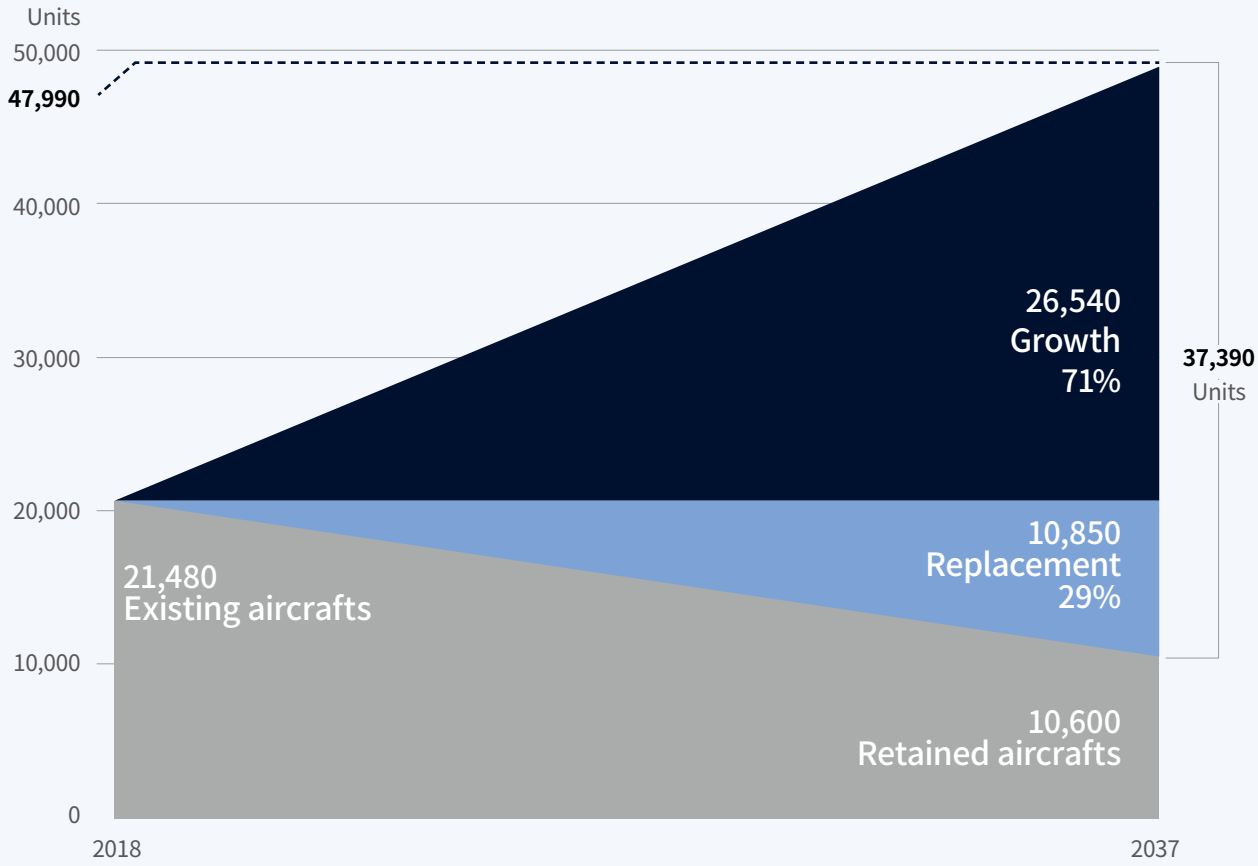
The growth beyond our expecting will be come truth. If you ignore the signal of the future, you can't grab your opportunities. It's time to know and learn the future exactly.

SOLUTION

What do you do for the future? What can you do for the future? There are answers of these questions. There are optimal solutions for the future.

Future Opportunity of Aerospace Industry

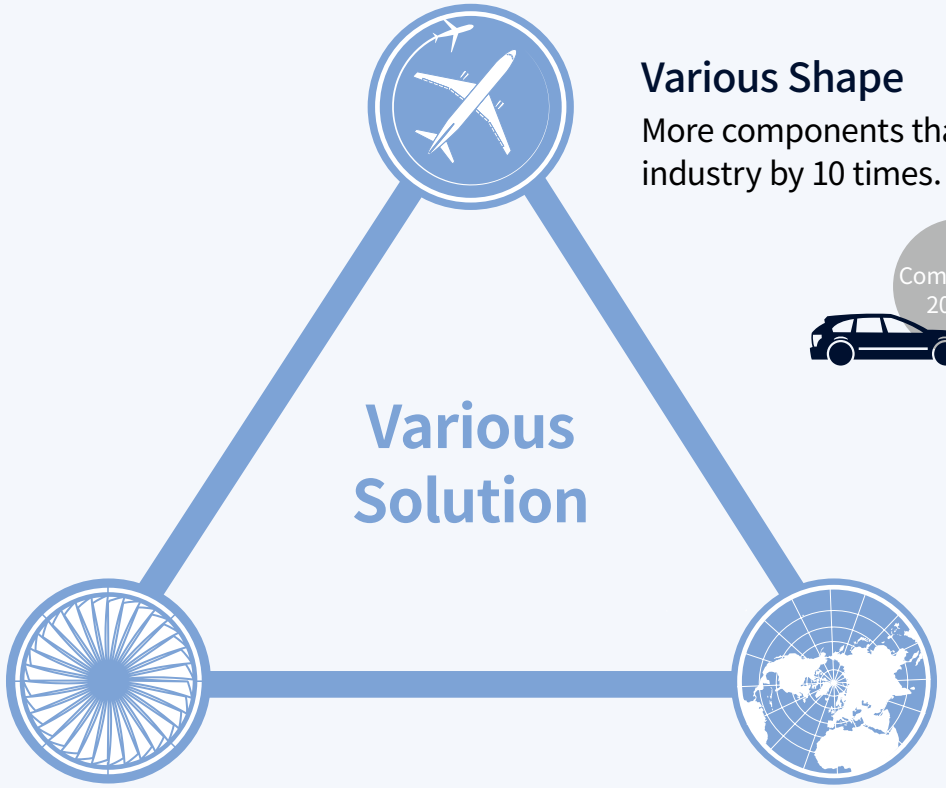
Older and less efficient airplanes will be replaced with more efficient, newer generation airplanes.
During the shift in the generation, companies can grasp more opportunity to grow further.



- 37,390 Aircrafts are planned to be manufactured
- Total number of aircraft in 2037 will be doubled comparing to 2018
- Doubled Market size means Doubled business opportunity

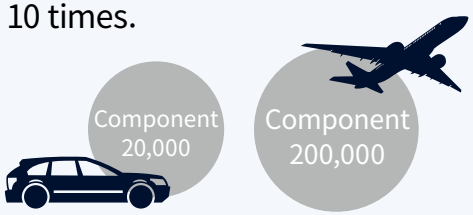
Source: Airbus Global Market Forecast

Need for various solution in aerospace Industry



Various Shape

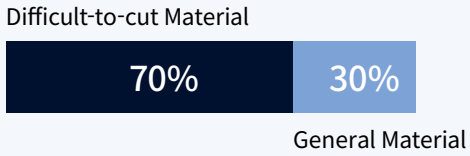
More components than automotive industry by 10 times.



10Times

Various Material

Difficult-to-cut Material(Titanium, Aluminum, Inconel, CFRP) become main material more and more



70%

Various Reference

One defective product can cause a huge calamity
Qualified machine and diverse experience is required

∞ damage

DN Solutions Capability in Aerospace Industry

For Various Shape

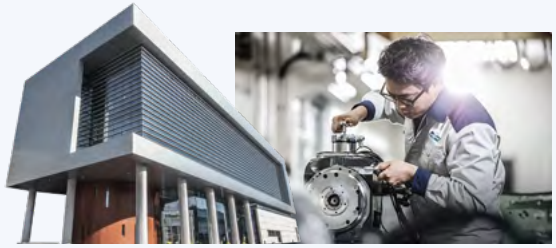
DN Solutions has to meet demands in aerospace industry.

450 Models

For Various Material

DN Solutions has exceptional solution for difficult-to-material from diverse experience and R&D capability

450 R&D researchers



Various Solution

For Various Reference

Most leading company and their partners choose DN Solutions

500+

aerospace customers in the world

DN Solutions coverage

DN Solutions's global top-tier customers

America

USA	Boeing, Pratt & Whitney, GE, Honeywell, M/S Aerospace, Kaydong, Infinisys, IDD, Moog, Kamatics, ES3…
Mexico	Honeywell Mexico

Europe

UK	Rolls Royce, AMRC(Partnership with UK dealer)
France	Airbus, Safran, UTC systems
Germany	Rolls Royce Germany
Italy	Umbra, Ellena, Sicamel S.p.A., Ar.Ter. Srl, A. Abete Srl
Turkey	HMS Makina, TEI Aviation, ALP Aviation, AYCAN Aviation, GE Turkey, Kale Pratt & Whitney, Roketsan

Asia

China	GE China
Korea	KAI, Hanhwa Techwin
Singapore	Pratt & Whitney
Indonesia	Pudak
India	Polymech Industries

Partnership to improve Aerospace solution

MILLS CNC

DN Solutions's UK dealer MILLS CNC join AMRC

"These are exciting times for Mills CNC. We're delighted to have become part of the AMRC and to be involved, right from the outset, in such a high-profile and important manufacturing project"

Managing director Kevin Gilbert

AMRC Advanced Manufacturing Research Centre / The University Of Sheffield.

AMRC(Advanced Manufacturing Research Centre)

"A world-class centre for advanced manufacturing research"

- Specialises in carrying out world-leading research into advanced machining, manufacturing and materials, which is of practical use to industry
- Partner for global giants like Boeing, Rolls-Royce, BAE Systems and Airbus
- 500 highly qualified researchers and engineers from around the globe

Two DN Solutions machines on AMRC

PUMA TT 1800SY

DNM 6700

MILLS CNC magazine article

Machine on the AMRC site

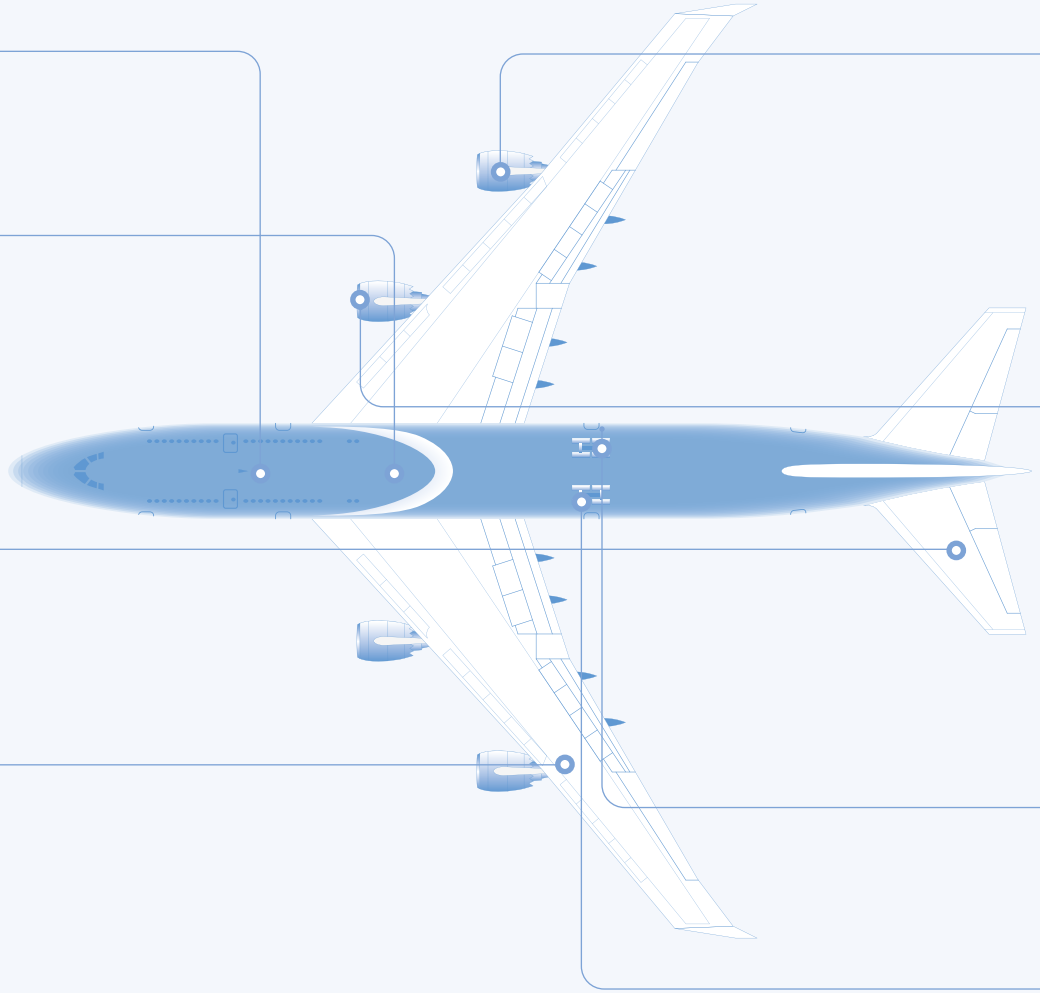
Structural Parts

BODY
Aircraft Door Hinge
Aircraft Body Bone

Component
Various Components
Main Rotor(Helicopter)

Tail
Tail Hanger
Frame
In-flight tanker part

WING
Rib Support



Engine Parts

Case
Engine Case
Turbine Disk
Engine AFT Inner
Engine Forward Case
Blisk
Engine part
Engine casering

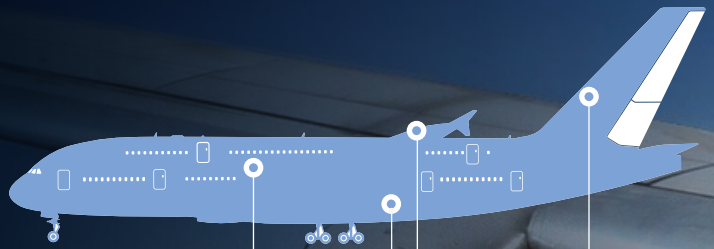
Blade
Aerofoil (Engine Blade)
Engine Fan Blade
Geared Turbo Fan

Landing Gear Parts

Beam
Landing Gear Pylon
Support

Disk
Brake Disk

Solution
Structural Parts



BODY

Customer S1

Customer S2

TAIL

Customer S3

Customer S4

Customer S5

COMPONENT

Customer S7

Customer S8

Customer S9

Customer S10

Customer S11

Customer S12

Customer S13

Customer S14

Customer S15

WING

Customer S6

Workpiece

Aircraft Door Hinge

Size

ø1390 mm (ø54.7 inch)

Material

Titanium

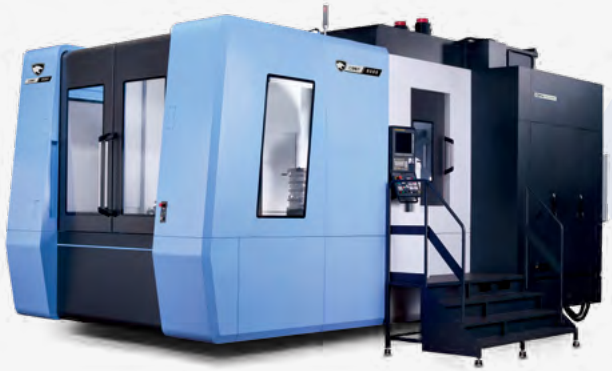
Customer Request

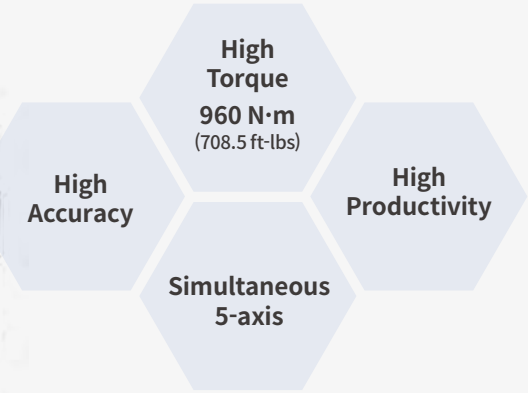
- More Economical Solution than a Company
- Guarantee Accuracy
- Curved Workpiece

Solution

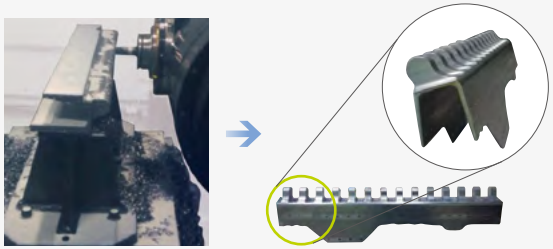
DHF 8000

Simultaneous 5-axis Horizontal Machining Center





Machining Process



Process	Tooling	Cutting Condition
Roughing	Ø42 mm (Ø1.7 inch) Insert Mill	700mm/min (27.6 ipm), 400r/min
Semi-finishing	Ø20 x R3.0 mm (Ø0.8 x R0.1 inch) End mill	600mm/min (23.6 ipm), 1200/min
Finishing	Ø20 mm (Ø0.8 inch) End mill (45° 6 blades)	150mm/min (5.9 ipm), 250/min

Productivity Improvement

Cycle time Reduce **20%**↓

A company	22 hours
DHF 8000	16 hours

-30%

"When I used a Japanese 5-axis machine to make this part, cutting tools were totally broken because of low rigidity. Now I use DHF 8000. This machine has enough power to cut titanium parts and high precision to meet strict condition of OEM. There are no precision issue on this machine by now." *- Plant Manager of Y company*

Customer S2

Workpiece

Aircraft Body Bone

Size
2850 x 850 mm (112.2 x 33.5 inch)

Material
Aluminum

Customer Request

- Large size Workpiece
- Curved Shape
- Universal Spindle

Solution

BM 2740U

Simultaneous 5-axis Universal Head Attached Bridge type Machining Center

- **Large size Table** 4000 x 2500 mm (157.5 x 98.4 inch)
- **30000 r/min**
- **Simultaneous 5-axis**

Various Spindle Line-up

Speed
12000~ 30000 r/min

Power
30 ~ 75 kW
(40.2 ~ 100.6 Hp)

Torque
143 ~ 48 N·m
(105.5 ~ 35.4 ft-lbs)

Better Chip Disposal

High Pressure TSC 7MPa (70 bar)

Customer S3

Workpiece

Tail Hanger

Size

1000 x 1000 mm (39.4 x 39.4 inch)

Material

Aluminum

Customer Request

- Guarantee Productivity
- High Torque Boring
- Compact Working Area

Solution

DBC 110S

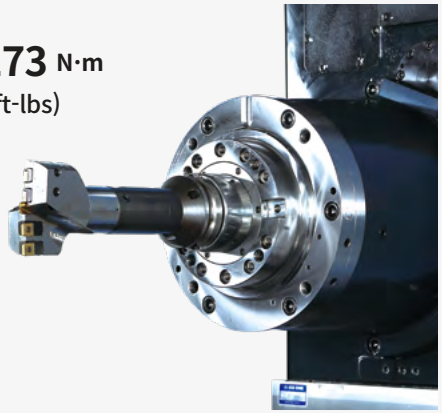
Column Moving Type
Boring Machine

- **Boring** 3000 r/min
- **Compact Size**
- **High Torque** 1273 N·m (939.5 ft-lbs)

Various Spindle Line-up

Torque

1137 / 1273 N·m
(839.1 / 939.5 ft-lbs)



Power

26 kW
(34.9 Hp)

Speed

3000 r/min

Working Area

Travel (X / Y / Z / W)

2000 / 1500 / 1200 / 500 mm
(78.7/59.1/47.2/19.7 inch)

Table Size

1400 x 1600 mm
(55.1 x 63.0 inch)

Customer S4

Workpiece

Frame

Size

1550 mm (61.0 inch)

Material

Titanium

Customer Request

- Gurantee Productivity
- Heavy Duty Machine
- 480pcs/Year

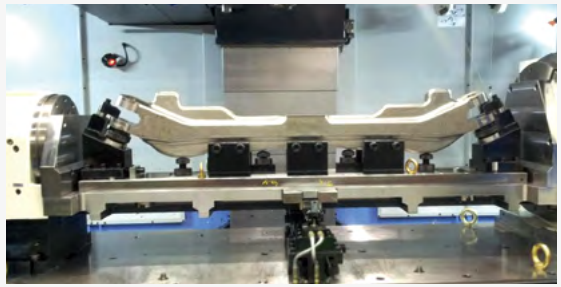
Solution

VM 960

Vertical Machining center

- Box Guideway
- High Rigidity
- High Torque 826N·m (609.6 ft-lbs)

Additional 4th axis



High Torque Spindle

Speed

6000 r/min

Power

26 kW (34.9 Hp)

Torque

825.9 N·m (609.5 ft-lb)

Customer S5

Workpiece

In-flight tanker part

Size

430 x 180 mm (16.9 X 7.1 inch)

Material

CRES

Customer Request

- High Productivity
- Complex Shaped Workpiece
- Precision part

Solution

VC 630/5AX

Simultaneous 5-axis Vertical Machining center

Simultaneous 5-axis

High Rigidity Design

High Accuracy

High Speed Built-in Spindle

Max. spindle speed

12000 r/min

(20000r/min option)

Good for High Speed Solution

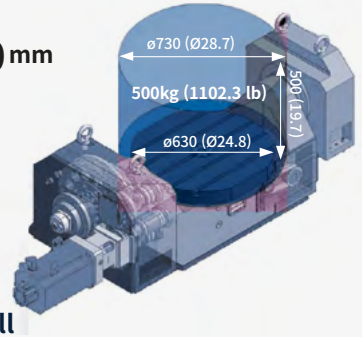
- Low centrifugal force
- Minimum heat generation

Response to Various size Workpieces

Max. size

ø730 x 500 mm

(Ø28.7 x 19.7 inch)



Max. Weight

500 kg

(1102.3 lb)

From Big to Small

- Machining a variety of workpieces by single machine

Customer S6

Workpiece

Rib Support

Size

1000 x 1700 x 60 mm
(39.4 x 66.9 x 2.4 inch)

Material

Aluminum

Customer Request

- High Productivity
- Large Working Area
- High Speed Machining

Solution

BM 2035M

Bridge type Machining Center for General Parts

Large size Table
3000 x 1850 mm
(118.1 x 72.8 inch)

30000 r/min

High Productivity

For High-speed Machining

Max. Spindle Speed

30000 r/min

Machining Process

27500 r/min
11050 mm/min (435.0 ipm)

For Large Workpiece

Table Size

3500 x 1850 mm (137.8 x 72.8 inch)

Max. Weight on Table

10000 kg (22045.9 lb)

Workpiece

Various Components

Size
Various

Material
Steel, Aluminum, Titanium

Customer Request

- High Productivity
- Complex Shaped Workpiece
- Precision Parts

Solution

VC 630/5AX

Simultaneous 5-axis Vertical Machining Center

- High Rigidity Design
- 20000 r/min
- Simultaneous 5-axis

High Speed Built-in Spindle

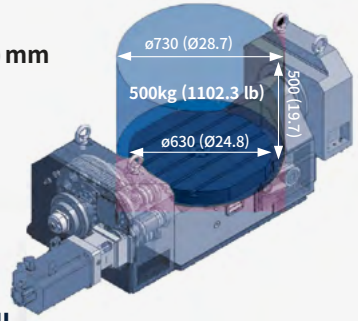
Max. Spindle Speed
12000 r/min
(20000r/min option)

Good for High Speed Solution

- Low centrifugal force
- Minimum heat generation

Response to Various size Workpieces

Max. Size
ø730 x 500 mm
(Ø28.7 x 19.7 inch)



Max. Weight
500 kg
(1102.3 lb)

From Big to Small

- Machining a variety of workpieces by single machine

Customer S8

Workpiece

Various Components

Size
Various

Material
Steel, Aluminum, Titanium

Customer Request

- Guarantee Productivity
- High Rigidity
- High Accuracy

Solution

DNM S series

Productivity Vertical Machining Center

Roller LM Guideway

Thermal Compensation

15000 r/min

Feedrate
42 / 42 / 36 m/min
(1653.5 / 1653.5 / 1417.3 ipm)

More Capacity

Table Size (A x B)

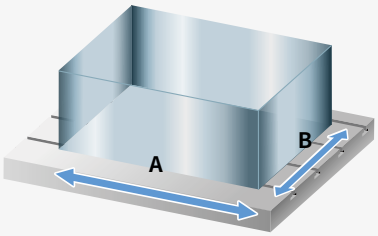
DNM 4500S
1000 x 450 mm
(39.4 x 17.7 inch)

DNM 5700S
1300 x 570 mm
(51.2 x22.4 inch)

Max Weight on Table

DNM 4500S
600 kg
(1322.8 lb)

DNM 5700S
1000 kg
(2204.6 lb)



High Speed Spindle for Productivity of DNM 4500S / 5700S

Speed
15000 r/min

Feedrate (X / Y / Z)
42 / 42 / 36 m/min
(1653.5 / 1653.5 / 1417.3 ipm)

Power
11/18.5 kW
(14.8 / 24.8 Hp)

Customer S9

Workpiece

Main Rotor(Helicopter)

Size

ø200 x 1500 mm (7.9 x 59.1 inch)

Material

Carbon Steel

Customer Request

- Multi tasking
- High Rigidity
- High Accuracy

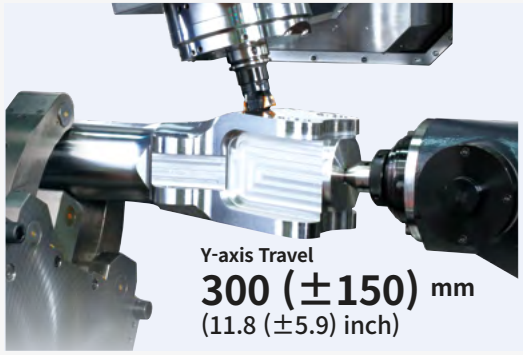
Solution

SMX series

Super Multi-Tasking Turning Center

- Max. Milling Spindle Speed 12000 r/min
- Simultaneous 5-axis
- Left & Right Spindles
- Max. Spindle Torque 30kW & 1203 N·m (40.2 Hp & 887.8 ft-lbs)

Machining Process



Y-axis Travel
300 (±150) mm
(11.8 (±5.9) inch)

Ø63 mm (2.5 inch) Face Mill	1200 r/min, 800 mm/min (31.5 ipm)
Ø25 mm (1.5 inch) End Mill	2200 r/min, 4000 mm/min (157.5 ipm)

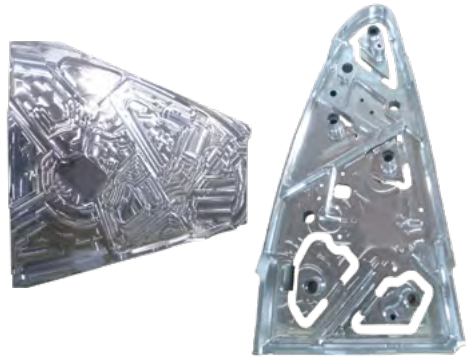
Solution for Productivity: Lower Turret

No. of Tool Stations	12 st
Rotary Tool Speed	5000 r/min
OD Tool Size	25 x 25 mm (1.0 x 1.0 inch)
Max. Boring Bar Size	Ø40 mm (1.6 inch)

Customer SI0

Workpiece

Rib



Size
Various

Material
Aluminum

Customer Request

Special Spec.
30000r/min High speed spindle

Solution

VC 630/5AX

Simultaneous 5-axis Vertical Machining center

- 630mm (24.8 inch) Rotary Table
- 30000 r/min
- Chip Disposal Solution

High Speed Built-in Spindle

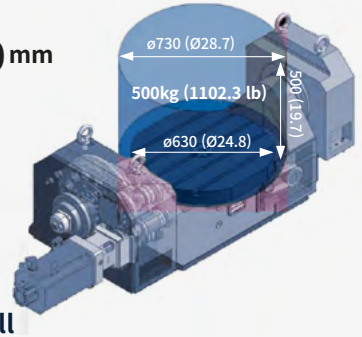
Max. spindle speed
30000 r/min option

Good for High Speed Solution

- Low centrifugal force
- Minimum heat generation

Response to Various size Workpieces

Max. size
ø730 x 500 mm
(Ø28.7 x 19.7 inch)



Max. Weight
500 kg
(1102.3 lb)

From Big to Small

- Machining a variety of workpieces by single machine

Workpiece

Various Aerospace item

Size
Various

Material
Various

Customer Request

- LPS 5000
- Manless Automation
- Machining various workpieces

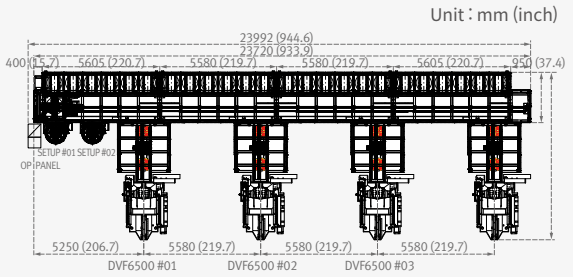
Solution

DVF 6500

High Precision Vertical 5-axis Machining Center

- LPS 5000
- 500x 500mm (19.7 x 19.7 inch) Pallet
- Manless Automation

LPS 5000 System



Customer S12

Workpiece

Wing, Rib

Size
4000 x 1500 mm

Material
Aluminum

Customer Request

- High-speed Spindle
- High volume chip disposal
- Productivity

Solution

HFP 1540

5 Axis Horizontal Simultaneous Machining Center for aircraft profiler

- 30000 r/min
- 4000 x 1500mm (157.5 x 59.1 inch) Large Tilting Table
- Chip Disposal Solution

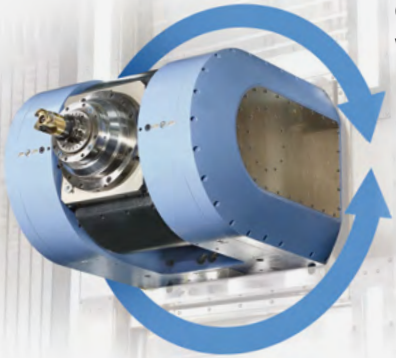
Spindle

Max. spindle speed
30000 r/min

Max. spindle motor power
75 kW (100.6 Hp)

Tool shank
HSK A63

A-axis Tiling angle
+105~ -105



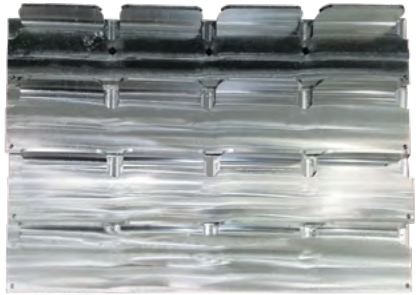
High-speed Scraper type Chip Conveyor

Chip conveyor width
700mm
(27.6 inch)

Max. Removal Capa.
7000 cm³/min
(427.2 inch)

Workpiece

Clip edge frame



Size
Various

Material
Inconel

Customer Request

- Hard-to-cut Material Cutting Package
- Powerful Cutting
- Thermal compensation

Solution

MD 6700

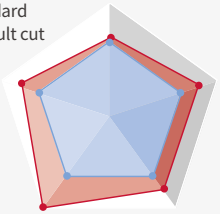
High Rigidity Vertical Machining Center

Option
Powerful Cutting
8000 r/min

Machining Process

Special Modification	Maximized machining performance on customer request
Option	BALL SCREW / Bearing / Servo Motor

Spindle Torque



Coolant(Amount, pressure)
25% Improved

Cutting(depth)
50% Improved

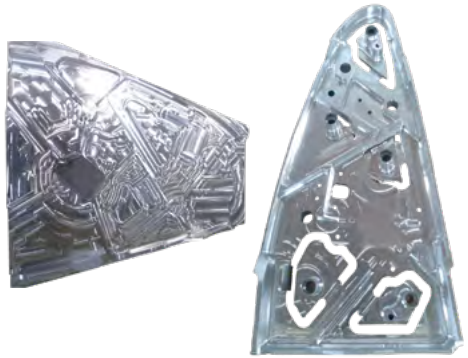
Axis thrust
20% Improved

Axis rigidity
23% Improved

Customer S14

Workpiece

Large Aerospace part



Size
Various Size

Material
Various Material

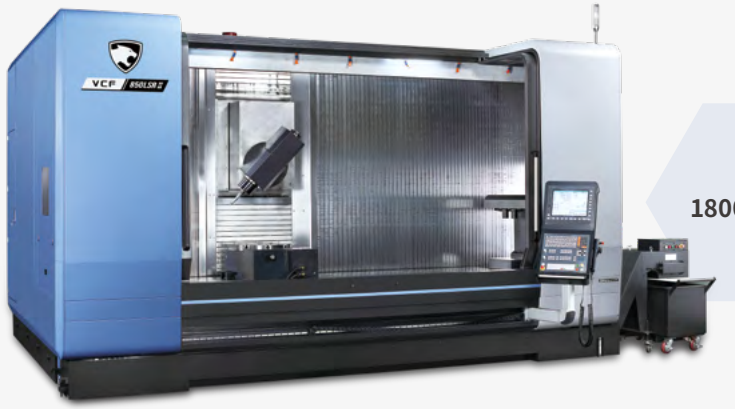
Customer Request

- High-speed Spindle
- 2-rotary table
- Multi solution

Solution

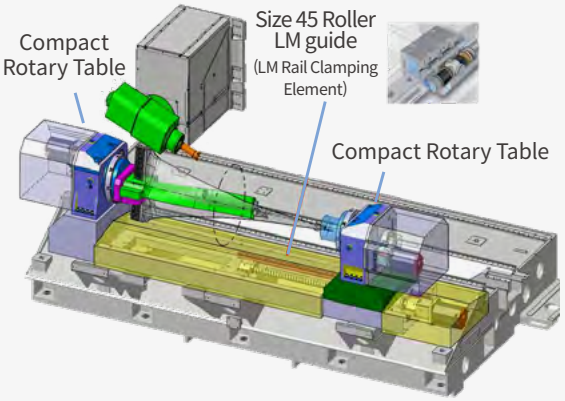
VCF850LS2R

VCF Aerospace Solution



- 2-rotary table
- 18000 r/min
- Multi solution

Machine Structure



Workpiece

Frame part

Material
Aluminum

Customer Request

- High-speed Spindle
- High volume chip disposal
- Productivity

Solution

HFP 1540

5 Axis Horizontal Simultaneous Machining Center for aircraft profiler

30000 r/min

4000 x 1500mm
(157.5 x 59.1 inch)
Large Tilting Table

Chip Disposal Solution

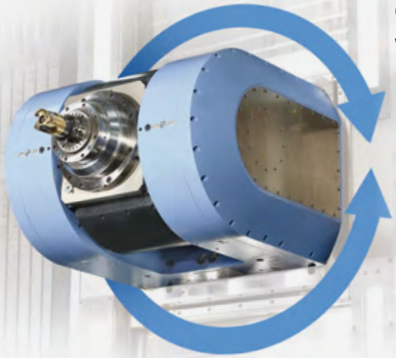
Spindle

Max. spindle speed
30000 r/min

Max. spindle motor power
75 kW (100.6 Hp)

Tool shank
HSK A63

A-axis Tiling angle
+105~ -105



High-speed Scraper type Chip Conveyor

Chip conveyor width
700mm
(27.6 inch)

Max. Removal Capa.
7000 cm³/min
(427.2 inch)

Solution
Engine Parts

CASE

- Customer E1
- Customer E2
- Customer E3
- Customer E4
- Customer E5
- Customer E6

BLADE

- Customer E7
- Customer E8
- Customer E9
- Customer E10

Customer E1

Workpiece

Engine Case

Size

ø1000 mm (ø39.4 inch)

Material

Inconel

Customer Request

- High Productivity
- High Rigidity
- Strong RAM head

Solution

PUMA VTR series

Large Vertical Turning Center with Rigid Ram Spindle

High Productivity

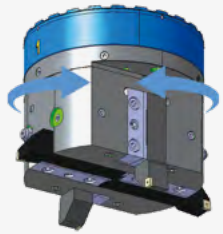
High Power / High Torque

Strong Ram Head

Unique Solution for Productivity of PUMA VTR series

Quad Tool Indexing

- 4direction rotating head
- DMT have the patent
- Reduce tool change time



Strong RAM head of PUMA VTR series

Clamping Force **8** ton (17636.7 lb)

Indexing **90** deg.

Max. Tool Length from Ram

180 ~ 200 mm (7.1 ~ 7.9 inch)

> Inconel is one of the most difficult material to cut. But It's easy to cut Inconel if you have PUMA VTS Series. I will seriously consider further purchase more PUMA VTS Series.
>
> *- Engineer of E company*

Customer E2

Workpiece

Engine Case

Size
ø800 mm
(ø31.5 inch)

Material
Inconel

Turbine Disk

Size
ø800 mm
(ø31.5 inch)

Material
Titanium

Customer Request

- High Accuracy
- High Productivity
- Large Capacity

Solution

PUMA V8300-2SP

2 Spindle Vertical Turning Center

Large capa.
Max turningdia
830 mm
(32.7 inch)

Max.
High Torque
2592 N·m
(1912.9 ft-lbs)

High
Productivity

Twin
Spindle

PUMA V8300-2SP key Strengths in Turning Process

- Strong machine rigidity supports stable fixation despite long working hours, and can handle items with a diameter as long as 830mm (32.7 inch)
- PUMA V8300-2SP have independent motor systems in each of its spindles, so productivity can be enhanced by operating two spindles at once.

Productivity Improvement

A Mmaximum ~50% in Cycle Time was Shortened **50%↓**

A Company	5 hours
PUMA V550	2.5 hours

-50%

As much as 40% Cut in Turning Costs **40%↓**

A Company	$20k
PUMA V550	$12k

-40%

Workpiece

Engine AFT Inner

Size
ø700 mm
(ø27.6 inch)

Material
Inconel

Blisk

Size
ø800 mm
(ø31.5 inch)

Material
Titanium

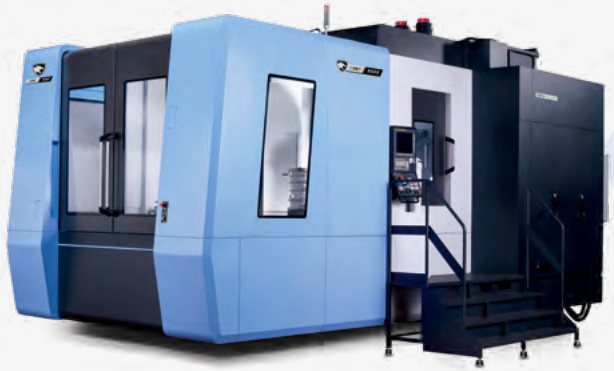
Customer Request

- Large size Workpiece
- ComplexShaped Workpiece
- Difficult-to-cut Material Solution

Solution

DHF 8000

Simultaneous 5-axis Horizontal Machining Center



Large Workpiece
1400 x 1400 mm
(55.1 x 55.1 inch)

High Torque
960 N·m
(708.5 ft-lbs)

Simultaneous 5-axis

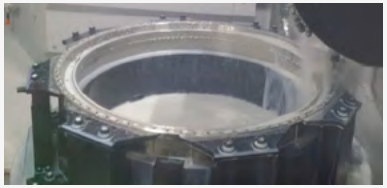
Machining Process

Upper Side Hole Drilling

- Ø6.7 mm (0.3 inch) drill
- 50mm/min (2.0 ipm), 700 r/min

Slope Side Boss part Surfacing

- Ø6.95 mm (0.3 inch) Row end mill
- 30mm/min (1.2 ipm), 200 r/min

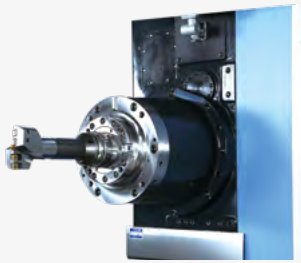


High Power Spindle Option for Difficult-to-cut Material

Torque
960 N·m(708.5 ft-lbs)

Power
35 kW(46.9 Hp)

Speed
6000 r/min



"DHF8000 is optimized to cut inconel and titanium."
- General Manager of Equipment management team

"This machine have enough power to machining difficult-to-cut material with tilting function"
- General Manager of Production team

Customer E4

Workpiece

Engine Forward Case

Size
ø800 mm
(ø31.5 inch)

Material
Inconel

Engine Case

Size
ø700 mm
(ø27.6 inch)

Material
Titanium

Customer Request

- Turning furnction
- Shorten Cycle time
- High Torque Spindle

Solution

DHF 8000ST

Simultaneous 5-axis Horizontal machining center
(Turning function)

- **Large Workpiece** 1600 x 1400 mm (63.0 x 55.1 inch)
- **High Torque** 960 N·m (708.5 ft-lbs)
- **HSK T100 tool shank**
- **Turning function**

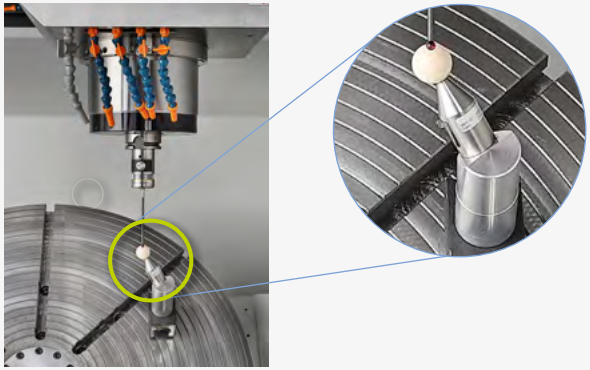
Turning table

Rotating speed **500 r/min**

Pallet size **Ø1000 mm (39.4inch)**

Intelligent Kinematic Compensation for 5-axis option

- Minimize error in complex 5-axis machining
- The tip of the tool is always in the correct position in relation to the workpiece



Customer E5

Workpiece

Engine part

Size

ø500 mm (ø19.7 inch)

Material

Inconel

Customer Request

- Complex Shaped Workpiece
- High Rigidity
- Precision parts

Solution

VC 630/5AX

Simultaneous 5-axis Vertical Machining Center

- High Rigidity Design
- 20000 r/min
- Simultaneous 5-axis

High Speed Built-in Spindle

Max. spindle speed

12000 r/min

(20000r/min option)

Good for High Speed Solution

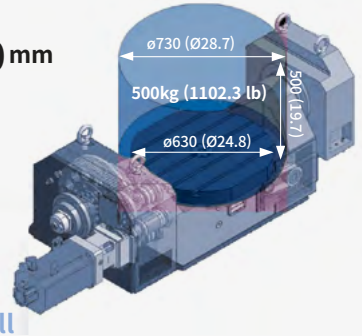
- Low centrifugal force
- Minimum heat generation

Response to Various size Workpieces

Max. size

ø730 x 500 mm

(Ø28.7 x 19.7 inch)



Max. Weight

500 kg

(1102.3 lb)

From Big to Small

- Machining a variety of workpieces by single machine

Customer E6

Workpiece

Engine casering

Size

ø800 mm (ø31.5 inch)

Material

Inconel 718

Customer Request

- High productivity
- High accuracy
- Strongram head

Solution

PUMA VTR1012F/1216F

Large Vertical Turning Center with Rigid Ram Spindle

High Productivity

High Power / High Torque

Strong Ram Head

Option

- Fixed column
- Full cover
- Linear scale
- Work & Tool Measuring
- Calibration Unit
- High pressure coolant 70bar
- Spin Window

Strong RAM head of PUMA VTR series

Clamping Force 8 ton (17636.7 lb)

Indexing 90 deg.

Max. Tool Length from Ram
180 ~ 200 mm
(7.1 ~ 7.9 inch)

> "Inconel is one of the most difficult material to cut. But It's easy to cut Inconel if you have PUMA VTS Series. I will seriously consider further purchase more PUMA VTS Series."
>
> *- Engineer of E company*

Customer E7

Workpiece

Aerofoil (Engine Blade)

Size

50 mm (2.0 inch)

Material

Inconel

Customer Request

- Special Quotation
- High Rigidity
- Guarantee Productivity

Solution

VC 510

High Productivity Twin Table Vertical Machining Center

- **Feedrate** 40 / 40 / 32 m/min (1574.8 / 1574.8 / 1259.8 ft-lbs)
- **14000 r/min**
- **Twin Spindle**
- **High Pressure TSC 7MPa (70 bar)**

Machining process

Special Modification	Machine ATC guard modified to take over size tool Ø200mm (Ø7.9 inch) required for s ome components.
Filtration	Drum filtration coolant system added to filter particles created by Grinding wheel.

Customer E8

Workpiece

Engine Fan Blade

Size

300 x 700 mm (11.8 x 27.6 inch)

Material

Aluminum

Customer Request

- Guarantee Accuracy
- High Rigidity
- Curved Shape

Solution

VC 630/5AX

Simultaneous 5-axis Vertical Machining Center

High Rigidity

High Accuracy

20000 r/min

Simultaneous 5-axis

High Speed Built-in Spindle

Max. Spindle speed

12000 r/min

(20000r/min option)

Good for High Speed Solution

- Low centrifugal force
- Minimum heat generation

Rotary Table type 5-axis Machine

Travels

A axis **+30 ~ -120°**

C axis **360°**

Rapid traverse

A axis **20** r/min

C axis **30** r/min

Customer E9

Workpiece

Size

750 x 180 mm (29.5X 7.1 inch)

Material

Inconel

Customer Request

- Special Spec.
- Continuous Operation
- Auto Compensation

Solution

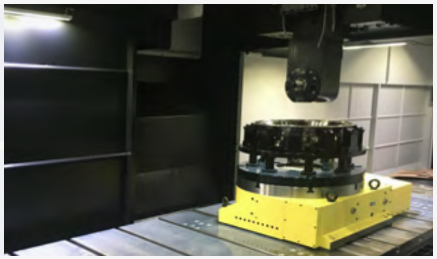
BM 1530M

Bridge type machining center

- 800mm Rotary Table
- Angle Head
- High Productivity

Machining process

Customized	Custom machining of up to 800mm workpieces for special workpiece
Option	Angle Head / Rotary table HSK-A63 / 100 tools



Customer E10

Workpiece

Split Engine Case

Material

Titanium

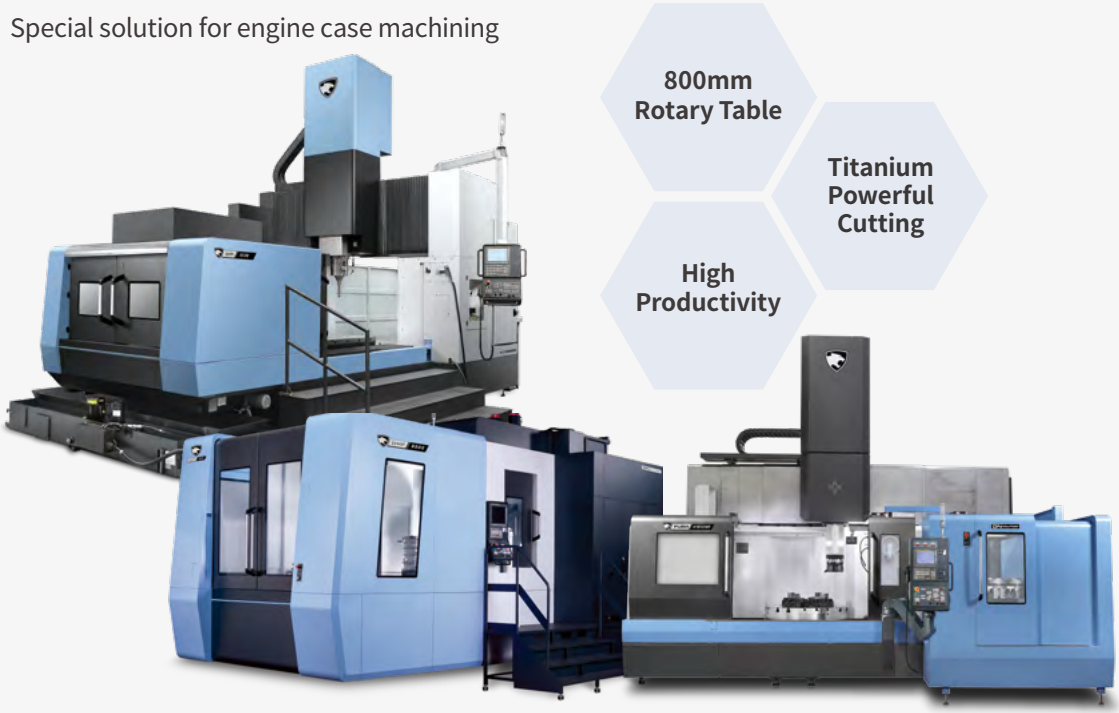
Customer Request

- Total solution
- Additional C-axis option
- Tolerance between hole 0.05mm
  (DN Solutions Measuring Macro P/G)

Solution

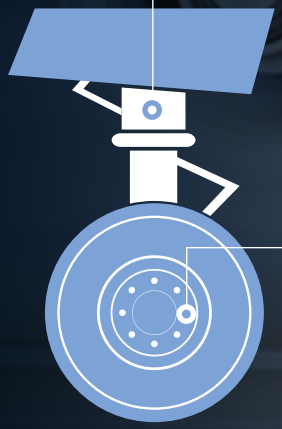
BM 1530M / DHF 8000 / PUMA VTR1216

Special solution for engine case machining



Customer Site

Solution
Landing Gear Parts



BEAM

Customer L1

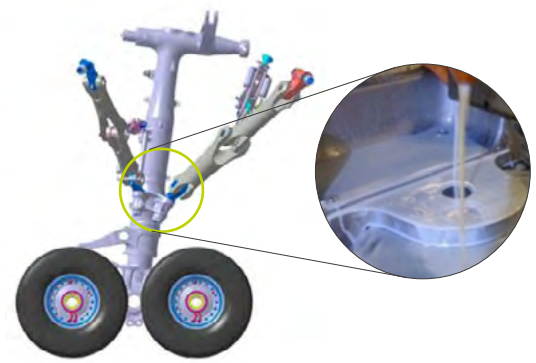
Customer L2

DISK

Customer L3

Workpiece

Landing Gear Pylon



Size

ø380 mm (ø15.0 inch)

Material

Titanium

Customer Request

- High Accuracy
- Heavy Duty Machine (High Torque)
- High Productivity & Rigidity

Solution

Mynx series

Heavy Duty Vertical Machining Center

- **Max. Torque** 617 N·m (455.3 ft-lbs)
- **Thermal Compensation**
- **Servo Magazine**
- **Box Guideway**

Machining Process

Initial Machining Condition

Speed	Feedrate	Required Torque
34 r/min	60 mm/min (2.4 ipm)	450 N·m (332.1 ft-lbs)

- Tool: Ø380mm(ø15.0 inch) slotting cutter

On the Cutting Trial

- Raise RPM to 55 and decrease feed per tooth
- Enough Torque:
  Max. torque of Mynx is over 450N·m (332.1 ft-lbs)

Test Result

- Comparable cycle time with reducing spindle load
- Get the additional order for other type of machine

Customer L2

Workpiece

Support

Size

800 x 800 mm (31.5 x 31.5 inch)

Material

Titanium

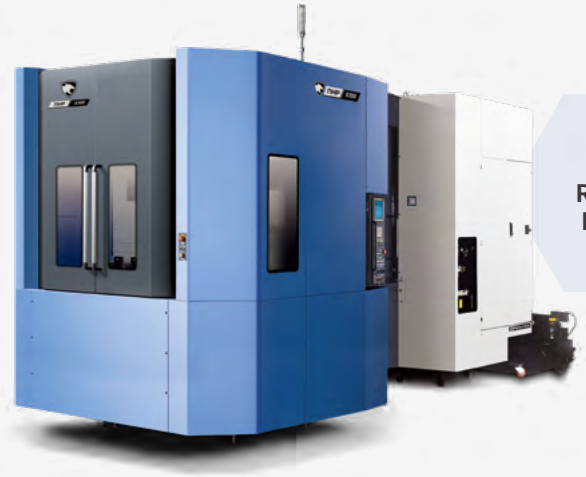
Customer Request

- Guarantee Rigidity
- High Productivity
- Heavy Duty Cutting

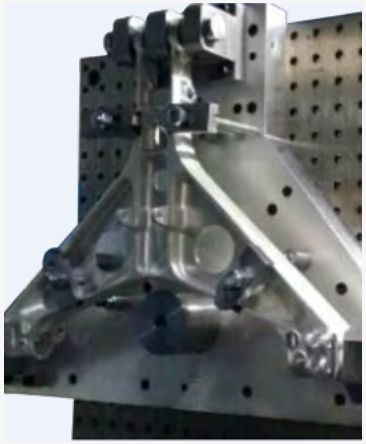
Solution

NHP/NHM series

Horizontal Machining Center



- High Rigidity Design
- Heavy Duty Cutting (NHM)
- High Productivity (NHP)



High Power, High Torque Spindle

NHP

Torque
600 N·m (442.8 ft-lbs)

Power
45 / 25 kW (60.3 / 33.5 Hp)

Speed
10000 r/min

NHM

Torque
1732 N·m (1278.2 ft-lbs)

Power
22 / 35 kW (29.5 / 46.9 Hp)

Speed
6000 r/min

Workpiece

Brake Disk

Size

ø500 mm (ø15.0 inch)

Material

Carbon Steel

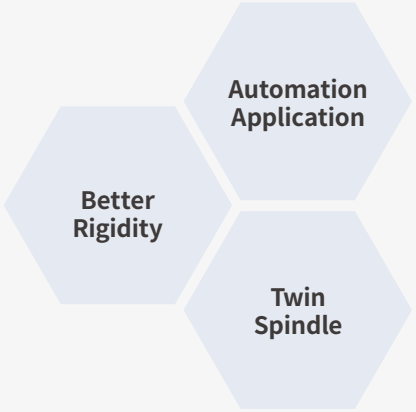
Customer Request

- Better Accuracy
- Automation Application
- Raise Productivity

Solution

PUMA V8300-2SP

2 Spindle Vertical Turning Center



Automation Solution

PUMA V8300-2SP
(Brand New Model of PUMA V550-2SP)

+

DNM 6700
(Brand New Model of DNM 650II)

+

Robot Cell

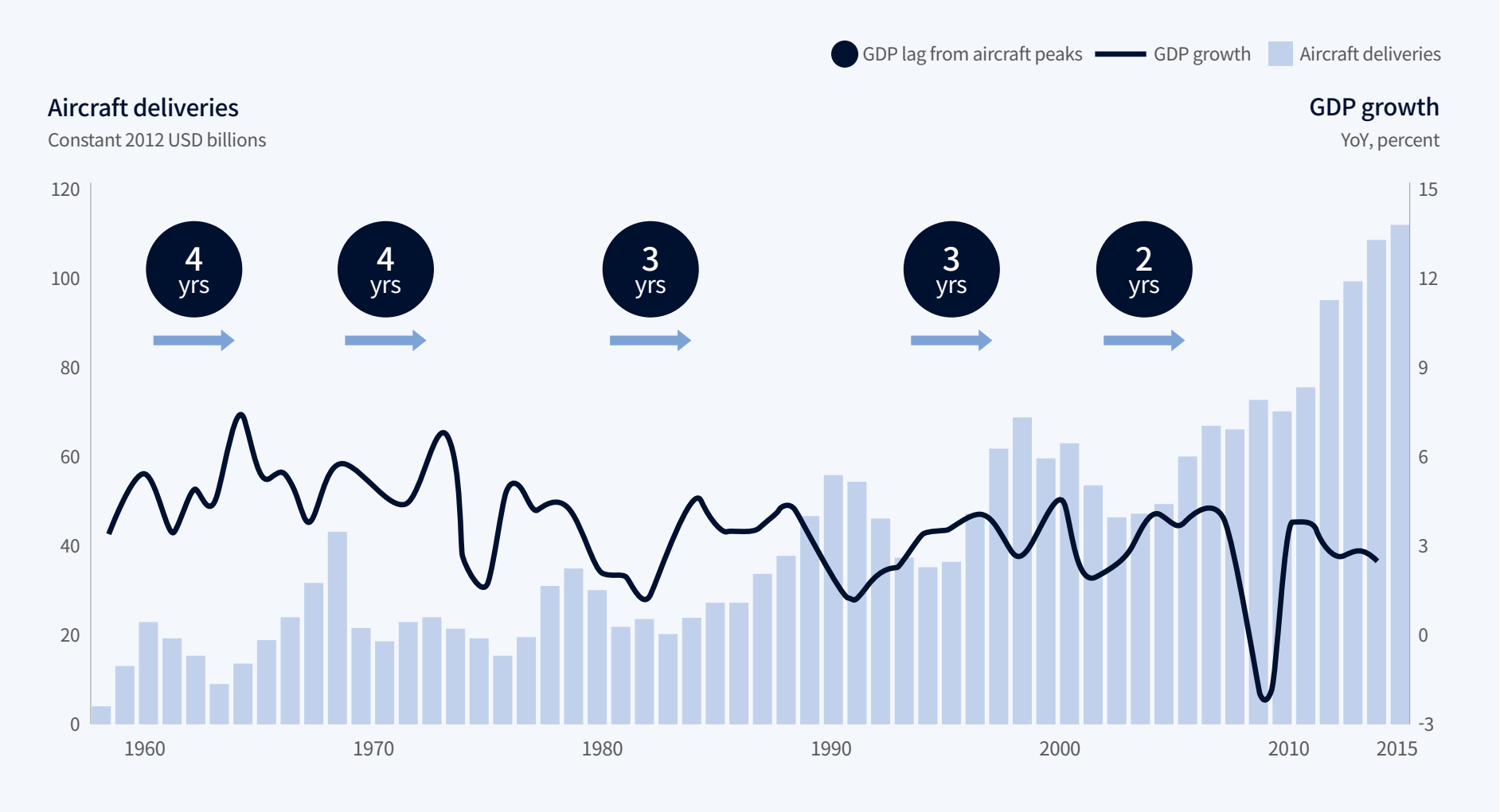
Appendix

Aircraft demand forecasts

Analysis on Aerospace parts machining

Supply Chain of Aerospace Industry

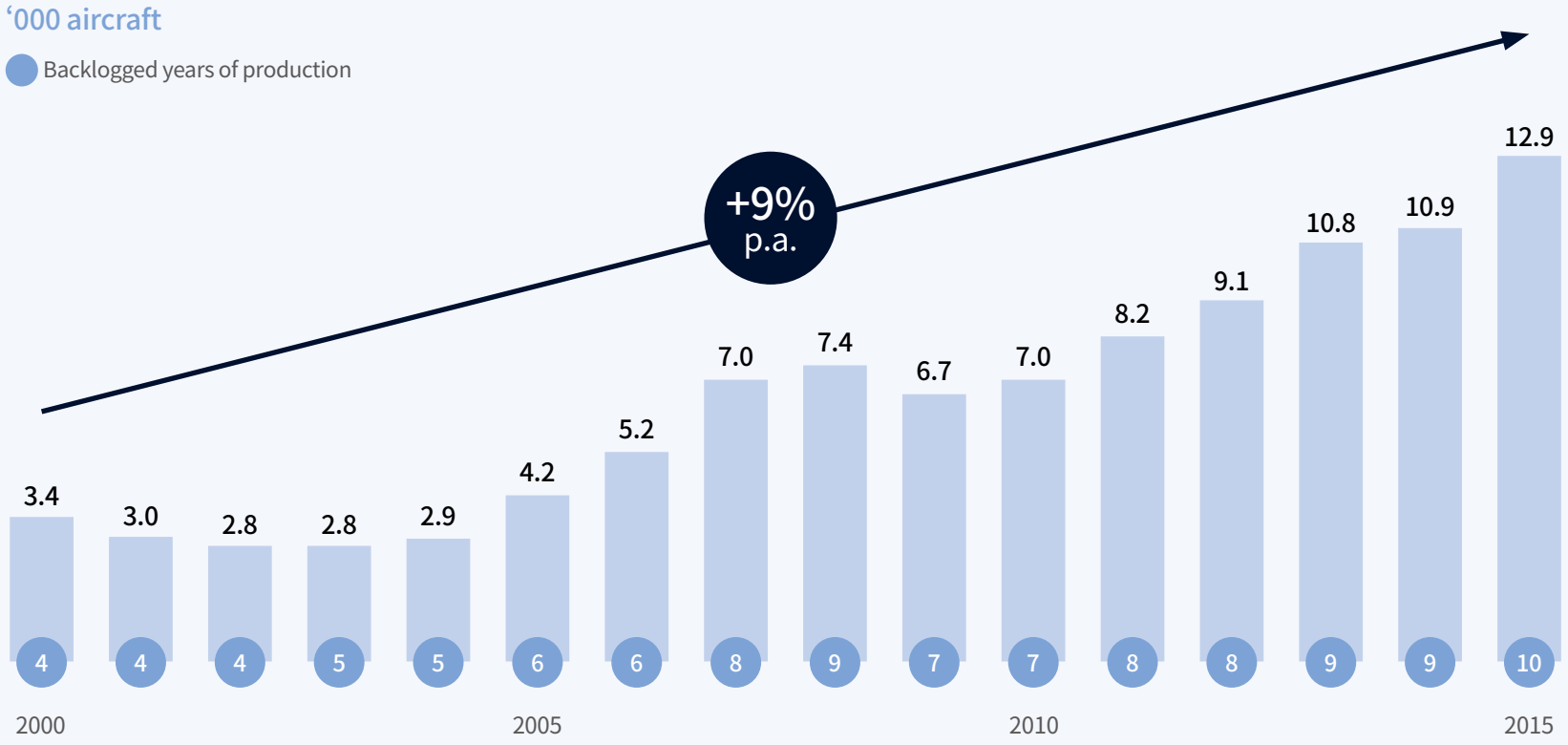
Aircraft deliveries have risen steadily for the past 50 years, reaching the historical peak in 2015



Note: Includes regional aircraft
SOURCE: Teal Group; OECD; EIU; IHS Global Insight; McKinsey

Order books are completely full – with a backlogs of 10 years' production (12,900 aircraft)

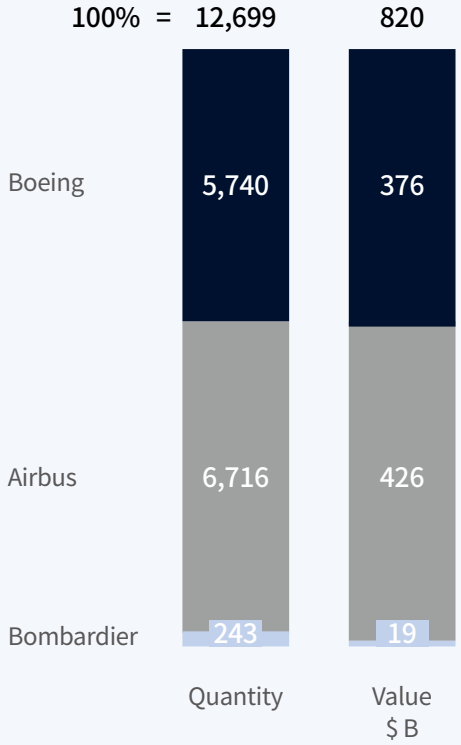
Commercial aircraft backlog (Airbus, Boeing, and Bombardier)



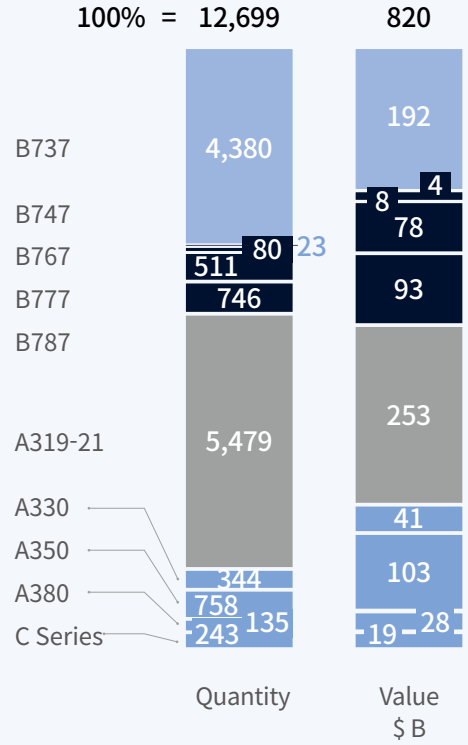
SOURCE: Company data; McKinsey

Most of the backlog is for Boeing and Airbus aircraft; Bombardier is a distant third, although they scheduled an entry into the narrow-body market in 2016

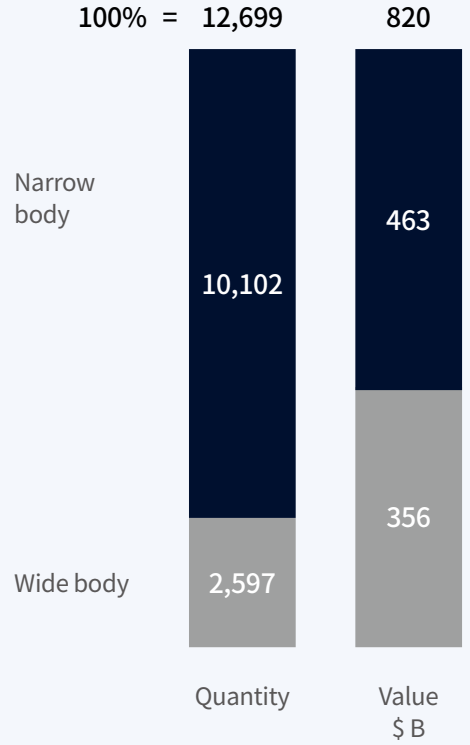
Backlog by **OEM**[1]



Backlog by **Model**

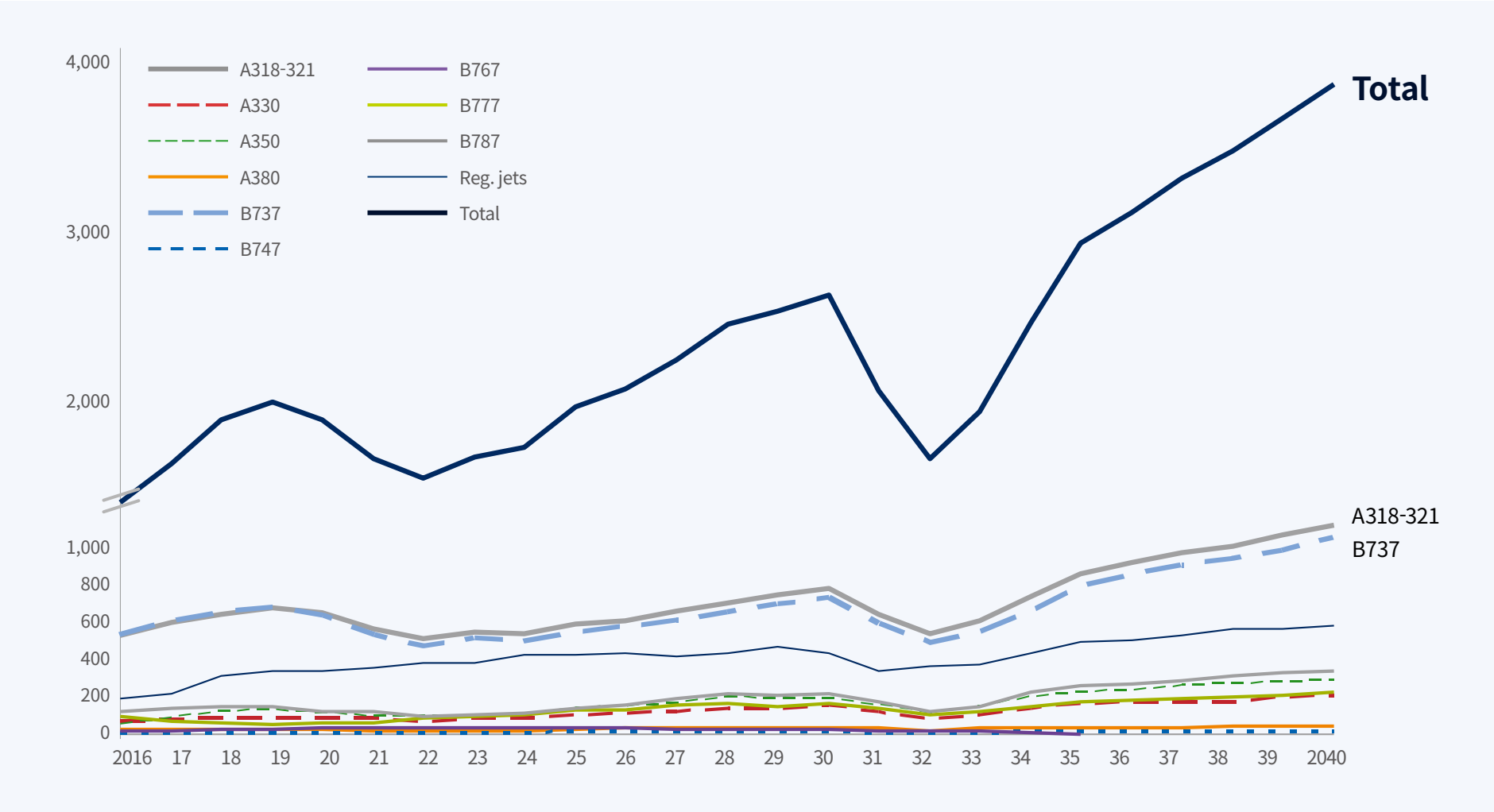


Backlog by **Type**



1 Figures as of April 2016
2 Does not include Regional or Business Jet business
SOURCE: Company website, TEAL

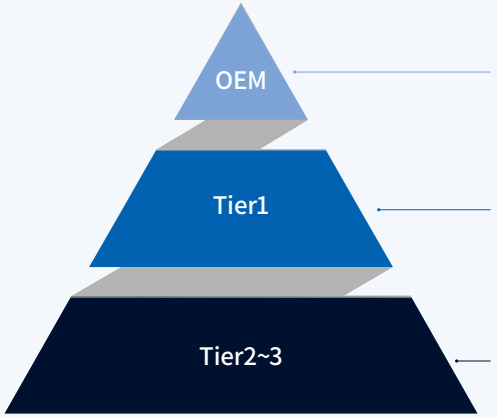
Projected aircraft deliveries, 2016 to 2040



1 Assuming titanium is acquired three years prior to aircraft delivery
2 Estimate – includes Russian, Chinese and Japanese aircraft
SOURCE: Airline Monitor June 2016

Aerospace industry for MTB

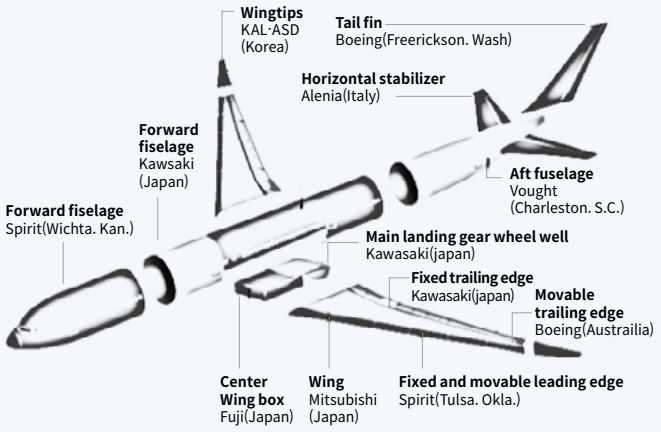
Aerospace Industry Structure



- Development & Assembly
- High level of outsourcing
- Machining main parts
- Mainly USA/Europe companies
- Supplier of OEM or Tier1
- Fast growing in Asia

- **Aerospace supply chain latest trends**
  - Direct cooperation between *MTB and OEM or Tier1*
  - Supply chain is expanded to developing countries

Boeing Parts Sourcing



Parts not shown

Landing gear
Messier Dowty
(England)

Wing/body fairing
Boeing(Canada)

Landing gear doors
Boeing(Canada)

Cargo access doors
Saab(Sweden)

Passenger entry doors
Latecoere(France)

Engines
GE(Evendale. Ohio)

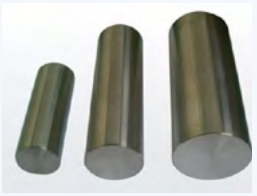
Engines
Rolls Royce(England)

Engines nacelles
Goodnch(Chula Vista. Calif)

Aerospace Industry Trend in Machining

- **Increasing Use of Hard-to-cut Material: Need for Solutions**
  - Aluminum alloy, Titanium: External parts of Aircraft
  - Heat-Resistance material: Engine
  - Machine tool concept, tooling, CAM, etc.


Aluminum

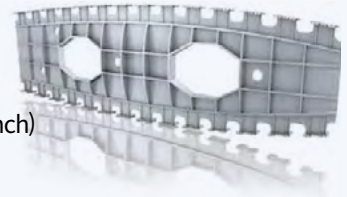

Inconel


Titanium

- **Composite Material(ex: CFRP)**
  - Partially applied buy price issue
  - Metal is still main material in the industry

- **Need for Better Chip Disposal**
  - 90% of raw material is removed as chip
  - Horizontal structure for chip disposal
    +Universal head for 5-axis machining

- **Machine classification for frame/ skin by size(table)**
  - Small size aircraft: 500~700mm (19.7~27.6 inch)
  - Middle size aircraft : 800~1300mm (31.5~51.2 inch)
  - Large size aircraft : 2000mm~ (79.7 inch~)

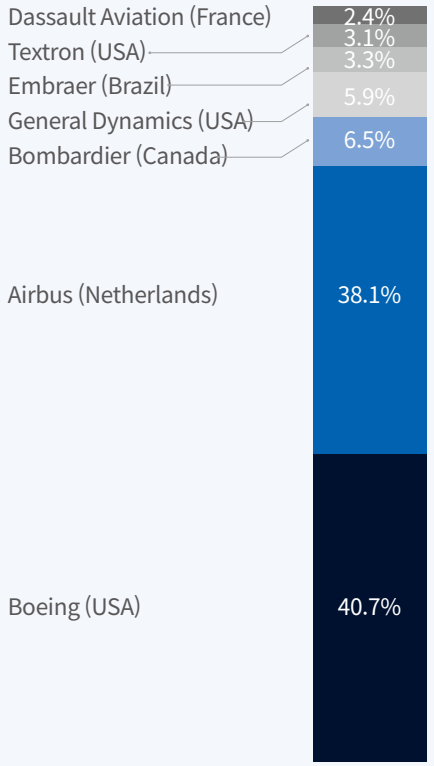


The industry is quite consolidated in the Engines segment, but this has not yet occurred in the Aero-structure one

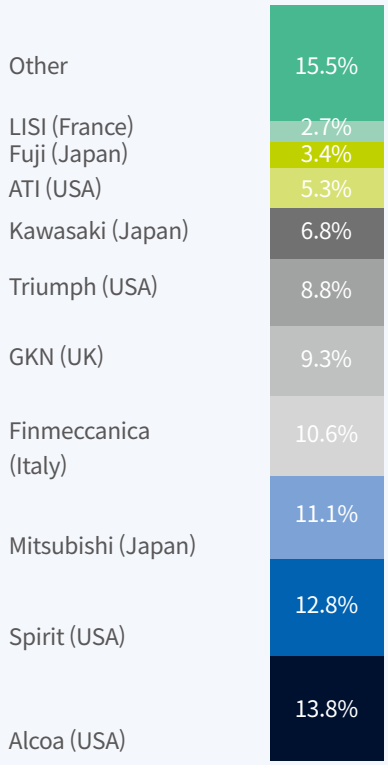
Share of revenues within top players from 100 aerospace suppliers[1]

2014, Unit : Percent

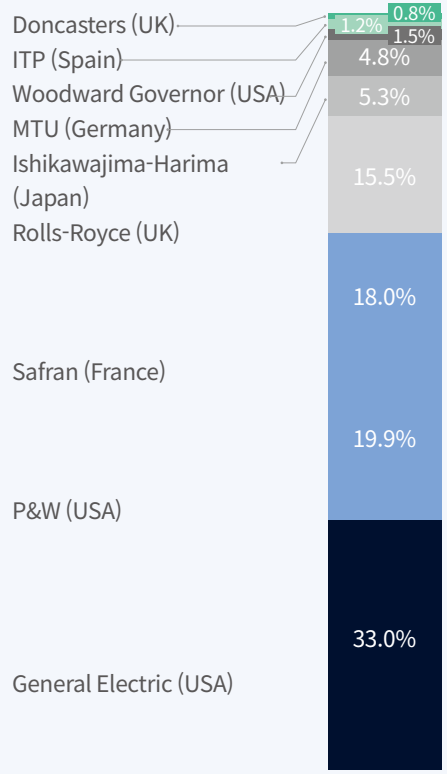
Aircraft OEMs



Aerostructure suppliers



Engine suppliers

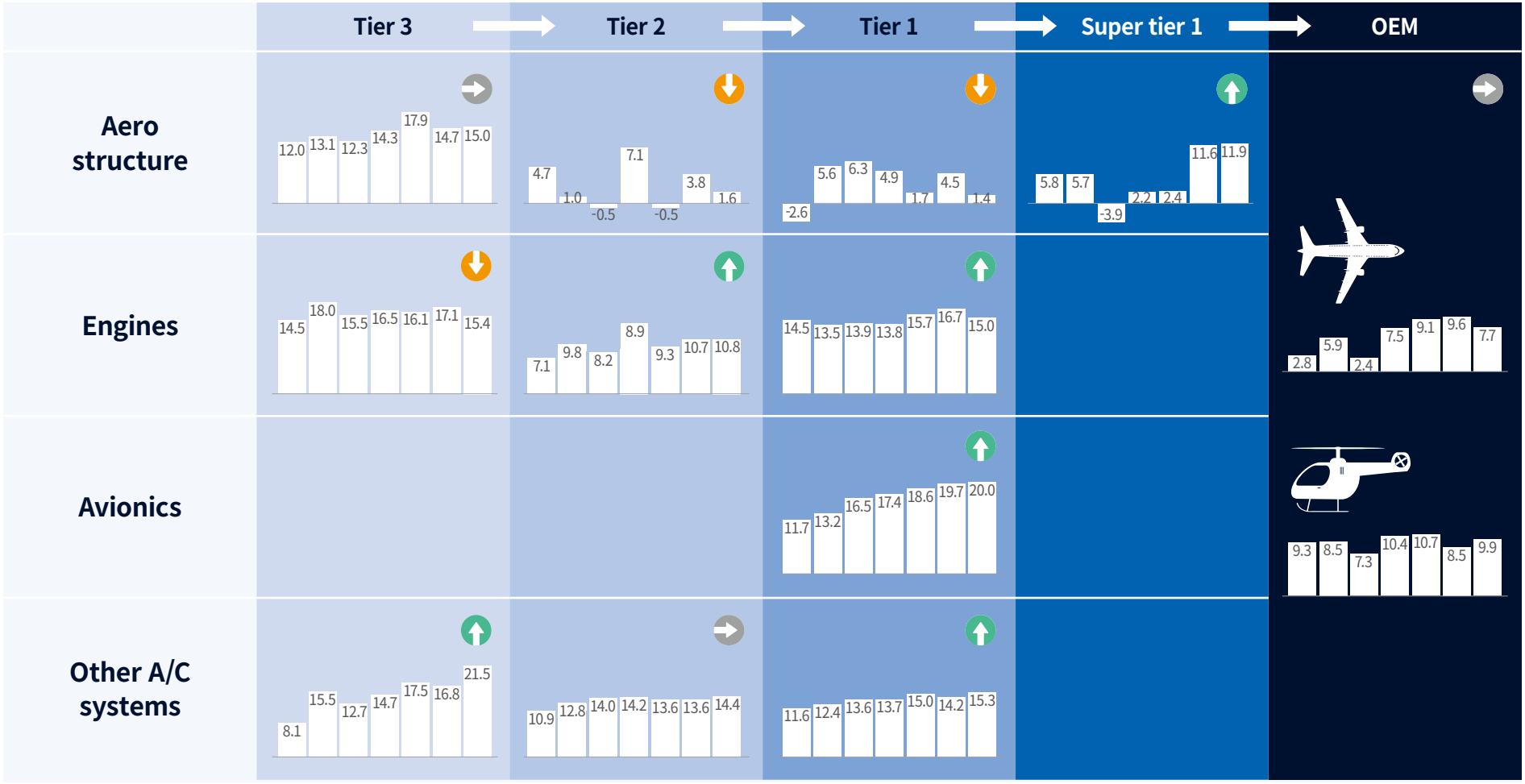


Note: Reflects database and not the entire industry as small players are not covered
1 If available, the data reflects the business division concerned, otherwise the whole company
SOURCE: Company data, McKinsey analysis

The production ramp up in commercial aviation results in diverse margin trends with 2015 being tough for OEMs

Average operating margin

Unit : Percent



- Increased margin more than 1 percentage point since 2012
- Stable margin (-1 < X < 1) since 2012
- Decreased margin more than 1 percentage point since 2012

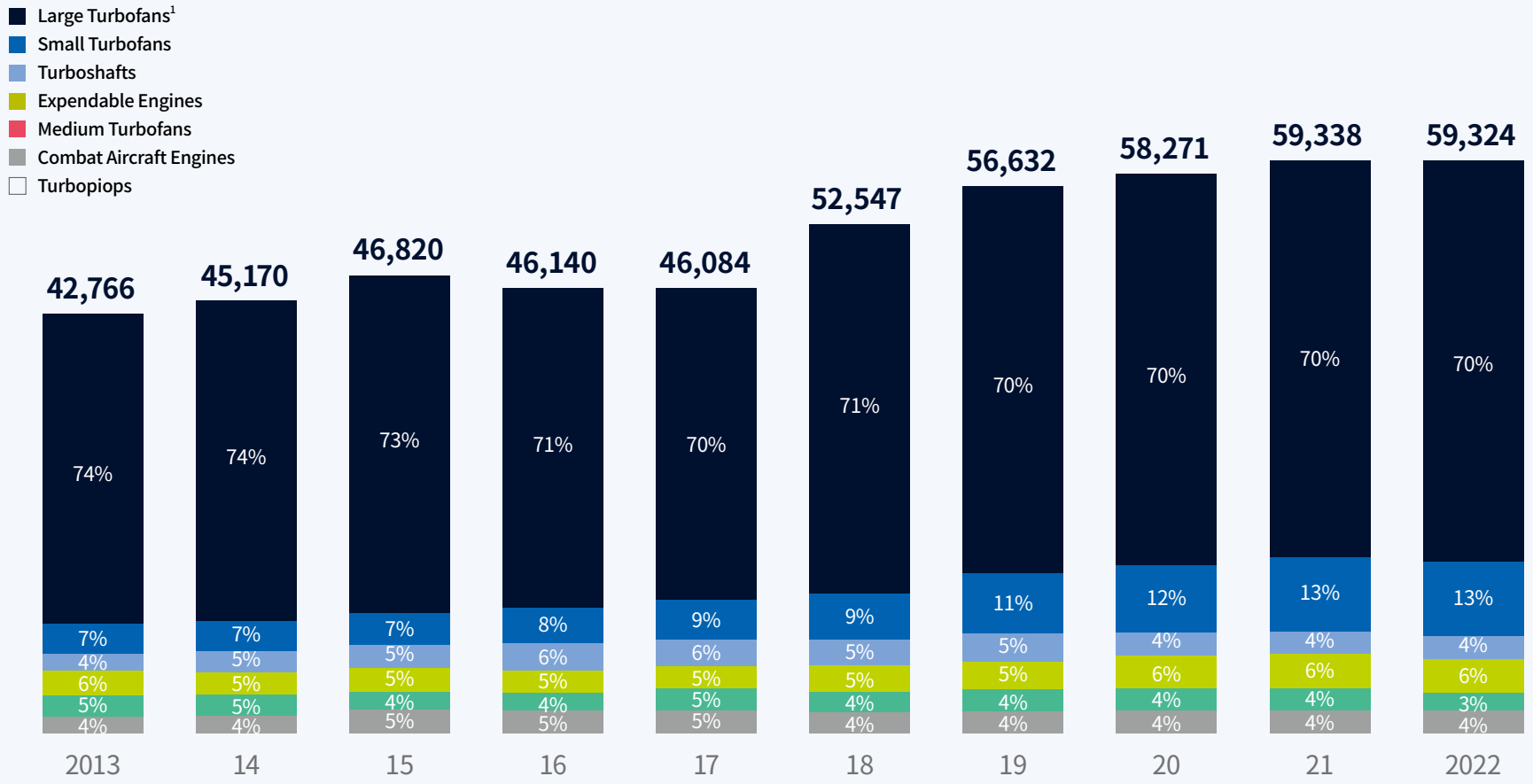
NOTE: Reflects database and not the entire industry; figures corresponding to commercial aircraft specific division whenever possible
SOURCE: McKinsey profit pool database

Engine market

The aero engine market is growing, driven primarily by medium-to-large turbofan engine developments

Value

2016, Unit : $ Millions



1 Engines for narrow-body and wide-body commercial jets
SOURCE: Teal Group

DN Solutions in the World

In an effort to provide solutions that fit each partners' unique needs, we constantly innovate our thinking, processes, and the way we do business. These optimal solutions lay the foundation for the success of our partners, which adds value to our partners' businesses.

Global Sales and Service Support Network

4 Corporations

155 Dealer Networks

51 Technical Centers

200 Service Post

3 Factories

Technical Center: Sales Support, Service Support, Parts Support

Supplying Parts

- Supplying parts without charges
- Supplying parts with charges
- Parts repair

Field Services

- On-site services
- Installment and trials
- Scheduled maintenance/ Preventive maintenance
- Repairs with/without charges

Technical Support

- Supporting machining technology
- Responding to technical inquiries
- Providing technical materials

Training

- Programming / Machine operation
- Maintenance
- Application engineering

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Fax +86-21-6405-1472

Fire Safety Precautions | There is a high risk or fire when using non-water-soluble cutting fluids, processing flammable materials, neglecting use coolants and modifying the machine without the consent of the manufacturer. Please check the SAFETY GUIDANCE carefully before using the machine.

* For more details, please contact DN Solutions.
* The specifications and information above-mentioned may be changed without prior notice.