Investor & Analyst Day 2018

London, 30th November 2018 – MTU Aero Engines AG
MTU Innovation Days

Learn more on our YouTube channel

Movie
## Agenda – MTU Investor & Analyst Day 2018

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Speaker</th>
</tr>
</thead>
<tbody>
<tr>
<td>11:00 – 11:10</td>
<td>Welcome</td>
<td>Michael Röger, VP Investor Relations</td>
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<tr>
<td>11:10 – 11:30</td>
<td>MTU’s Market Environment</td>
<td>Reiner Winkler, Chief Executive Officer</td>
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</tbody>
</table>
| 11:30 – 12:30 | Commercial OEM | Military OEM | Commercial MRO  
|               | Q & A                                                       | Michael Schreyögg, Chief Program Officer     |
| 12:30 – 13:30 | Lunch                                                            |                                              |
| 13:30 – 14:15 | Status Execution | Smart Factory | Technology Roadmap  
|               | Q & A                                                       | Lars Wagner, Chief Operating Officer        |
| 14:15 – 15:00 | Future presentation OEM-MRO | Guidance 2019 | Long-term outlook  
|               | Q & A                                                           | Peter Kameritsch, Chief Financial Officer    |
| 15:00 – 15:30 | Outlook | Summary  
|               | Q & A                                                          | Reiner Winkler, Chief Executive Officer      |
MTU’s market environment – Ongoing growth backed by normalizing market indicators

Reiner Winkler, Chief Executive Officer
Positive environment for aerospace despite rising oil price

<table>
<thead>
<tr>
<th>Demand indicators</th>
<th>~ 2000</th>
<th>~ 2010</th>
<th>Today</th>
<th>Influence on demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Backlog</td>
<td>4 yrs</td>
<td>8 yrs</td>
<td>8 yrs</td>
<td>Backlog has stabilized at 13,900 a/c since 2017 Production growing</td>
</tr>
<tr>
<td>2 Technology status</td>
<td>'90s</td>
<td>'90s</td>
<td>'10s</td>
<td>Proven step change in efficiency achieved</td>
</tr>
<tr>
<td>3 Cost of debt</td>
<td>High</td>
<td>Mid</td>
<td>Low</td>
<td>Attractiveness of aircraft as investment remains intact</td>
</tr>
<tr>
<td>4 Oil</td>
<td>30 $/b</td>
<td>100 $/b</td>
<td>70 $/b</td>
<td>Increase driven by geopolitics/security but shale oil becomes competitive again</td>
</tr>
</tbody>
</table>
Backlog remains at historic high level, represents 8 years of production

Growing production is stabilizing backlog and turning it into deliveries

- Recent cancellation and deferral data remain negligible as a share of backlog
- 1,442 aircraft ordered in the first 9m 2018
- +11% production in 2018 y-o-y is stabilizing backlog and turning it into deliveries

Source: Fleet Analyzer, western-built narrowbody and widebody airframes only (no RJ and TP), excludes LoIs, gross orders shown
Production plans under review for increase

Backlog distribution vs. production plans

- Narrowbody backlog equates to 10 years of production alone
- With currently planned rate 63, the A320neo is overbooked in 2020-25
- Airbus is examining rate 70, supply chain readiness is key

- Widebody backlog equates to 6 years in production
- Backlog justifies upcoming rate hikes in 2019-20
- Production of the 787 and 767 Freighter set to rise with 777X beginning ramp-up

Source: Ascend firm orders and LoIs as of 30.09.2018, OEM announced production rates, Airbus and Boeing aircraft only
GTF technology offering a step change in fuel efficiency

US$ 150 billion of kerosene to be saved alone by PW1100G-JM

Fuel savings GTF fleet to date

- 290+ GTF powered aircraft
- Airline operating costs lowered by US$ 140 million

260 million litres of fuel saved

Total expected fuel savings PW1100G-JM fleet alone

- Lower airline operating costs of US$ 150 billion expected
- 20,000 GTF deliveries expected in total
- 16% fuel burn advantage over V2500
- PW1100G-JM has the lowest fuel burn among single-aisle powerplants
- US$ 10 increase in Brent means US$ 100,000 savings per year over A320ceo

300 billion litres less fuel expected
Latest rise in oil prices too recent to have a material impact on aftermarket

Strong traffic demand continues to stimulate usage of both mature and newer MTU engines

- Recent increase driven by supply factors (geopolitics, OPEC/Russia efforts to limit production and re-instatement of sanctions against Iran)
- US shale oil and slowing global demand growth should help limit further price increases

Source: IATA, Boeing, US Energy Information Administration (EIA)

• Traffic demand continued to be supported by strong economic activity, Asia and low airfares
Strong traffic growth has led to a continuing decline in parked and retired engines

- Industry park rate at a record low level not seen since the 1990s
- MTU retirements on a similarly strong downward trend

Source: Fleet Analyzer 1) % of total fleet (active+stored/parked)

Source: Fleet Analyzer, based on aircraft retirements (installed engines), does not cover spare engine retirements
* Last 12 months (Sep 17 to Sep 18)
Global geopolitics and imbalances in the global economy send some negative signals

Mitigation especially through MTU’s fleet and backlog

Trade barriers
US$ strength vs. emerging markets currencies
Rising US interest rates
Higher oil price (US$ ~70)

IATA sees minimal impact from tariffs on the industry but warns against escalation
Diversified MTU fleet: affected countries representing 4% of MTU fleet and orders only
Historically interest rates still on a low level
Key MTU engines lead in fuel efficiency

Brexit mitigation under way at MTU
Traffic outlook into 2019 remains positive
Intact investors’ appetite for financing new a/c
Higher fuel prices support MTU backlog

Some programs show positive correlation (PW800)
Higher growth expectations in all business units

Michael Schreyögg, Chief Program Officer
### Commercial Programs

- Growing spare parts business
- V2500, CF6-80, PW2000
- Rate 70 becomes A220
- GENx, Rising Market Share, Falcon 6X

### Military Programs

- National & International Opportunities
- Next European Fighter Engine
- Tornado Euro Fighter Aircraft

### Commercial MRO

- PW1100G-JM LEAP@TZ
- Capacity Expansion New Programs
- Strong demand meets consolidated market
- Partnership development
- Overproportional revenue growth
Commercial OEM in the sweet-spot for organic growth
New Falcon 6X application strengthens MTU’s position in the heavy business jet segment

New PW812D powers Falcon 6X

### Business Jet engine outlook

- High value heavy business jet segment
- Positive EBIT contribution from series with full MRO participation for MTU
- New Falcon 6X complements PW800 position following G500 and G600
- Common core with regional GTF
- MTU secured 15% program share incl. MRO
- Revenues from MTU business jet programs roughly triple over 10 years (2015ff)

<table>
<thead>
<tr>
<th>Maximum Operating Speed</th>
<th>Mach 0.90</th>
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<tbody>
<tr>
<td>Range</td>
<td>~ 5,500 nm</td>
</tr>
<tr>
<td>Number of passengers</td>
<td>Up to 16</td>
</tr>
<tr>
<td>EIS</td>
<td>2022</td>
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</tbody>
</table>
Airbus takeover of CSeries spurs the PW1500G program

A220 complementing Airbus single-aisle portfolio

PW1500G outlook

- A220 brings superior economics and efficiency
- Delivery outlook clearly improves thanks to Airbus financial strength and global customer reach
- PW1500G exclusively powers the A220
- Anticipated future production capacity to increase by factor 5 compared to 2018
- A220 has growth potential beyond 130-seat
Rate 70 makes sense and requires a 10% production increase for large GTFs at MTU

**A320 family orders vs. production scenarios**

![Bar chart showing A320 family orders vs. production scenarios from 2017 to 2025.](chart)

**PW1100G-JM outlook**

- A320 family backlog stands at 6,600 firm orders & LoIs as of September (10 years of production)
- Rationale for Rate 70:
  - Today Airbus is overbooked for 2022-2025
  - A321neo LR and a possible future XLR have the potential to stimulate demand further
- Supply chain readiness is however a pre-requisite
Latest MTU widebody platform GEnx with growing market share

Growing GEnx installed base and orders

**GEnx outlook**

- 4th largest MTU commercial fleet following V2500, CF6-80 and PW2000
- Fast-growing installed base reaching over 1,300 engines
- Stable 787 backlog representing 5 years of production
- LTM 85% order intake for 787 as of September 2018 resulting in 70% market share of backlog

**GEnx in-service fleet (787 and 747-8)**

<table>
<thead>
<tr>
<th>Sep-17</th>
<th>Sep-18</th>
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<tbody>
<tr>
<td>GEnx</td>
<td>1,190</td>
</tr>
<tr>
<td>Trent</td>
<td>508</td>
</tr>
<tr>
<td>Unannounced</td>
<td>506</td>
</tr>
<tr>
<td>Total</td>
<td>1,348</td>
</tr>
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</table>

**GEnx backlog (787)**

<table>
<thead>
<tr>
<th>Sep 17</th>
<th>Sep 18</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEnx</td>
<td>788</td>
</tr>
<tr>
<td>Trent</td>
<td>492</td>
</tr>
<tr>
<td>Unannounced</td>
<td>386</td>
</tr>
<tr>
<td>Total</td>
<td>886</td>
</tr>
</tbody>
</table>

Source: Fleetanalyzer fleet, firm orders and洛s as of Sept. 2018
High visibility of PW2000 aftermarket

PW2000 fleet by usage

- **Freighter**
- **Passenger**
  - (Others)
  - (Delta Airlines)

1,600 PW2000 engines in service

C-17 Mil. Transport

**Highlights**

- Younger C-17 application accounts for 2/3 of total fleet
- 200 engines are under the wing of the 757 freighter with FedEx and UPS.
- 300 engines continue to remain in 757 passenger service, the majority of which with Delta
- Delta’s interest in NMA indicates its readiness to keep the 757 flying well into the next decade
The last few years of strong passenger and freight traffic have led to a stabilization of the CF6-80 fleet, boosting spare parts demand.

Highlights

- CF6-80 fleet has grown in spite of its maturity
- Used serviceable material is scarce, driving healthy demand for HPT blades and vanes at MTU
- Freighter aircraft remain in general 5 to 10 years longer in service than their passenger equivalent
- 1,600 CF6-80C engines in freighter, military or executive service
- 767-300 freighter version new production and conversions of passenger 767 are currently accelerating to meet the growth of e-commerce
- CF6-80E represents a young fleet

CF6-80C/E fleet by usage:

- 3,100 CF6-80 engines in service or on order
- CF6-80C Passenger
- CF6-80E Passenger
- CF6-80C Freighter
Rising maintenance events and growth in SV content drives V2500 aftermarket growth

V2500 fleet by year of delivery

Growing share of heavy shop visits

- The gradual ageing of the V2500 fleet is pushing an ever increasing number of engines towards the 1st and 2nd shop visits
- 40% of the fleet have not had their first regular shop visit (performance restoration)
- 70% of the fleet have not had the first heavy shop visit requiring replacement of life limited parts
- On average, a heavy shop visit generates 2 to 3 times the spare parts revenue of a performance restoration

Source: Flightglobal, MTU
MTU is facing stronger growth in series than planned last year in all market segments

MTU engine delivery schedule

- PW800’s position has strengthened with a new application
- Airbus majority stake in CSeries partnership is securing the future of the PW1500G program, with higher production rates likely
- MTU needs to get ready to produce around 900 large GTFs p.a. to meet Airbus rate 70
- 787 rate hike, improved GEnx market share and the upcoming GE9X ramp-up will lead to fast growing TCF deliveries
Military Business with Attractive Growth Opportunities
Over 11,500 military engines with MTU components are flown worldwide

MTU's worldwide footprint in Military Business

North America / Canada
- Fighter: ~3,500
- Transport: ~910
- Helicopter: ~630

Europe
- Fighter: ~2,190
- Transport: ~920
- Helicopter: ~520

Middle East
- Fighter: ~1,360
- Transport: ~140

Asia Pacific
- Fighter: ~760
- Transport: ~90
- Helicopter: ~40

Latin America
- Fighter: ~50
- Transport: ~100

Africa
- Fighter: ~330
MTU is well positioned in the international military aircraft market

**Fighter**
- 140 Eurofighters and 85 Tornados in service in Germany
- Eurofighter with attractive export potential
- Increasing aftermarket for EJ200
- Germany phase out of Tornado from 2025 onwards

**Transport**
- 170 A400M ordered, thereof 67 delivered
- A400M well positioned for export
- Potential cooperation between Boeing and Embraer on KC-390 (equipped with V2500) could strengthen order activity

**Helicopter**
- 181 Eurocopter Tiger delivered
- CH53-K entry into service on track for 2019 and excellent positioned for export
Revenue contribution from Fighters by far most important

MTU Military revenue split (2021)

- Helicopter
- Transport
- Fighter

2021 Military revenues
~500 m€

Highlights

- Revenue share increase from ~70% today to ~80% by 2021
- Growing customer base secures Eurofighter aftermarket business
- Fighter export campaigns with high potential
- Eurofighter with high potential to replace Eurofighter Tranche 1 and later Germany’s Tornado fleet
- Future German/French combat aircraft enables access to customer funded technology development
MTU wants to participate in the New European Fighter Aircraft

**Highlights**

- Successor for Eurofighter / Rafale
- Airbus and Dassault collaborate as Airframe OEM
- First prototype expected by ~2031
- Entry into service expected by ~2040
- Roughly 1,100 engines (incl. spares) expected
MTU and Safran target joint development for the Next European Fighter Engine (NEFE)

Cooperation with Safran could secure strong MTU role within NEFE project

MTU objectives

- MTU as German engine partner
- Clear division of responsibilities and a partnership at eye level
- Achievement of 50% workshare with focus on MTU key competencies
- Customer financed development
Early start of technology development secures entry into service of New European Fighter Aircraft by 2040

Timetable of the New European Fighter Aircraft project

- Technology development
- Engine certification
- Certification of weapon system
- Entry into service of NGWS
Improved sentiment in the military business leads to an annual expected growth rate of ~ mid single digit

MTU Military revenue outlook 2018 to 2025 (in m€)

Highlights
- Fighter engines remain key revenue drivers
- Upside potential driven by ongoing national and international campaigns
- Development of Next European Fighter engine could lead to additional revenue contribution 2020 onwards
- Most likely scenario foresees increased revenue expectation for the mid 2020s
- German Defense Budget increase in sight
MRO Roadmap
MRO revenues significantly outperformed the market

**Highlights**

- Key drivers are the V2500 and PW1100G-JM
- Higher material content
- Mature engine types perform better than expected
- Increase in share of OEM flighthour agreements
- Increasing customer demand for engine lease and asset management
MRO

Movie

Learn more on our YouTube channel
Independent MRO continues its success story

Independent MRO campaign wins 2014 – 2018 in US$ billion

Highlights

- Ongoing strong campaign wins
- Key programs are V2500, CF34, CFM56, GE90G
- Basis for future revenue growth
Increase in market shares by OEMs secures workload for decades

OEM-MRO cooperation order book as of 30th September 2018

Highlights
- V2500 ~60% under FHA agreement
- FHA-share on new programs increase
- GTF ~70-80% under FHA agreement
- Access to OEM-MRO cooperation secured by Risk and revenue sharing partnership (RRSP)
Higher than expected volumes drive capacity increase primarily at best-cost locations

Capacity demand vs. available capacity

Highlights

• Rising demand for mature and new engine programs
• Short term: Full capacity utilization at existing locations
• Mid to long term: Increase capacity at best cost locations
• Strengthen partnerships with China Southern, LHT
• Best cost share will raise from 30% to 50%
Expansion of MRO Network by short term measurements and structural adjustments

Disassembly Assembly Test Facilities

- **MTU Maintenance Canada**
  - V2500 MRO capability

- **MTU Maintenance Berlin-Brandenburg**
  - New logistic center

- **EME Aero (Poland)**
  - New GTF MRO shop in cooperation with LHT

- **MTU Maintenance Hanover**
  - Additional space & workforce
  - MRO for GTF engines

- **MTU Maintenance Zhuhai**
  - Extension in cooperation with China Southern

- Ongoing capacity adjustments
- Long-term Capacity increase
Site extension of MTU Maintenance Hanover and MTU Maintenance Berlin-Brandenburg

Site extension Berlin

MTU Maintenance Berlin
New logistic center

MTU Maintenance Hanover
Additional space & workforce
MRO for GTF engines

Site extension Hanover
JV with China Southern secures future growth in the strong growing Asian market

MTU Maintenance Zhuhai No.1 MRO shop in China with strong revenue growth

Highlights

• 50:50 JV with China Southern
• Prolongation of JV with China Southern until 2051
• JV partner China Southern intends to double its aircraft fleet until 2035
• Target to expand to new engine platforms
• Increase capacity at MTU Zhuhai by another 50%
• Long term expansion concept in China under development
Lufthansa Technik – a strong partner for our new GTF MRO shop in Poland

EME Aero will become the most efficient GTF MRO shop worldwide

Highlights

- 50:50 JV with Lufthansa Technik
- Total investment of €150m from both shareholders
- Start of operations in 2020
- Workforce ~ 800 employees
- Capacity ~ 450 Shop visits
Further increase in added value business will enable further profitable growth

Repair & Service locations with strong growth potential

- Eastern Europe
  - New Best Cost repair shop
  - New construction

- Netherlands
  - MTU Maintenance Lease Service
  - Strong growth since founding year

- Malaysia
  - Airfoil Services (ASSB)
  - Expansion with LHT
Together with Lufthansa Technik we intend to expand our repair shop in Malaysia

ASSB – a competitive repair shop

Highlights

• Successful JV with LHT since 2003
• Focus on repair of LPT and HPC airfoils
• Future growth in repair hours driven by new engine programs
• Capacity increase by 60% at ASSB
Rising demand for repairs requires additional capacity increase

New best cost repair shop under examination

Motivation for a new best cost repair shop

- Growth especially through new programs
- Currently full utilization in existing locations
- New repair shop being established in a best cost country
- Competitive production costs support EBIT adj. margin in MRO
MRO service portfolio is complemented by engine lease and asset management

Business model of MTU Maintenance Lease Services in Amsterdam

Thrust Solutions

Asset Management

Short Term Leasing

Lease-In

Lease-Out
- Fleet Mgmt.
- Technical Services

Lease-end
- Exit Mgmt.
- Sunset

Purchase of engines

Disassembly

Sale of components

Repair to ready for use

Sale of modules and engines

Mounting Thrust Solutions

Lease-In

Lease-Out

Lease-end
MTU Maintenance Lease Service (MLS) is a successful Joint Venture with Sumitomo

Strong growth performance of MLS since foundation

Highlights

- Focus on engine leasing and asset & material management
- Revenue growth exceeded expectations since founding year
- Lease pool of +100 engines by 2022
- More than 600 engines are assessed annually

CAGR + 104%  
~ US$ 200m
Clear strategy to increase MRO service portfolio and capacity

Overview about expansion roadmap

MRO Service Portfolio

<table>
<thead>
<tr>
<th>New programs</th>
<th>Repair shop</th>
<th>Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adding new engine programs</td>
<td>Construction</td>
<td>Expansion of service portfolio</td>
</tr>
<tr>
<td>Further expansion of repair services</td>
<td>Ramp-up</td>
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MRO Network Structure

<table>
<thead>
<tr>
<th>EME Aero</th>
<th>Repair shop</th>
<th>MTU Zhuhai</th>
<th>ASSB</th>
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<tr>
<td></td>
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<tr>
<td></td>
<td>Construction</td>
<td>Project</td>
<td>Expansion</td>
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<td>Ramp-up</td>
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<tr>
<th></th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
<th>2023</th>
<th>2024</th>
<th>2025</th>
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All business segments to grow stronger than previously expected

<table>
<thead>
<tr>
<th>Commercial OEM business</th>
<th>Military OEM business</th>
<th>Commercial MRO business</th>
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<tbody>
<tr>
<td>• New application for PW800</td>
<td>• Positive sentiment from national and international campaigns</td>
<td>• New engine programs and further expansion of MRO services</td>
</tr>
<tr>
<td>• A220 secures PW1500G program with likely higher production rates</td>
<td>• Next European Fighter Engine key for future growth</td>
<td>• Expansion of MRO network structure with clear focus on best cost</td>
</tr>
<tr>
<td>• Airbus rate 70 would further increase GTF production</td>
<td></td>
<td></td>
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<tr>
<td>• 787 rate hike – improved GEnx market share – upcoming GE9X ramp-up</td>
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Higher growth expectations in all business units
Lunch
MTU 4.0

Movie

Learn more on our YouTube channel
Successful execution and a prosperous technology roadmap

Lars Wagner, Chief Operating Officer
Status Execution
With PW1900G and PW800 two more engine programs entered service in 2018

Development milestones of new engine programs

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<tbody>
<tr>
<td>First engine to test</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
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<tr>
<td>Tested in flying test-bed</td>
<td>✔</td>
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<td>N/A</td>
<td>✔</td>
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<tr>
<td>Engine certification</td>
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<td>✔</td>
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<td>✔</td>
<td>✔</td>
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<td>Entry into service</td>
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<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>2020</td>
</tr>
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* T408: Certification of whole aircraft system after flight testing
GTF engine programs continue to be a main driver for company growth

Strong ramp-up in GTF engine deliveries

Aircraft applications

- A320neo
- MS-21
- A220
- MRJ
- E-Jets

CAGR + 42%
GTF product family powers eleven different aircraft and provides a wide range of thrust

Classification according to core engine size

<table>
<thead>
<tr>
<th>Classification</th>
<th>Medium by-pass direct drive turbofan</th>
<th>High by-pass geared turbofan</th>
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<tbody>
<tr>
<td>Large core</td>
<td>PW814: Gulfstream G500</td>
<td>PW1100G-JM: Airbus A320neo family</td>
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<tr>
<td></td>
<td>PW815: Gulfstream G600</td>
<td>PW1400G-JM: Irkut MS-21</td>
</tr>
<tr>
<td>Medium core</td>
<td>PW814: Gulfstream G500</td>
<td>PW1500G: Airbus A220 family (ex C Series)</td>
</tr>
<tr>
<td></td>
<td>PW815: Gulfstream G600</td>
<td>PW1900G: Embraer E190-E2</td>
</tr>
<tr>
<td>Small core</td>
<td>PW1200G: Mitsubishi Regional Jet</td>
<td>PW1200G: Mitsubishi Regional Jet</td>
</tr>
<tr>
<td></td>
<td>PW1700G: Embraer E175-E2</td>
<td>PW1700G: Embraer E175-E2</td>
</tr>
</tbody>
</table>
GTF in-service fleet is growing and meets all specifications of economical performance

Deliveries and in-service experience

- More than 290 GTF-powered aircraft delivered to 31 operators, flying to ~570+ destinations on 5 continents
- More than 550,000 flights accomplished, 260 million litre of fuel saved for customers
- Engine deliveries are on track to meet production commitments in 2018

- Focus is still on
  - Ramp-up of the supply chain and delivery performance
  - Availability of lease engines to ensure any disruption is minimized
  - Progress on technical improvements
OEM production is continuously ramping-up with additional demands in various programs

Deliveries per year of all OEM programs

### Production status

- Quality is on a high level
- Program demands further increased in 2018
  - Commercial: additional 12% increase for 2019
  - Military: additional 8% increase for 2019
- Efficient capacity use and increase of capacity
- Extension of best-cost site Rzeszów (Poland)
- Further automation efforts in Munich
  - Extension of blisk and disk manufacturing
External supply chain management is a key factor to ensure company growth

OEM and MRO purchasing figures in 2017

- € 2.5 billion purchasing volume for OEM and MRO
- Broadly based OEM supply chain
  - # 197 in Germany
  - # 154 in Europe, Middle East and Africa
  - # 195 in America
  - # 36 in Asia and Pacific Region
- 80% OEM purchasing volume is at # 50 suppliers

- Utilization levels are very high
- Ramp-up weaknesses identified
- Actions to mitigate risks
  - Double or triple sourcing where necessary
  - Improvement teams at critical suppliers
  - Digitalization efforts: end-to-end transparency
- Goal is to reduce inventory with simultaneously increasing on-time deliveries
Smart Factory
Production ramp-up triggers extensive automation with state-of-the-art production technology (1 / 2)

Blisks (compressor)  Disks (turbine)  Blades (turbine)  Flow path hardware (turbine center frame)
Production ramp-up triggers extensive automation with state-of-the-art production technology (2 / 2)

<table>
<thead>
<tr>
<th>Blisks (compressor)</th>
<th>Disks (turbine)</th>
<th>Blades (turbine)</th>
<th>Flow path hardware (turbine center frame)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• State of the art production capabilities established</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Further extension of automated production decided</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• 30% lower production cost and 50% lower labor utilization rate already achieved</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• New disk machining shop in Munich decided</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Fully automated with latest production technology</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Target is comparable efficiency as blisk machining</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Flexible manufacturing system in realization: trial machining started</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• 4 robotized units replacing 20 conventional machines</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Target is unmanned production with ~ 7,000 machining hours per year and 24/7 capabilities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• State of the art production capabilities established: finish-cutting and complex fixture construction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• New production line with robotized part and tooling transfer in preparation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Target is 60 to 70% lower labor utilization rate with 24/7 capability</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
A broad digitization strategy enables automation and supports efficient company growth

- **Work 4.0**
  - RPA
  - IT-Security

- **MRO 4.0**
  - UCC
  - E-learning

- **Supply chain end-to-end**
- **Manufacturing 4.0**
  - Additive Manufacturing

- **Aftermarket**
  - Predictive Maintenance
  - Predictive Analytics

- **Technology 4.0**
  - Digital Twin
  - Virtual Engine
  - Simulation of materials and production processes
  - Intelligent machine control & automation
Manufacturing 4.0: Additive manufacturing to create new (bionic) design possibilities

Estimated amount of AM parts in aero engines

- Substitution of castings
- Integral structure design
- Lightweight Bionic Design
- Static Hot Section Parts
- Rotating blades with complex cooling system *

* Picture source: Central Institute of Aviation Motors

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Manufacturing 4.0: Manufacturing Execution System (MES) to optimize in-house production flow and capacity utilization

Basic structure of production planning and control

- **ERP level:** Enterprise resource planning
  - Real-time network to connect, monitor and control entire manufacturing process
  - Monitors all available resources for optimized material flow
  - Enables autonomous decision making

- **MES level:** Manufacturing execution system
  - Monitors all available resources for optimized material flow
  - Enables autonomous decision making

- **Plant level:** Machine controllers, devices, parts tracking
  - Resource management
  - Data acquisition, Analysis
Manufacturing 4.0: Supply chain end-to-end connection to create a highly efficient value stream

E2E connection of all tiers

- Upstream Supplier
- Supplier
- Logistic Inbound
- In-house Production
- Logistic Outbound
- Customer

Transparency of data along the entire value chain E2E
Integrated sales and operations planning process
Based on integrated data and system landscape SAP S/4 HANA
Technology 4.0: Process data management to utilize available (big) data for enhancement of automated processes

Basic scheme

- Real-time processing and usage of big data out of production processes
- Basis are machine data, data from production resources/tools and produced parts

Example of a trend analysis

- Enabling predictive part quality – with high impact on quality management
- Enabling predictive machine maintenance – with high impact on machine availability
Technology 4.0: Cutting edge simulation methods to improve materials and production processes

Vibration analysis (for machining processes)

- Simulation of physical interaction between part, tool and machine
- Reduction of iteration loops on the machine
- Reduction of time to market
- Integration of manufacturing simulation in early part design process
Technology Roadmap
Updated technology roadmap is based on three time horizons

Scopes of 10 / 20 / 30 years plus

- **Commercial engines:**
  Entry-into-service of 2. Geared Turbofan (GTF) engine generation

- **Military engines:**
  Entry-into-service of Next European Fighter Engine (NEFE)

- **New propulsion concepts:**
  Entry-into-service of new design

Source: Bauhaus Luftfahrt
GTF engine concept has a high enhancement potential for further applications

Commercial technology development for 2. GTF engine generation

**Targets**
relative to 1. GTF generation

- 10% fuel burn at least
- 10% dB noise
- Up to 2x more life
- Technology ready 2027+
- Entry-into-service 2033+

**Key enabler**

- Higher By-Pass-Ratio (BPR): bigger fan and slim nacelle
- Higher Overall-Pressure-Ratio (OPR): small core engine with higher temperatures
- Very efficient components
- New materials
- Robust and reliable design – easy to access
- Improved aircraft/engine integration
Various key technologies will enable entry-into-service of the 2. GTF engine generation

- CMC materials
- On-wing repairs
- Digitalization and industry 4.0
- Additive manufacturing
- New production technologies
- “World class” testing and validation
- Engine trend monitoring
- Simulation
GTF engine concept results from a straight roadmap since decades

Commercial and military technology development in the past

- **PW2000**: First MTU-designed commercial LPT
- **EJ200**: First MTU-designed military LPC (all-blisk) & HPC
- **PW6000**: First MTU-designed commercial HPC winning Innovation Award
- **TP400-D6**: New military IPC & IPT
- **GP7000**: New commercial HPC & LPT winning Innovation Award
- **GE9X**: First MTU-designed commercial TCF

**New commercial LPT that sets new standards**

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>PW2000, First MTU-designed commercial LPT</td>
</tr>
<tr>
<td>1990</td>
<td>EJ200, First MTU-designed military LPC (all-blisk) &amp; HPC</td>
</tr>
<tr>
<td>2000</td>
<td>PW6000, First MTU-designed commercial HPC winning Innovation Award</td>
</tr>
<tr>
<td>2010</td>
<td>GP7000, New commercial HPC &amp; LPT winning Innovation Award</td>
</tr>
<tr>
<td>2015</td>
<td>GE9X, First MTU-designed commercial TCF</td>
</tr>
</tbody>
</table>

**LPT**: Low-pressure turbine  
**LPC**: Low-pressure compressor  
**HPC**: High-pressure compressor  
**IPC**: Intermediate-pressure compressor  
**IPT**: Intermediate-pressure turbine  
**TCF**: Turbine center frame
NEFE 4.0

Learn more on our YouTube channel
Next European Fighter Engine (NEFE) – a new impulse at the military market

Military technology development for NEFE

Targets

- Long range
- High mission flexibility
- High availability
- Low observability
- Low operating costs
- First prototype 2031+
- Entry-into-service 2040+

Key enabler

- Variable cycle engine technology
- Very efficient components
- High temperature, low weight materials
- Integrated aircraft / engine heat management
- Full digitalized design and aftermarket process
Significant synergies between commercial and military development are achievable

GTF 2. Generation:
- Technology ready 2027+
- Entry-into-service 2033+

NEFE prototype:
- Technology ready 2025+
- Entry-into-service 2031+
Electrification of jet engines will play a role in the future

Evaluation and actions for hybrid and turbo-electric propulsion

- Turbo-electric (hybrid) concepts are technology-wise necessary for aircraft with more than 4 passengers
- Gas turbine to generate electric power to run an electric motor boosted by batteries
- For these applications a highly efficient gas turbine will be necessary
- MTU is assessing the feasibility by collaborating in a short-term regional pilot aircraft
Revolutionary new propulsion concepts are necessary for Flightpath 2050 targets

Targets and fields of research

- **Targets relevant to 1. GTF engine generation**
  - -25% fuel burn
  - -25% dB noise
  - Low emissions

- **Strategic concepts**
  - Gas turbine including piston engine
  - Gas turbine with water steam injection

Source: Bauhaus Luftfahrt
Conclusion

Status Execution

- Engine programs are successively entering into service and accumulating flight hours
- Ramp-up continues with high growth rates and focus on supply chain performance

Smart Factory

- Cutting-edge production capabilities are installed or planned for every part commodity
- Digitalization and industry 4.0 activities increase the level of automation / efficiency

Technology Roadmap

- Technology roadmap is in place to align next generation commercial and military engines
- Revolutionary engine concepts will power turbo-electric propulsion in the future
Successful execution and a prosperous technology roadmap
MTU Financials & Outlook: Ramp-up of cash conversion continues

Peter Kameritsch, Chief Financial Officer

30.11.2018

Investor & Analyst Day 2018 – London
Future presentation
OEM-MRO cooperation
shopvisits
Today MTU Hanover is sole contract partner to IAE for V2500 FHA shopvisits

All Revenues for MRO services are fully consolidated even work is carried out by MTU Zhuhai

Contracting streams V2500 FHA OEM-MRO shopvisits

- MTU Hanover
- MTU Zhuhai

IFRS consolidated revenue

<table>
<thead>
<tr>
<th>Segment</th>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>OEM Segment</td>
<td>Invoice MTU-H→IAE</td>
<td>2 m€</td>
</tr>
<tr>
<td>MRO Segment</td>
<td>Invoice MTU-Z→MTU-H</td>
<td>-</td>
</tr>
<tr>
<td>Group</td>
<td>MTU Group Revenue</td>
<td>2 m€</td>
</tr>
</tbody>
</table>

Fully consolidated

Consolidated at equity
Starting 2019 MTU Zhuhai will be contracted for V2500 MRO work directly from IAE

Revenue of MRO segment will be lowered leading to higher margin and less complexity

Contracting streams V2500 FHA OEM-MRO shopvisits

IFRS consolidated revenue

<table>
<thead>
<tr>
<th>Segment</th>
<th>Revenue (m€)</th>
</tr>
</thead>
<tbody>
<tr>
<td>OEM Segment</td>
<td></td>
</tr>
<tr>
<td>MRO Segment</td>
<td>Invoice MTU-H→IAE 1 m€</td>
</tr>
<tr>
<td>MRO Segment</td>
<td>Invoice MTU-Z→IAE -</td>
</tr>
<tr>
<td>Group</td>
<td>MTU Group Revenue 1 m€</td>
</tr>
</tbody>
</table>
In newer engine programs such as PW1100G-JM the OEM segment is today prime contractor.

MRO services are recognized in both segments and 1x eliminated for group consolidation.

Contracting streams PW1100G-JM FHA OEM-MRO shopvisits

|PW1100G-JM| Airline Customers| Holds a FHA agreement with |
|MTU Munich| 1 x 1 m€| Subcontracts maintenance work to |
|MTU Hanover| 1 x 1 m€| |

IFRS consolidated revenue

| OEM Segment | Invoice MTU-M→IAE | 1 m€ |
| MRO Segment | Invoice MTU-H→MTU-M | 1 m€ |
| Group | Consolidation | -1 m€ |
| MTU Group Revenue | 1 m€ |

- Fully consolidated
- Consolidated at equity
Starting **2019** OEM-MRO co-operation revenues will be presented in MRO segment only

Segmentation by content instead by legal entity will avoid increase in elimination line

**Contracting streams PW1100G-JM FHA OEM-MRO shopvisits**

<table>
<thead>
<tr>
<th>IFRS consolidated revenue</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OEM Segment</strong></td>
</tr>
<tr>
<td>MTU Munich</td>
</tr>
<tr>
<td><strong>MRO Segment</strong></td>
</tr>
<tr>
<td>Invoice MTU-M→IAE</td>
</tr>
<tr>
<td>1 m€</td>
</tr>
<tr>
<td><strong>Group</strong></td>
</tr>
<tr>
<td>MTU Group Revenue</td>
</tr>
<tr>
<td>1 m€</td>
</tr>
</tbody>
</table>

Holds a FHA agreement with

PW1100G-JM

Airline Customers

Holds a FHA agreement with

MTU Munich

MTU MRO

1 x 1 m€

Fully consolidated

Consolidated at equity
Presentation of OEM-MRO cooperation shopvisits equalized and simplified from 2019

Summary

V2500

- MTU Zhuhai will directly invoice OEM-MRO shopvisits to IAE
- Implementation in 2018 would have lead to ~200 m€ less revenues, EBIT unchanged. Group and MRO margin up

GTF, GE nx, GP7000

- OEM-MRO shopvisits will be presented in MRO segment only
- Revenues in OEM business and elimination line will be reduced
- Group revenues unchanged
- Restatement for 2018 with release of Q1 2019 results
## Guidance 2018: Thereotical restatement would lead to less revenues, hence higher margin

<table>
<thead>
<tr>
<th></th>
<th>As reported</th>
<th>Assuming direct invoicing MTU-Z → IAE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Group Sales</strong></td>
<td>~ 4.4 bn€</td>
<td>~ 4.2 bn€</td>
</tr>
<tr>
<td><strong>Military</strong></td>
<td>Stable</td>
<td>Stable</td>
</tr>
<tr>
<td><strong>Commercial OE</strong></td>
<td>Up ~ 30%</td>
<td>Up ~ 30%</td>
</tr>
<tr>
<td><strong>Commercial Spares</strong></td>
<td>Up low teens</td>
<td>Up low teens</td>
</tr>
<tr>
<td><strong>Commercial MRO</strong></td>
<td>Up mid twenties</td>
<td>Up mid twenties</td>
</tr>
<tr>
<td><strong>EBIT adj.</strong></td>
<td>~ 660 m€</td>
<td>~ 660 m€</td>
</tr>
<tr>
<td><strong>EBIT adj. Margin</strong></td>
<td>~ 15%</td>
<td>~ 15.7%</td>
</tr>
</tbody>
</table>
Guidance 2019
# The year 2019:

**Tailwinds will overcompensate headwinds from GTF growth**

<table>
<thead>
<tr>
<th>Ongoing strong growth of aftermarket (Com. Spares &amp; MRO)</th>
<th>Total OE losses to stabilize in 2019 despite continuous ramp-up</th>
<th>Capacity ramp-up in both segments requires an increase in PPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Military Business’ growth re-initiated</td>
<td>OEM-MRO cooperation business continues to grow in 2019 with limited profit contribution</td>
<td></td>
</tr>
<tr>
<td>Working Capital to grow less than revenues</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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The year 2019: Further growth of EBIT adj. and Free Cashflow

2019 Main Drivers

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Military</td>
<td>+10%</td>
</tr>
<tr>
<td>Commercial OE</td>
<td>Low teens</td>
</tr>
<tr>
<td>Commercial Spares</td>
<td>Up mid to high single digit</td>
</tr>
<tr>
<td>Commercial MRO</td>
<td>Stable (Organically high single digit)*</td>
</tr>
<tr>
<td>EBIT adj.</td>
<td>Stable Margin*</td>
</tr>
<tr>
<td>CCR**</td>
<td>~ 50–60%</td>
</tr>
</tbody>
</table>

*) based on equal assumptions with IAE OEM-MRO shopvisits consolidated, see page 87
**) Cash Conversion Rate = Free Cashflow/Net Income adj.
Long term outlook
Increase in production rates continue to drive strong growth backed by order book

MTU Commercial OE Revenue Breakdown

- Business Jet shows a higher revenue share with IFRS15 implementation
- Regional Jet revenue contribution will gain importance
- Assuming rate 70 Narrowbody doubles & will remain most important
- GE9X will start to contribute to Widebody revenue early 2020s
Spare parts revenues growth driven by narrowbody engines

MTU Commercial Spares Revenue Breakdown

- V2500 contributes ~40% of spares revenues today and grows until mid 2020s
- PW1100G-JM starts to contribute 2020 onwards
- CF6-80 starts to decline early 2020s
- GEnx and GP7000 show steady growth and compensate decline of CF6-80
- PW2000 remains stable
Increasing likelihood of campaign wins in military business leads to an improved outlook

MTU military OEM revenue breakdown

- Approximately 2/3 of today's revenues come from fighter engines EJ200 and RB199
- Military revenue will grow towards ~600 m€ until 2025
- Underlying assumption are campaign wins for Eurofighter and the development of the next fighter engine
Both market segments within commercial MRO business will continue to grow strongly

MTU commercial MRO revenue breakdown

- Majority of newer engines sold by the OEM with flighthour agreements
- OEM-MRO cooperation workload secured through risk & revenue sharing agreement
- Strong independent MRO wins in the past years lead to an improved growth expectation
- Share of independent vs. OEM-MRO cooperation will remain stable
## Long-term Outlook 2019–2025 Update

**Improved Free Cashflow conversion confirmed despite ongoing capacity build-up**

<table>
<thead>
<tr>
<th>Net Income adj.</th>
<th>Steady growth</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Working Capital</td>
<td>Growing less than revenues</td>
</tr>
<tr>
<td></td>
<td>• No consumption of prepayments</td>
</tr>
<tr>
<td></td>
<td>• Inventory turns will improve</td>
</tr>
<tr>
<td></td>
<td>• More FHAs with preferential Cashflow profile</td>
</tr>
<tr>
<td>CF from investing</td>
<td>Will decline moderately</td>
</tr>
<tr>
<td></td>
<td>• Less payments for intangibles</td>
</tr>
<tr>
<td></td>
<td>• Mid-term higher spendings for capacity build-up (PPE) and automation</td>
</tr>
<tr>
<td></td>
<td>• R&amp;D capitalization declines as programs enter into service</td>
</tr>
<tr>
<td>CCR*</td>
<td>High double digit %</td>
</tr>
</tbody>
</table>

*) Cash Conversion Rate = Free Cashflow/Net Income adj.
MTU’s target is a balanced leverage ratio in the range of 1 x net Debt/EBITDA

MTU’s Cash Deployment Strategy

<table>
<thead>
<tr>
<th>Prio</th>
<th>Instrument</th>
<th>2019–2025</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Investment in organic growth</td>
<td>Limited opportunities for new programs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ongoing spendings for capacity build-up</td>
</tr>
<tr>
<td>II</td>
<td>Dividend deployment</td>
<td>Growth stronger than net income</td>
</tr>
<tr>
<td>III</td>
<td>Share buyback programs</td>
<td>Instrument to limit deleveraging and manage dilution</td>
</tr>
<tr>
<td>IV</td>
<td>M&amp;A</td>
<td>No new targets expected</td>
</tr>
</tbody>
</table>
MTU Financials & Outlook: Ramp-up of cash conversion continues
Outlook & Summary
Reiner Winkler, Chief Executive Officer
For the potential expansion of Airbus portfolio and the next generation of narrowbodies the GTF technology is very well positioned.

<table>
<thead>
<tr>
<th>Today</th>
<th>Future</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AIRBUS</strong></td>
<td>A320 Family ceo/neo</td>
</tr>
<tr>
<td></td>
<td>A220</td>
</tr>
<tr>
<td><strong>Boeing</strong></td>
<td>737NG/MAX</td>
</tr>
<tr>
<td><strong>COMAC</strong></td>
<td>C919</td>
</tr>
<tr>
<td><strong>HS忘</strong></td>
<td>MS-21</td>
</tr>
<tr>
<td>A321 neo stretch?</td>
<td>NGSA Airbus</td>
</tr>
<tr>
<td>A220 stretch?</td>
<td>NGSA Boeing</td>
</tr>
</tbody>
</table>

Source: MTU

Entry into Service

2018 2030
MTU is targeting up to 25% program share for the next generation of GTF engines

Increasing MTU share of narrowbody engine revenues

**Building on success**

- MTU has succeeded in growing its single-aisle revenues through A320neo, A220 and MS-21 applications
- MTU is targeting up to 25% share on Gen2 GTF
- Technology roadmap aligned and discussions with partner ongoing
- 25% program share would almost double MTU’s market share in a favorable dual-source scenario with Airbus and Boeing
In the widebody segment, MTU benefits from a positive outlook for CF6-80C, GEnx and GE9X

<table>
<thead>
<tr>
<th>Today</th>
<th>Future</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AIRBUS</strong></td>
<td></td>
</tr>
<tr>
<td>A380–800</td>
<td>A350–1000 stretch?</td>
</tr>
<tr>
<td>A350</td>
<td>A330 successor?</td>
</tr>
<tr>
<td>A330 ceo/neo</td>
<td></td>
</tr>
<tr>
<td>747-8I/F</td>
<td>777X</td>
</tr>
<tr>
<td>777–300ER</td>
<td>777-9 stretch?</td>
</tr>
<tr>
<td>787</td>
<td>NMA?</td>
</tr>
<tr>
<td>767F</td>
<td>787 successor?</td>
</tr>
<tr>
<td></td>
<td>C929</td>
</tr>
</tbody>
</table>

Source: MTU
Key Take Aways

- **Market indicators** continue to outperform historical average
- **Ramp-up** continues and requires ongoing investment into capacity and automation
- **Higher OE growth** expectation in all thrust segments
- **Technology roadmap** secures long-term market position and sustainability
- **Military business** back on the rise
- **Ongoing growth** of earnings and cash flow in 2019 and beyond
- **Aftermarket** (spares and MRO) will continue its strong performance
- **Long-term guidance** confirmed
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