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# Keep them flying

Find your winning position in the MRO game

Aerospace and Defense



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# Keep them flying

## Find your winning position in the MRO game

By Ralph Carpenter and Allan Henderson

*Maintenance, repair and overhaul (MRO) services play an invaluable role in assuring that commercial airliners remain safe, durable and profitable. As new companies enter the aircraft maintenance business and others change or expand their value propositions, MRO providers will be compelled to become more collaborative, more open – and more competitive. To position themselves for the future, these organizations must be prepared to take on new roles and heighten their value by working more closely with others.*

### **Maintaining commercial aircraft: An attractive and growing opportunity**

Today's US\$40.1 billion maintenance market for commercial aircraft is large and growing – attracting new companies and changing the roles of existing ones. The market is expanding at a 3.6 percent compound annual growth rate (CAGR), and is expected to reach US\$58 billion by 2016.<sup>1</sup>

Nearly two-thirds of today's MRO market is split between North America and Western Europe.<sup>2</sup> Over the next 20 years, the center of gravity of the world's airline fleet will tilt toward the Asia-Pacific region: almost 40 percent of air traffic will be to, from or within those areas.<sup>3</sup> The largest MRO growth will be seen in Asia (+US\$5.6 billion).<sup>4</sup>

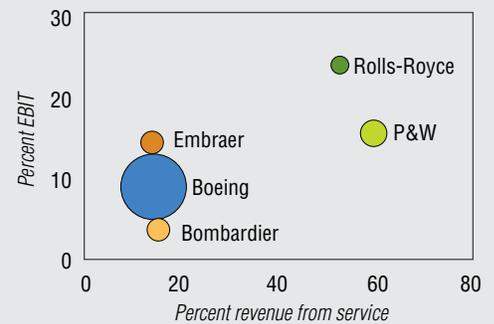
The aircraft maintenance supply chain currently holds an inventory of about US\$44 billion and supports an active global fleet of nearly 17,000 aircraft. This has resulted in approximately US\$2.5 million in inventory available to each active aircraft.<sup>5</sup>

These factors have made aircraft maintenance one of airlines' biggest costs – averaging 13 percent of their total expenditures. (Fuel and labor are other big expenses.)<sup>6</sup> Airlines spend an average of US\$870 in direct maintenance costs for every flight hour. (Those numbers can range between US\$300 per flight hour to US\$1,800 per flight hour, depending on the type of aircraft, its age, its condition and operational parameters.)<sup>7</sup>

It's no surprise that financial indicators point to commercial aircraft maintenance as an attractive opportunity. For example, there is a positive correlation between services revenue as a percentage of total revenue and earnings before interest and taxes (EBIT) in key other equipment manufacturers (OEMs).

Also, engine OEMs that have major portions of their revenues coming from after-market service are more profitable than aircraft OEMs, as Figure 1 shows.<sup>8</sup>

FIGURE 1.  
**There is a positive correlation between services revenue as a percentage of total revenue and earnings before interest and taxes (EBIT) in key OEMs.**



Source: IBM analysis of financial data from Thomson One Banker and these companies' annual reports.

# Keep them flying

*Find your winning position in the MRO game*

**Few MRO segments can fulfill every requirement – creating new and expanding opportunities for these businesses.**

## **Aircraft MRO has several segments**

The attractiveness of the aircraft maintenance business is underscored by the number of new companies entering the field, and the fact that existing MROs are shifting and expanding their roles, as the rest of this paper describes.

Aircraft MRO is commonly segmented into four main service groupings:

1. *Line maintenance*, which diagnoses and corrects troubles on the aircraft and carries out minor and major aircraft checks and repairs, is very labor-intensive. While only about 15 percent of line maintenance is currently outsourced, the service is expected to grow from about US\$8 billion to over US\$11 billion by 2017.<sup>9</sup>
2. *Component maintenance*, which repairs components such as wheels, brakes and interior components, is also primed to prosper – from around US\$8 billion today to over US\$11 billion by 2017. (Approximately 70 percent of component maintenance is currently outsourced.)<sup>10</sup> For component maintenance, the actual nature of the service provided is shifting. Customers are looking for suppliers who offer component access services that combine component maintenance, logistics and component engineering on a “power by the hour” basis.
3. *Engine maintenance*, which includes dismantling, inspecting, assembling and testing aircraft engines, is the largest MRO segment.<sup>11</sup> Engine maintenance makes up about 35 percent of maintenance spend, and is expected to increase from around US\$17 billion today to over US\$26 billion by 2017. (More than 60 percent of the cost of engine maintenance is materials, with labor being 22 percent.)<sup>12</sup>
4. *Heavy maintenance*, which encompasses structural modifications, landing gear repair, engine changes and regular calendar checks, is also expected to grow – from around US\$9 billion (about 23 percent of spend) today to over US\$13 billion by 2017. More than 65 percent of the cost of heavy maintenance is labor – making it attractive to set up low-cost locations around the world. The use of composites in new aircraft frames will help keep down the costs of heavy maintenance.<sup>13</sup>

These four groupings vary enough to be viewed as fundamentally different businesses. They each require a different set of skills and services, and few independent maintenance companies specialize in all.

### Different levels of aircraft maintenance checks

“The aircraft industry refers to ‘checks’ for different levels of maintenance. While the industry practice today is to phase these activities to improve availability, the terminology is still common:

- Walk around inspection. Maintenance personnel at commercial airports regularly perform a ‘walk around’ inspection of an aircraft’s exterior to look for fuel leaks, worn tires, cracks, dents and other damage.
- A Check. Every three to five days, an A check at the airport gate inspects the aircraft’s landing gear, control surfaces, fluid levels, oxygen systems, lighting and auxiliary power systems.
- B Check. About every eight months, a B check at the airport gate inspects internal control systems, hydraulic systems, and cockpit and cabin emergency equipment, as well as A check items.
- C Check. Approximately every 12 to 17 months, a C check opens the aircraft for inspection of wear, corrosion and cracks. C checks typically take place in a maintenance hangar, including at an airline’s hub airport.
- D Check. After a certain number of flight hours, a D check inspects aspects of the plane that involve the disassembly of an aircraft at a specialized facility. D checks take about 30 days to complete.”

– Dixon, Matthew C. “The Maintenance Costs of Aging Aircraft: Insights from Commercial Aviation.” *The Rand Corporation*, 2006.<sup>14</sup>

### Dynamics of the aircraft maintenance business

While the dynamics of the MRO business have been changing for many years, the pace seems to be accelerating. Six forces are driving the change:

1. *Increased focus of OEMs on MRO:* Aircraft and engine OEMs, such as Boeing and Rolls-Royce, are putting additional focus on the maintenance business and are starting to offer “total care” solutions.<sup>15</sup> OEMs are also in a special position to leverage the sense and respond data from electronic monitors on aircraft and perhaps even take control of the scheduling of aircraft maintenance.
2. *Outsourcing MRO:* As airlines outsource more maintenance work and focus on their core business, opportunities open up for new companies to compete in the MRO space – increasing competition, expanding

the potential for improving service and driving down costs. Low-cost carriers are leading the way in outsourcing MRO.<sup>16</sup>

3. *Globalization:* Low-cost labor locations such as India, Latin America and China are now set up for MRO service centers. Already, Asia is seeing net inflows in labor-intensive airframe heavy-maintenance MRO activities, whereas the United States is a net exporter.<sup>17</sup>
4. *PMA parts:* The FAA’s Parts Manufacturer Approval (PMA) process allows non-OEMs to reverse-engineer OEM parts and sell them at a significant discount. Such PMA parts are gaining wider acceptance, and their use is growing rapidly – creating much more competition for spare parts. Also, the recent entry of Pratt & Whitney into the PMA market underscores how PMA parts heighten competition.<sup>18</sup>

**Demands for new skills and services will reshape the MRO market.**

5. *Prognostics and Health Management (PHM)*: PHM enables aircraft maintenance to be proactive – rather than reactive – by monitoring and assessing the health of a part or component in realtime, predicting failure and determining appropriate actions. PHM can help optimize maintenance scheduling and possibly change who controls maintenance scheduling. New-generation aircraft are in a position to lead the way in PHM adoption. The Airbus A340-500 monitors 13,000 parameters from 48 computers.<sup>19</sup> More than half of the air-transport engines are monitored. GE monitors more than 9,000 engines in flight.<sup>20</sup>

6. *New technology trends*: Several technology trends are further changing the structure of MRO by requiring that service suppliers have the skills to keep up with these advances. For example:

- *Green engines* provide more fuel efficiency and lower emissions than conventional engines. They require less maintenance and can help reduce cost of ownership. At the same time, these engines' design and material requirements oblige service suppliers to develop new skills and capabilities.
- *Composite materials* are becoming common in new aircraft. For example, composites make up 50 percent of the structural weight of the Boeing 787 fleet, and 25 percent of the Airbus A-380's structural weight.<sup>21</sup> Maintenance of

composite structures and components will call for different skills from service suppliers – opening opportunities for new providers.

- *More electronic functionality*: Electronic systems continue to replace mechanical systems. As electronics systems become more complex, companies will require increasingly specialized skills for after-market service and repair – which may invite OEMs further into the service mix.

Underlying all of these dynamics is the fact that the aircraft maintenance business is capital-intensive and that the key to making the business equation work is to achieve economies of scale. To that end, many MRO companies are continuing to expand into locations such as Eastern Europe, China, Indonesia, and the Philippines.

### **Outsourcing: Extending the roles of MRO businesses**

Until the 1980s, airlines performed their own aircraft maintenance. Since then, these companies have been increasingly interested in trimming costs and reducing investments in what is often seen as a non-core activity. Consequently, more airlines are outsourcing MRO work. MRO outsourcing is currently at about 50 percent and is projected to reach around 65 percent in 2020.<sup>22</sup> Component and engine maintenance lead in outsourcing, each with over 70 percent outsourced.<sup>23</sup>

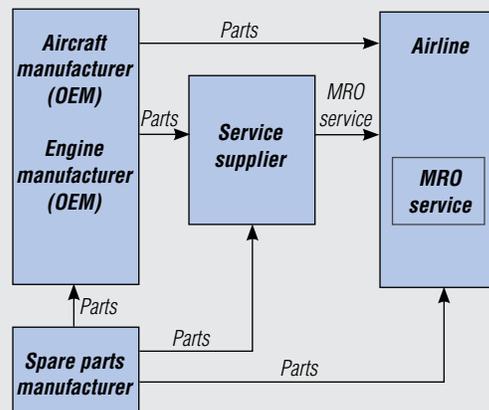
Today's growth in outsourcing creates fertile ground for MRO businesses old and new to play larger roles. Major airlines that outsource all or most of their MRO service today include Southwest Airlines, Northwest Airlines, Alaska Airlines and US Airways.<sup>24</sup>

We observe four main entities in today's commercial aircraft maintenance business (see Figure 2):

- Aircraft or engine manufacturers
- Spare parts manufacturers
- Service suppliers
- Airlines.

The next several paragraphs describe the changing roles of MRO organizations, discuss some of their challenges, and give examples of companies that are leveraging their capabilities in this evolving market.

FIGURE 2.  
**Basic relationship among companies in the commercial aircraft maintenance business.**



Source: IBM Institute for Business Value.

### Role 1 – Aircraft and engine OEMs

While OEMs' major role is to make the original aircraft or engine, their function in aircraft maintenance has primarily been to supply parts. This is starting to change as OEMs look to focus more on aircraft support opportunities and expand their participation in the maintenance value chain. The strengths they bring are technical superiority, bargaining power, and a unique position from which they can offer bundled sales and services.

Their challenges come from independent service suppliers that can offer a wide breadth of services and/or comparable services at a lower cost. Another problem comes from non-OEM substitute parts (PMA parts), which have the potential to erode OEMs' bargaining power.

The following examples describe what some of today's leading aircraft and engine OEMs are already doing to strengthen their positions in this space:

- Boeing, the number-two commercial aircraft company by sales, already has a number of service programs in place – Airplane Health Management and Integrated Materials Management, for example – to support the MRO business.<sup>25</sup> Boeing also offers an innovative, total care package, GoldCare, for new 787 aircraft, which Boeing describes as “the next level of lifecycle management service.” This full-service offering has the potential to change the rules of MRO.<sup>26</sup> Also, Boeing's recent acquisition of Aviall strengthens its position in the supply chain and in the distribution of aviation parts. MRO facilities in India and Shanghai will help the company tap into more service opportunities in Asia.<sup>27</sup>

- Airbus, the number-one commercial aircraft company is developing its Air+ program, which enlists a network of service suppliers.<sup>28</sup> The Air+ program leverages the MRO network to bring together the best service from various network partners, and to develop tailor-made MRO solutions.<sup>29</sup> Airbus has also shown interest in setting up MRO capabilities in countries like India, often through partnerships.<sup>30</sup>
- Rolls-Royce is already strong in the aero-engine aftermarket space, with 48 percent of its fleet covered by its TotalCare or CorporateCare service offerings.<sup>31</sup> The company's TotalCare service provides a comprehensive technical and financial solution for engine fleet maintenance. Its CorporateCare offering oversees maintenance and associated logistics of accessories, as well as engines. Rolls-Royce operates a comprehensive global service network in 16 locations on four continents.<sup>32</sup>
- Pratt & Whitney provides engine maintenance, material supply management, and line maintenance services on a broad range of engine models. Pratt & Whitney has also entered the PMA parts market, including the life-limited parts arena. United Airlines is its first PMA parts customer.<sup>33</sup>

### ***Role 2 – Airlines***

Today, airlines' role in maintenance is changing as they outsource more maintenance activities. An increasing number of low-cost carriers (LCCs) are leading this trend. However, some airlines have seen MRO as a business opportunity and have set up their MRO operations on a commercial basis. The business model varies: some of the MRO organizations have become separate companies, while others

operate as profit centers within the existing airline. Still other airline MRO operations operate in the market on a more opportunistic basis to sell excess capacity.

The airlines' MRO strengths include their longstanding understanding of the needs of MRO customers and the ability to offer MRO services in the least possible time. They also tend to have an established network of suppliers.

For example, Delta TechOps is the largest airline MRO in North America – earning more than US\$312 million in revenue in 2006. It provides maintenance and engineering support for Delta Airlines' fleet of 440 aircraft, and also serves more than 100 aviation and airline customers from around the world.<sup>34</sup>

### ***Role 3 – Service supplier***

The service supplier performs service maintenance on aircraft, acquiring spare parts from OEMs and other sources, but providing its own technical skills.

Today's service suppliers are made up of either independent MRO providers or MRO arms of airline operators. As they transform into full-service suppliers, their role is moving towards that of a one-stop shop for all of an airline's MRO needs.

The strengths of service suppliers lie in their cost advantage; they can often provide the same quality of service at a lower price. They also offer multi-OEM aircraft servicing capabilities. And many of the service suppliers, such as Lufthansa Technik, excel in technical capabilities and have been leaders in selling "power by the hour" contracts.

**As roles evolve, companies in any aspect of the MRO business will need to strengthen their capabilities – and their value propositions.**

Service suppliers may be at a disadvantage if OEMs start bundling services with aircraft sales/ lease agreements. However, bundling long-term maintenance services with aircraft sales contracts has a downside; in many countries, accounting rules will force the OEM to book the value of the actual aircraft sale over the same period as the maintenance service. This will create pressure to keep aircraft sales and maintenance in separate contracts.

Furthermore, existing spare part distribution companies are very interested in this market and have the strong advantage of leading practices in managing distribution.

The following examples describe what a few of the airlines are already doing:

- Singapore Technologies Aerospace operates a global MRO network with facilities in the Americas, Asia Pacific and Europe. It maintains a global customer base that includes many of the world's leading airlines, low-cost carriers, airfreight operators and military operators. The company recently established a facility in Panama to complement MRO facilities in Mobile, Alabama, and San Antonio, Texas. Its joint venture facility in China, STARCO, has been operational for two years, and now serves Chinese and international carriers. The business acquired SAS Component in 2005 to strengthen and complement its component MRO offering in the European region.<sup>35</sup>
- Lufthansa Technik is a successful airline MRO – providing services ranging from complete MRO solutions to parts logistics. The company has an overhaul, completion, and logistics center in Hamburg, as well as maintenance sites in Munich and Frankfurt. Lufthansa Technik acquired a controlling interest in Hawker Pacific Aerospace in

2000 – increasing its U.S. market access. The company is planning to make a “big ticket” MRO investment in India with GMR – an Indian infrastructure developer based in Bangalore, India – to tap into the growing market there. Lufthansa Technik has also started an engine-maintenance joint venture with Rolls-Royce to serve the Trent family of engines. And it has signed a Total Component Support (TCS) deal with a host of national and international airlines.<sup>36</sup>

**Role 4 – Spare parts manufacturer**

Traditionally, these companies manufacture spare parts only, under the wing of an OEM. However, the FAA's recent PMA process allows private vendors to reverse-engineer parts and sell the non-OEM parts at a reduced price. While this could be very significant in the future, the penetration of PMA parts today is still small.<sup>37</sup> In short, the PMA process means that the role of a spare-parts manufacturer can change significantly as these organizations become masters of their own destiny.

The strengths of spare-parts manufacturers are that they can offer PMA parts at reduced costs and are in a good position to cater to low-value, high-volume “nuts and bolts” requirements.

Their biggest challenge is that OEMs will bundle total care programs with new aircraft sales.

For example, HEICO, a PMA parts manufacturer with a strong presence in the aftermarket distribution system, has agreements/partnerships with major airlines – including Lufthansa (which owns 20 percent of HEICO), American Airlines, United Airlines and Delta Airlines. The company has also established a significant global footprint with operations throughout the United States, in Europe and in Asia. Twenty-

eight percent of its revenues come from international operations. Traditionally, HEICO has concerned itself with engines; however, over the next few years, it will look at other areas, such as interiors, components, cockpits and in-flight entertainment.<sup>38</sup>

### What's ahead: Future scenarios for aircraft spare-parts providers

Figure 3 shows the primary elements of the aircraft maintenance business. Different companies can perform different roles. Key questions for the future of the MRO industry include:

- Who controls the sense data from aircraft?
- Who schedules the aircraft maintenance?
- Who controls the service centers?
- Who makes and distributes spare parts?
- Who controls the technicians?
- Who controls the service delivery network?

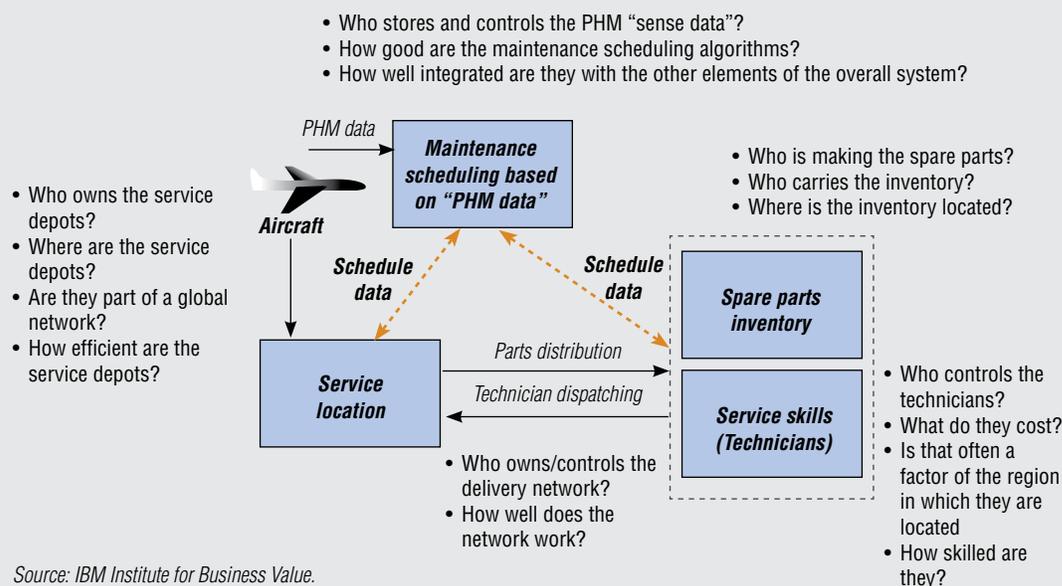
As the new MRO system develops, companies in commercial aircraft maintenance will be taking on more roles and will collaborate more with other companies to share those responsibilities. The MRO landscape of tomorrow could be quite different from today's. The critical factors for success in the competitive MRO market of the future are:

- Competitive service products
- Global scale
- The ability to run an MRO business: the right contracts for the right price
- Customer focus.

The immediate battleground may be over the control of PHM data. The owner of the aircraft possesses that data today, not the OEM. Different aircraft owners have different degrees of willingness to share that data with the OEMs. Operators of smaller fleets may be more willing today to share the data with

FIGURE 3.

#### Answers to key questions will determine the future of the aircraft MRO business.



OEMs, or even give over control of the data to those companies.

We see six possible future scenarios unfolding:

1. *OEMs take over spare parts but outsource service to service suppliers.* OEMs control spare-parts distribution. Airline operators outsource full-service contracts to OEMs that outsource service work to service suppliers. Key implications are that:

- OEMs will invest in building spare-parts distribution competencies, and perhaps acquire spare-parts distributors.
- Service suppliers will invest in building global shops for aircraft servicing – locating in low-cost regions.
- Airline operators will outsource services to those that offer the best value for the money (low cost, quick turnaround, etc.).

2. *Service suppliers take over; OEMs and spare-parts manufacturers act as suppliers.* Third-party service suppliers provide full service. OEMs and spare-parts manufacturers become mere participants in the distribution channel. Key implications of this scenario are that:

- Service suppliers invest in building global shops for aircraft servicing – locating in low-cost regions.
- Service suppliers invest in acquiring complex aircraft-servicing capabilities that call for specialized skills.
- Mergers among spare-parts distribution specialists and logistics providers will drive this scenario.

3. *OEMs take over, and service suppliers are left out.* OEMs control the spare-parts distribution channel, and also perform services themselves. This means that independent service suppliers have no role to play in the new scenario. Key implications of this situation are that:

- OEMs will invest in building spare-parts distribution competencies and acquire spare-parts distributors.
- OEMs will also work at building worldwide MRO networks for aircraft servicing. Emerging markets and low-cost regions represent key locations.
- OEMs will enhance logistics competencies, or partner with third-party providers with more reach and scale.
- Spare-parts manufacturers will carry the inventory.

4. *Airlines focus on MRO in a big way.* Airline MROs start providing service to external customers – primarily to access the profitable aftermarket and improve overall their profitability. Key elements of this scenario are that:

- Airlines procure either PMA parts or original parts for servicing their aircrafts, as well as the aircraft of other airlines (especially low-cost carriers that do not have the capability to do it themselves).
- Legacy carriers may take this path as a way to improve their profitability.
- This scenario will erode the bargaining power of the OEMs – enabling PMA parts to penetrate even faster into the marketplace.

**Value, global reach, collaboration and integration – as well as supply chain expertise – will become fundamental requirements.**

5. *Balanced OEMs and Service suppliers.*

Service suppliers and OEMs control separate supply chains for specific aircraft. OEMs will probably be limited to servicing their own aircraft. Key implications of this scenario tell us that:

- The system will move toward a collaborative network in which both OEM and service suppliers coexist and compete.
- PMA parts will make their entry through the independent MRO route – eventually forcing OEMs to rethink their service strategies.
- Mergers between supply chain participants and logistics providers and then with Independent MROs will shift the power base.

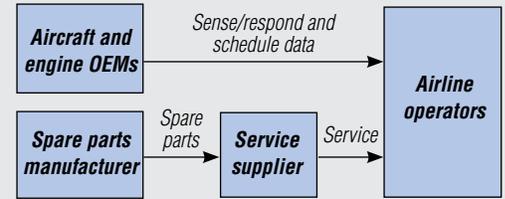
6. *Service suppliers provide onsite support to airlines (see Figure 4), while OEMs manage the “sense and respond” side of the business and schedule services.*

Service suppliers perform the actual maintenance process; OEMs monitor aircraft health and schedule maintenance and spare parts based on the performance of the aircraft in flight. Key implications of this scenario are that:

- OEMs are well positioned to build the systems that use the sense data coming from monitors in the aircraft.
- OEMs will be able to partner with logistics providers to quickly build the system.
- Using the sense data includes predicting when service is needed, and developing the collaborative logistics system necessary to control the scheduling of work throughout the entire MRO process.

FIGURE 4.

**Future scenario #6. OEMs monitor aircraft health and schedule maintenance and spare parts based on the performance of the aircraft in flight.**



Source: IBM Institute for Business Value.

We believe that scenarios five and six are the ones most likely to influence the paradigm of the future because:

- Major OEMs are determined to succeed in the MRO market. These OEMs probably have the best initial opportunity with airlines that have small fleets. Large airlines with commercial MRO subsidiaries are likely to send the bulk of their MRO work to those subsidiaries. In the end, OEMs will need to prove that they can compete with other, more established MRO players.
- Service suppliers will continue to gain industry influence.
  - For maintenance of engines and complex assemblies, the engine OEMs are in a strong position. Former airline MROs that now operate as separate commercial companies are also well poised to compete. But the cost of investment for doing engine maintenance may lead to further consolidation in this area.
  - For component services and simpler assemblies, the component OEMs are in a good position, although their main strength is with their own components. As “power by the hour” becomes the norm, a small number of logistics providers are starting to act as the service providers

that face the customer, while a larger number of technology specialty shops do the actual maintenance.

- Airlines will focus more on their core business, which translates into outsourcing even more of their MRO work.
- Parts suppliers are likely to become the owners of spare-part inventory in the distribution channel.

### What to do now

A company can help decide how it will play in the MRO business by answering three key questions:

- How deeply to play? An organization can choose to (1) Do it all with the company's own resources; (2) Do it together with a partner, with shared resources.
- In what area to play? An organization can choose only to play in specific areas of the

MRO business (such as line, components, engine or heavy), or can be a full-service player.

- What value proposition to offer? A company can be a systems integrator, which is at the end of the supply chain and provides the final value to the end customer. Or it can be a supplier that serves organizations higher in the chain.

Because business situations can change, your company should answer these questions in a way that allows it to shift – or even reverse – direction later on.

As the MRO business becomes more competitive, providers will be called upon to strengthen key capabilities to compete effectively. Figure 5 summarizes several fundamental capabilities that deserve attention by any company providing MRO service today – and in the future.

FIGURE 5.  
**Fundamental capabilities for a company providing MRO services.**

Capability	Explanation and examples	Important for
Offering value	<ul style="list-style-type: none"> <li>• Developing “total care” MRO service offerings</li> <li>• Developing specialized MRO service offerings</li> </ul>	<ul style="list-style-type: none"> <li>• Systems integrators</li> </ul>
Global scope	<ul style="list-style-type: none"> <li>• Developing and using new MRO service centers in emerging markets, and in low-cost regions</li> <li>• Growing by acquiring MRO companies that are a strategic fit with the company's own capabilities</li> </ul>	<ul style="list-style-type: none"> <li>• Systems integrators</li> </ul>
Collaboration and systems integration	<ul style="list-style-type: none"> <li>• Using processes and tools to work together with other partners in the supply chain as if within the same company</li> <li>• Interconnecting automated systems among all the companies to optimize the performance of the entire network</li> </ul>	<ul style="list-style-type: none"> <li>• Suppliers and companies working with suppliers</li> </ul>
Supply chain and logistics	<ul style="list-style-type: none"> <li>• Optimizing the spare-parts distribution network</li> <li>• Building a logistical control network that uses “sense” data from aircraft to schedule maintenance across all the MRO companies</li> <li>• Using diagnostics and prognostics to drive condition-based maintenance</li> </ul>	<ul style="list-style-type: none"> <li>• Suppliers and systems integrators (Supply chains can be internal to the company, between companies, or both)</li> </ul>
Cost reduction	<ul style="list-style-type: none"> <li>• Greater economies of scale</li> <li>• Sourcing from low-cost regions</li> <li>• Efficiencies from improving processes</li> </ul>	<ul style="list-style-type: none"> <li>• Suppliers and systems integrators</li> </ul>

Source: IBM Institute for Business Value.

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