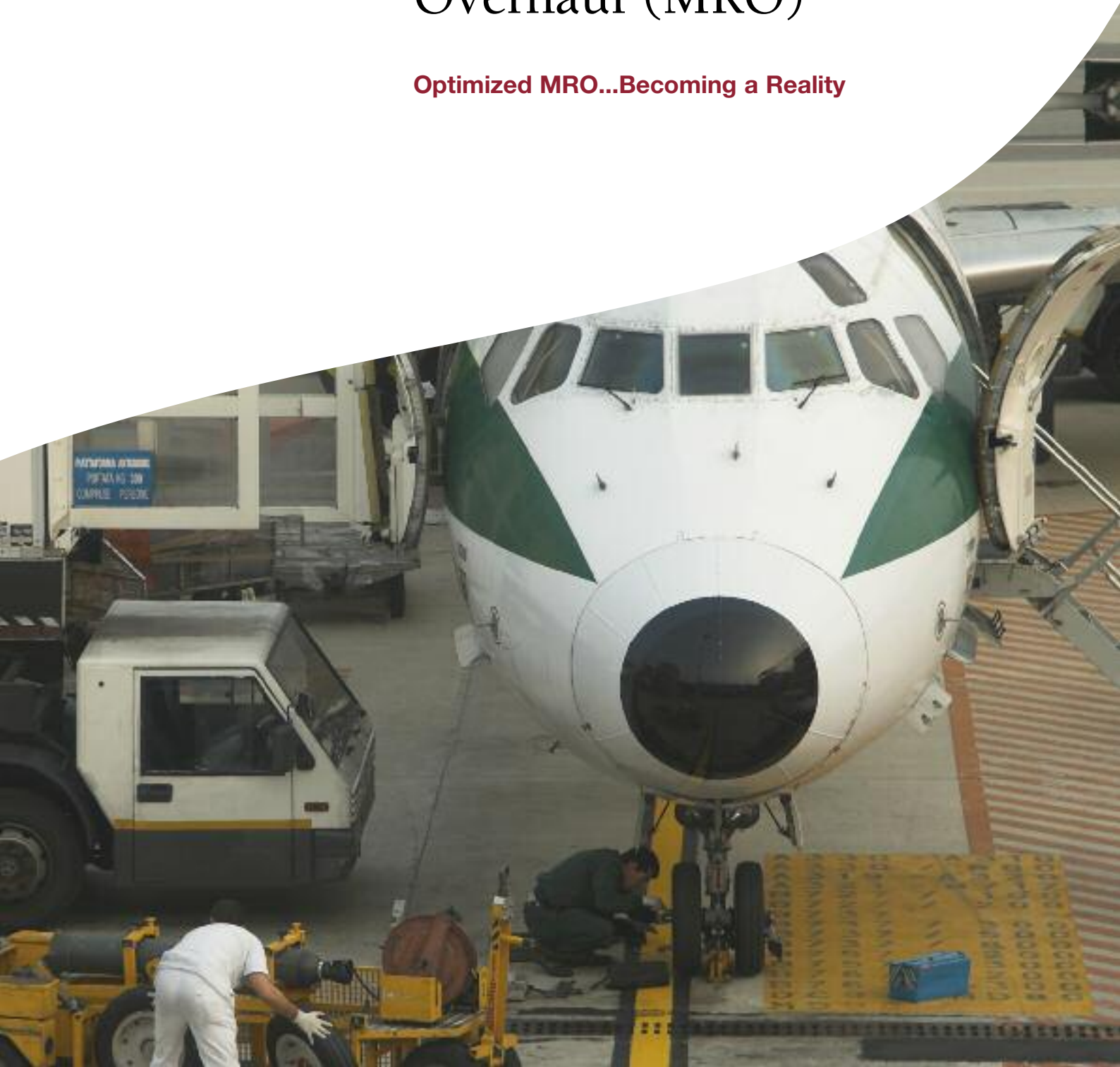


Maintenance, Repair and Overhaul (MRO)

Optimized MRO...Becoming a Reality

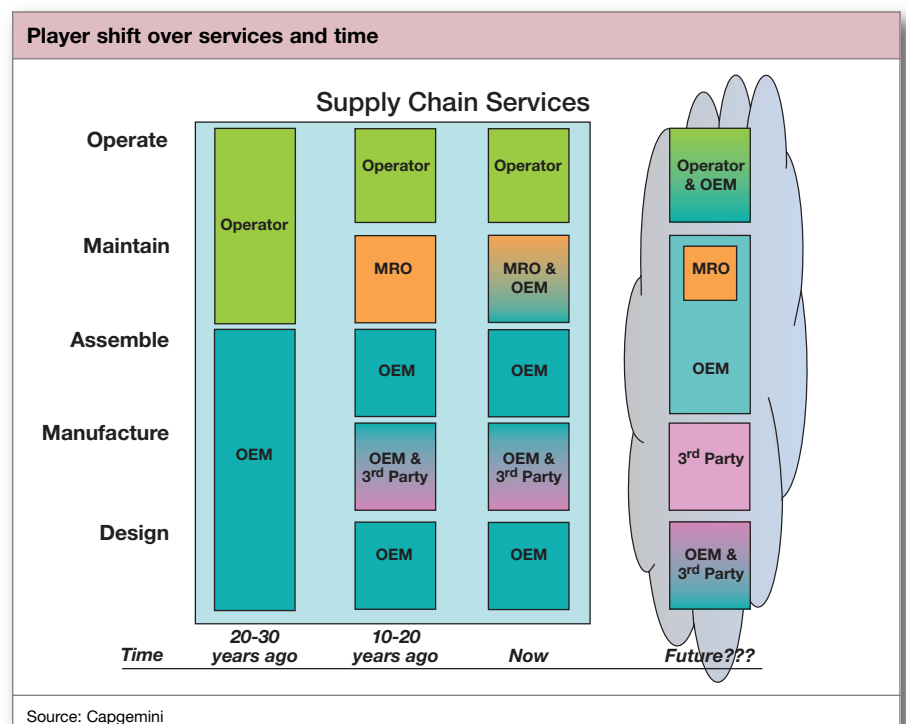


Over the past 10 years, the Maintenance, Repair and Overhaul (MRO) business has seen trade and revenues peak and trough as the industry has felt the effects of world economic and political ups and downs.

For many years, maintenance has been viewed predominantly as the activity and cost of the asset operator. The Original Equipment Manufacturers (OEMs) optimized the process of designing and building the asset, and the operators, in order to maximize asset availability, optimized its maintenance, repair and overhaul. This approach started to change in the late 1980s as most of the technical challenges were met. Airlines began to look for areas of cost reduction and outsource work.

A number of operators saw the opportunity to increase their revenue from MRO operations and established separate operational entities. This saw the arrival of many new maintenance-focused organizations, whose role was

to optimize maintenance activities. Diversification of the MRO industry removed one of the most complex and largest costs to entering the asset operations business and this was combined with buoyant economic times and high demand, leading to an increase in the number of companies wanting to operate assets and the birth of low-cost carriers. These industry trends took us up to 2000 and encouraged extended investment in optimization by the operators, maintenance companies and manufacturers within their individual business areas. The economy was booming, demand was high and there was little, if any, drive to look at options to optimize the end-to-end supply chain in this industry.



This all changed in September 2001 as the buoyant marketplace suddenly declined. As a result, the aviation supply chain entered a new phase. These new drivers have seen industry players start to restructure their service provision offerings and compete in different ways across the supply chain.

Market trends have encouraged industry players to reposition themselves across the service supply chain. This has led to technology integration end-to-end and is one of the key drivers of the most recent supply chain technology developments in self-diagnostics. Of course, this technological change isn't purely driven by industry trends but is also supported by IT and digital advances that allow such developments.

There has also been a notable change in the operators' view of the supply chain – where service contracts with the maintenance companies are becoming more common. In turn, this puts more pressure on the maintenance companies to keep an asset mobile, and to achieve this means that better communications tools are required along the supply chain.

It is these two fundamental industry changes that are driving the need for advances across the end-to-end supply chain of aviation asset management.



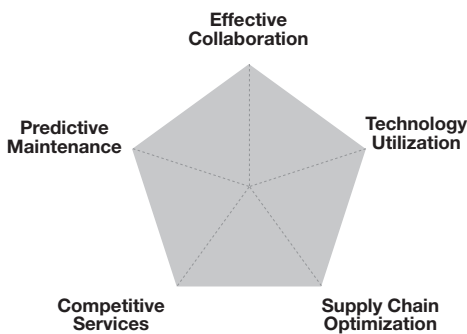


Issues and Challenges

Within this changing market the industry faces a perpetual challenge to strike the optimum balance between minimizing operating costs, maximizing fleet availability and assuring compliance with regulatory requirements.

In striking this balance, industry leaders will confront and overcome the following challenges:

- **Competitive Services** - What is the optimum set of integrated maintenance offerings that provides asset owners and operators with genuine levels of “service”?
- **Predictive Maintenance** - How best to predict and accurately plan maintenance events and ensure that these events are not just scheduled but scheduled in the optimum location to maximize the availability of the maintained asset?
- **Effective Collaboration** - Who offers partnerships to be fostered and who represents the competition, either currently or, just as importantly, in the future? The scope for genuine collaboration with OEMs, third-party logistics providers and suppliers has never been greater, but it has, conversely perhaps, never been easier for organizations to reconfigure themselves by developing new capabilities and service offerings.
- **Technology Utilization** - Which new technologies can be deployed now and how best should they be used? The rate of technological change is increasing and is rapidly exceeding the industry’s ability to keep up. We live in genuinely “exponential times” and those that can identify which changes offer the greatest value will be the industry leaders of the future.
- **Supply Chain Optimization** - Where should critical components and services be physically located around the world to provide the quickest possible reaction time without over-committing extremely valuable capital investment in slow-moving inventory and redundant facilities?



Automated In-flight Maintenance Planning and Part Provisioning

As an example of meeting the combined challenges of effective collaboration and supply chain optimization, we see technology being used to access aircraft performance in near real-time to get the right people with the right material to ramp at the right time.

In our example below, major aircraft OEMs are supplying operators with on-board health monitoring solutions as well as on-ground solutions to receive and process this information.

Capgemini, through its Sogeti subsidiary, has sole responsibility for the development of the Real Time Maintenance and Diagnostic System (RTMDS) for a major aircraft OEM. This is a solution that has an on-ground-based software, optimizing the maintenance of fly-by-wire aircraft, equipped with an On-Board Maintenance System (OMS) and sensors, and a Real-Time Communication System (ACARS/ATSU).

As a longstanding partner of airline MRO, aircraft manufacturers and MRO service providers, Capgemini understands that the true value is not found in the technology itself, but in the way maintenance organizations are structured and how they integrate the flow and usage of this newly available information into their existing maintenance planning activities.

Today, being able to manage the vast amount of information that the maintenance organization requires is critical, and the leverage and integration of all information (old and new) in a structured and decisive way will dramatically increase the operational efficiencies of MRO organizations.

Let’s take an example of how this integration can ideally be used to give a maintenance organization a competitive advantage and bring value to its customers.

Airline X is departing from Munich to Lisbon. The passenger aircraft is equipped with OMS and ACARS/ATSU.

After its departure from Munich, and while flying over France, on-board sensors detect an abnormal situation. The sensors' information is processed and fed into the Flight Warning Computer, which checks data discrepancies. Information is then displayed in the Electronic Centralized Aircraft Monitor (ECAM) and provides the aircraft crew with messages detailing the problem and

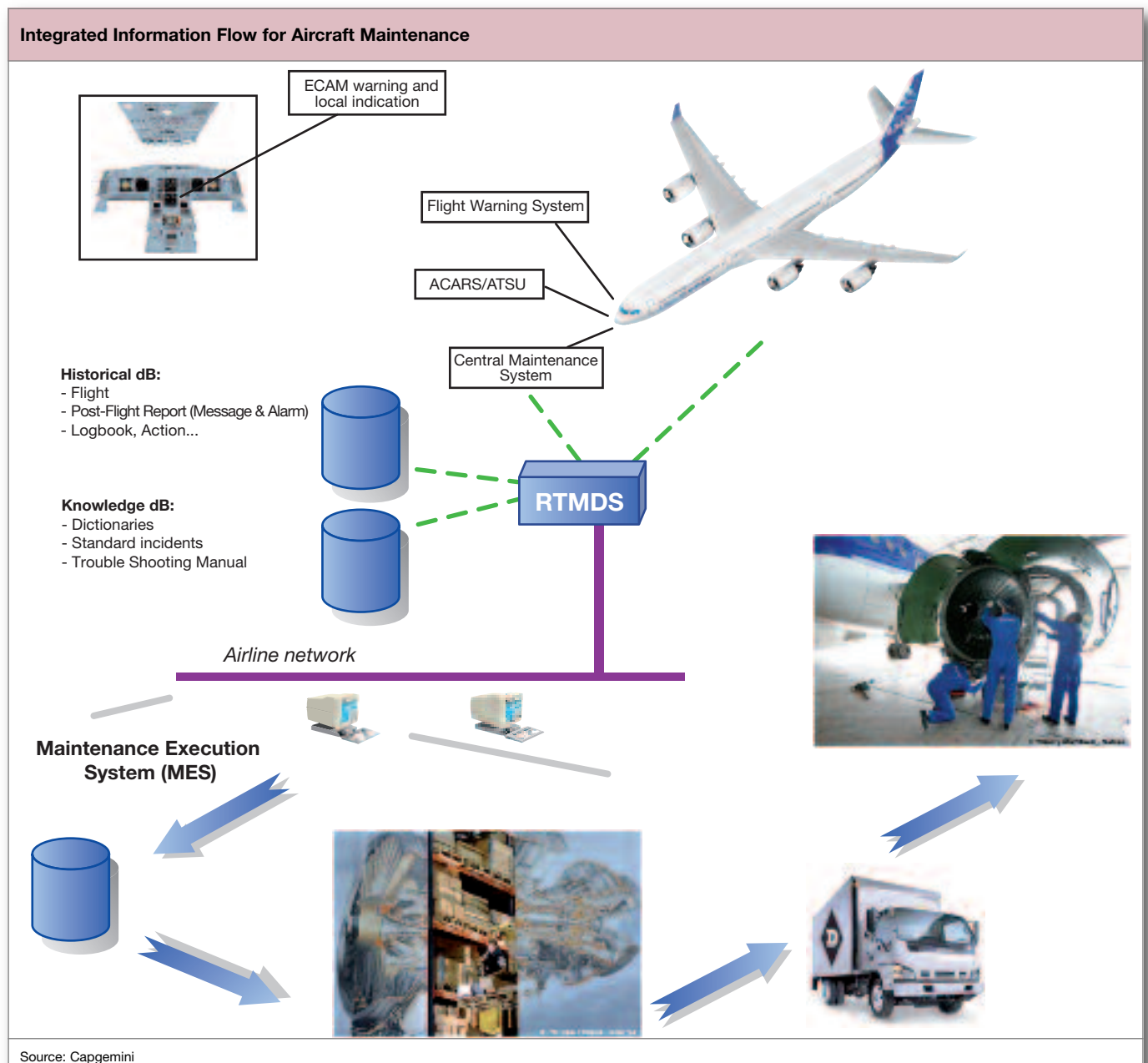
the correct procedure to follow to correct it. During the flight, the crew analyzes the problem and enters the necessary information into the Electronic Logbook.

At the same time, the On-Board Centralized Maintenance Computer automatically and instantaneously sends ACARS diagnostic data to RTMDS.

The automatic diagnostics processed in RTMDS advise that it is safe to continue the flight to Lisbon and change the faulty part on arrival.

The diagnostic message is automatically sent back to the ECAM in order to provide the crew of Airline X with the results of the diagnostic, so that they can safely continue their flight.

From Capgemini's point of view, the real value of generating integration is for RTMDS to automatically and simultaneously send the diagnostic message into the ERP maintenance system. This triggers an automatic workflow to check the actual configuration of the aircraft and check the parts that need replacing.





The maintenance system will check if the parts are in stock at the nearest warehouse and send an automatic logistics process to have the parts sent to Lisbon. At the same time, the maintenance system issues a service order to allocate the adequate resources (technicians) in Lisbon.

Upon landing in Lisbon, the technician and the parts will already be on site, and the necessary maintenance can be performed to have the aircraft back in service within a minimum turnaround time.

As a technology integrator, Capgemini understands that value comes from integrating different systems, rather than any one system working as a standalone. Working together, be it the sensors, Electronic Logbook, On-Board System, Health Monitoring System, Prognostic System, Maintenance Planning System, or the Maintenance Execution System (MES), they will give the maintenance organization a unified view in order to make a quick decision.

The Real World of People and Parts

This is the technology viewpoint. However, we should not forget that somewhere the technology process stops and is transferred to the real world of people and parts. Quite rightly, many MROs claim, “a computer never repaired an aircraft.” This means that, in order to take advantage of the powerful diagnostic capabilities of modern systems and the tremendous speed of process that can be achieved by integrating systems, organizations must brace themselves to deal with these powers and make them work in their favor. Let’s take the example described above one step further into the organization.

The crew has analyzed the ECAM messages and has completed troubleshooting as per the applicable procedures to identify the fault and the implications for the safety of the

flight. The diagnosis is confirmed by the automated on-ground diagnostic system. The crew has also assessed the impact of this defect on the subsequent flight.

Now the captain calls the Operations Control to discuss the next steps. Ops Control connects the captain to an MRO specialist who supports further troubleshooting and makes efforts to fix the problem during the flight. This is also a technology-supported process where the MRO expert may relay additional information to the crew by ACARS, for example, or other data transmission features. If the crew manages to solve the defect, the issue is closed. If not, maintenance intervention is launched by Ops Control.

In most organizations, this is where the procedure ends. But how about the related processes? The airplane may or may not be delayed for the next flight, boarding would need to be postponed, loading rescheduled and the gate could become overcrowded, among other consequences. Airlines need proper processes and methods of communication to ensure that all related procedures are informed and action taken to minimize the disruption and associated cost.

The work order is launched, a technician needs to be dispatched to the aircraft with the proper diagnostic history, the right documentation and, if possible, the right parts. However, the most suitable technician may not be available right away. This means that within the MES, the duty manager needs to assess the work at hand and decide on staff, priorities and locations.

Once the repair process has started, communication remains crucial. Passengers and freight are waiting, crew duty time is ticking away and back-up scenarios may need to be activated. An airline needs to manage these interactions carefully to ensure

that it can reap maximum benefit from having access to speedy and accurate MRO data. The cost and benefits are not so much in the MRO process as standalone, but in the management of the impacts on the operation, the consequent effects and the reputation of the airline.

In short, a speedy repair process is not something that you can sell to passengers and freight-forwarding customers. They do not want to hear about problems; they want to fly on time and they want to fly safely. The rest is detail. So, unless the airline is equipped to convert the process advantages of technology integration into added value for customers, the exercise remains rather useless.

Capgemini has proved itself in the airline MRO industry as an established provider of business and IT solutions. Because of these deep, longstanding relationships, we are in a unique position to realize these kinds of real, end-to-end integrated value propositions that incorporate Capgemini developed industry technology and our deep IT and business integration and ERP capabilities.

Capgemini is actively working with companies that are innovatively leading the way in the development and use of technology in this industry. In combination with our established global core consulting capability, we can help companies leverage this value-adding capability and make a real difference for their customers and shareholders.

In today's harsh competitive environment, our customers can benefit from setting the new industry standards of business, while others who do not act will struggle to keep up with developments and fall behind.

More than ever, it seems a case of "survival of the fittest" in this industry. Customers are paying more and more attention to the detail and dependability of your service. Can you afford not to do the same?





About Capgemini and the Collaborative Business Experience™

Capgemini, one of the world's foremost providers of consulting, technology and outsourcing services, enables its clients to transform and perform through technologies.

Capgemini provides its clients with insights and capabilities that boost their freedom to achieve superior results through a unique way of working, the Collaborative Business Experience™. The Group relies on its global delivery

model called Rightshore®, which aims to get the right balance of the best talent from multiple locations, working as one team to create and deliver the optimum solution for clients. Present in more than 30 countries, Capgemini reported 2008 global revenues of EUR 8.7 billion and employs over 90,000 people worldwide.

More information about our services, offices and research is available at www.capgemini.com

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