Through-life Management:
A Catalyst for Process Excellence in Customer Support and Maintenance, Repair & Overhaul (MRO)

UK Lean Aerospace Initiative Report
May 2006
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Executive Summary

The UK Lean Aerospace Initiative (UK LAI) aims to increase the competitiveness of the UK aerospace industry through the promotion of lean principles and practices. The UK LAI, therefore, represents a key enabler of the UK Government’s Aerospace Innovation and Growth Team (AeIGT)’s productivity and process excellence objectives. The AeIGT stresses the importance of embracing the concept of through-life management in order to increase the UK aerospace industry’s market share in the longer term. The success of through-life management will be highly dependent on a re-evaluation of the provision and delivery of customer support and MRO activities and the recognition of the increased strategic importance of customer support and MRO as significant elements of through-life solutions.

This exploratory study has been conducted as part of the UK Lean Aerospace Initiative (UK LAI), in collaboration with a number of UK aerospace companies, to gain insights into the adoption of through-life management within the industry, to highlight the implications for Customer Support and MRO businesses, and to make recommendations regarding the appropriate way forward for the aerospace industry.

Section 1 of this report describes the rationale for conducting this exploratory study and outlines the scope of the report.

Section 2 proposes a generic definition of through-life management and identifies the three primary drivers for through-life management in the aerospace industry – (1) customer demand, (2) increased revenues, and (3) increased competitiveness.

Section 3 reveals the service ambitions and visions of aerospace companies and examines the matching service developments. It also assesses the transition of aerospace companies to total service providers and argues that three key factors affect this transition – (1) the communication of the through-life service vision, (2) the level of business currently conducted under through-life-type contracts, and (3) the maturity of lean implementation.

Section 4 highlights the strategic importance and value of Customer Support and MRO business. In addition, three important process excellence challenges facing
Customer Support and MRO businesses are identified – (1) Lean thinking in Customer Support and MRO environments, (2) Services management, and (3) Information systems to support through-life management.

Section 5 presents the key conclusions of the study and makes recommendations in four key areas:

- The extension of lean thinking to Customer Support and MRO
- The strengthening of services management and customer service skills
- The development of information technology and systems that support through-life management, and
- The re-evaluation of organisational design for seamless through-life solution delivery.
Section 1: Introduction

The UK Lean Aerospace Initiative (UK LAI)\(^1\) was established in 1998 with the aim of improving the competitiveness of UK aerospace companies through the promotion and implementation of lean principles and practices. To date, the UK LAI has focused predominantly on improving performance within the design and manufacturing phases of the product life-cycle. However, it is becoming increasingly clear that performance improvement and process excellence initiatives need to extend to the in-service support phase of the life-cycle, particularly in light of the adoption of the through-life management concept throughout the industry.

Continued cost reduction pressures and increased levels of competition in the industry have triggered a fundamental transformation in the operations strategies employed by aerospace manufacturers. The concept of through-life management, involving the provision of a complex combination of products and services over extremely long life-cycles, is being widely advocated throughout the industry. The emergence of total customer solutions and integrated support contracting arrangements are evidence of this trend. At the Government level, the Aerospace Innovation and Growth Team (AeIGT, 2003) stresses the criticality of embracing through-life management in order to increase the UK aerospace industry’s market share in the longer-term, in both commercial and defence markets. The AeIGT (2003) calls on the commercial sector to provide “service-based, life-cycle packages, allowing the main civil customers to focus on their core businesses” (p65) and “to exploit opportunities in MRO (maintenance, repair and overhaul) and through-life services” (p66). In relation to the defence sector, the AeIGT stresses the “importance of full through-life support” (p67) and envisages the development of a “world-leading ability in a complete through-life service provision” (p68), supported by cost competitiveness, value for money and excellent customer satisfaction. The achievement of such a vision is dependent on a recognition of the increased strategic importance of Customer Support and MRO activities as fully integrated

\(^1\) The UK Lean Aerospace Initiative (UK LAI) was established in 1998 and is a consortium comprising the University of Bath, Cranfield University, the University of Nottingham and the University of Warwick in conjunction with the Society of British Aerospace Companies (SBAC). The UK LAI represents part of the SBAC’s Best Practice programmes. Further information can be accessed at www.sbac.co.uk.
elements of through-life solutions. In addition, it will require a re-evaluation of the methods of provision and delivery of Customer Support and MRO activities.

Although many aerospace companies are promoting total customer solutions and through-life services in the marketplace, there is no clear understanding of how through-life management is being implemented across the whole of the aerospace industry. There is a need for a more in-depth understanding of the industry-wide shift to a through-life management approach, how individual companies are implementing through-life strategies, business models and services, and what changes are required within Customer Support and MRO businesses as a result.

Consequently, the UK LAI has conducted an exploratory research study in collaboration with a number of UK aerospace companies to gain insights into the adoption of through-life management within the industry, to highlight the implications for Customer Support and MRO businesses, and to make recommendations regarding the appropriate way forward for the aerospace industry.

1.1 Scope of this Report

The objective of this report is to present the findings of this exploratory research study. The study investigates the adoption of through-life management in the aerospace industry and, more specifically, examines the role of Customer Support and MRO activities in delivering through-life customer value. The report:

- identifies the drivers for through-life management in the aerospace industry and, hence, the drivers for performance improvement and process excellence in customer support and MRO
- captures how through-life management is being defined and interpreted throughout the aerospace industry
- provides an insight into the increased strategic importance of services to aerospace manufacturers
- analyses the implementation of through-life management within aerospace companies and the associated improvement initiatives within Customer Support and MRO businesses
• assesses the stage of transition of aerospace companies to through-life total-service providers
• highlights the process excellence challenges for Customer Support and MRO businesses.

In so doing, the study supports the national-level AeIGT vision for the development of “world-leading ability in a complete through-life service provision”.

Eleven aerospace companies have participated in this exploratory study over a seven month period from October 2004 to April 2005. These companies are either promoting through-life management or are involved in the support and maintenance of aerospace equipment throughout its life-cycle. Participating companies include Original Equipment Manufacturers (OEMs), prime support contractors, first tier suppliers to OEMs and OEM-owned service providers. Six of the companies predominantly serve the military market, two companies carry out primarily civil work while the remaining three companies conduct a mixture of civil and military work.

Semi-structured interviews were held on-site at each of the companies involved. Eighteen interviewees have contributed to the study. The roles of the interviewees within their respective companies represent a broad spectrum of experience, including Managing Director, Head of Integrated Logistics Support, Business Improvement Director, Strategic Development Executive and Service Centre Manager, among others. Respondents have subsequently been given the opportunity to review and validate their views as expressed in this report. In addition, publicly available information (e.g. company brochures, web-sites) has been used to supplement the data obtained through the interview process.
Section 2: Through-life Management

The nature of the aerospace industry is changing fundamentally as a consequence of the widespread promotion of the through-life management concept. The support and service businesses of aerospace manufacturers are now being required to improve performance and embrace process excellence initiatives, building on the experiences of their manufacturing divisions over the past 5-10 years. In order to understand the changes required in the delivery of support and services, it is important to recognise the context within which these changes are taking place.

This section examines the concept of through-life management in detail. Firstly, a generic definition of through-life management is proposed. Then, the drivers for through-life management in the aerospace industry are identified. The section concludes by highlighting the need for increased service orientation to support the through-life concept.

2.1 Defining Through-life Management

Despite the fact that the concept of through-life management is currently widely used throughout the aerospace industry, there is no commonly accepted definition either in the literature or in practice. The UK Ministry of Defence’s SMART Acquisition documentation provides valuable guidance, proposing that through-life management includes:

- “deliver[ing] a fully integrated…..capability”,
- “manag[ing] the project throughout the life-cycle”,
- “managing the Cost of Ownership”, and
- “tak[ing] full account of all the longer term implications of acquisition”
  (UK MoD, 2004, pp4-5).

This is reinforced by promotional material from Rolls-Royce plc which states, “By harmonising our products and services we are stepping towards total service solutions, ranging from traditional support such as spare parts supply to engine leasing and state of the art predictive maintenance services, including real time
engine health monitoring. These services offer our customers the most economical and reliable way to acquire, manage and maximise the value of their engine assets throughout the life cycle” (Flight International, 2004, pp146-147).

Recent developments in the lean literature propose the concept of “lean consumption” which focuses on the whole cycle of buying and using a product, including “researching, obtaining, integrating, maintaining, upgrading, and, finally, disposing of this purchase” (Womack and Jones, 2005, p2). Through-life management is essentially the same concept but applied to an industrial or business-to-business setting rather than to consumer goods.

Given the absence of a commonly accepted definition, through-life management is defined as follows for the purposes of this report:

“Through-life Management involves the life-cycle management of the products, services and activities required to deliver a fully integrated capability to the customer, while reducing the cost of ownership for the customer”.

Figure 1 illustrates, in a simplified way, the scope of through-life management.

Through-life management aims to provide value to the customer over all stages of the product life-cycle in a more integrated and holistic manner than in the past.
2.2 Drivers for Through-life Management in Aerospace

Through-life management is causing a fundamental shift in the strategies and business models of aerospace companies. It is important to understand what is driving the adoption of through-life management prior to analysing how individual companies are implementing it in practice and examining the implications for Customer Support and MRO.

Through-life management requires providing customers with a total solution, comprising a mix of products and services. It is suggested by the literature that there are three primary reasons for integrating services into core product offerings – (1) customer demand (2) increased revenues, and (3) increased competitiveness (Mathe and Shapiro, 1993; Mathieu, 2001b; Oliva and Kallenberg, 2003). This study has revealed these to be the exact drivers for the adoption of through-life management in the aerospace industry.

2.2.1 Customer Demand

The respondents reveal that there is significant customer pressure for manufacturers to provide products and services in a different way than would have been the case in the past. The customer’s focus has shifted away from the acquisition of products to the acquisition of through-life capability. This is dramatically changing the way aerospace companies are providing customer value. In contrast to the manufacturer selling a product and, subsequently, providing support, maintenance and repair services, through-life management aims to satisfy all of these requirements in an integrated offering to the customer. On the military side, support contracts are increasingly being linked to equipment availability targets in a drive to transfer risk to the manufacturer or support provider and reduce total costs of ownership. The focus, therefore, has changed from inputs to outputs. Similarly, airline customers are demanding cost and reliability guarantees. As a result, customer requirements are driving improvements in equipment reliability and, therefore, reducing the number of spares and the amount of maintenance, repair and overhaul (MRO) required over the product life-cycle. However, this shift in customer requirements opens up significant opportunities for manufacturers to develop new value-added services (this will be further discussed in the Section 3.2: Service Developments).
Paradoxically, although there is a drive from customers, both civil and military, to progress towards through-life solutions, concerns have also been raised about moving in this direction. Respondents reveal that there are customer concerns with regard to the transparency of through-life costs or cost of ownership. In addition, respondents believe that customers fear that they may lose capability if aerospace manufacturers or prime contractors take control of tasks which the customer would previously have carried out themselves. Another key concern relates to risk. Through-life contracts should theoretically transfer risk from the customer to the manufacturer or contractor. However, respondents suggest that customers are concerned that the ultimate operating risk still remains with them.

Many of these concerns are deemed to have stemmed from past relationships of distrust between aerospace companies and their customers. However, the strong drive by aerospace manufacturers themselves to pursue through-life management – in order to protect revenues and maintain competitiveness – means that manufacturers are keen to address these challenges.

2.2.2 Increased Revenues

In addition to customer pressure to move towards through-life management, aerospace manufacturers themselves are keen to develop models for through-life operations. Traditionally, aerospace manufacturers concentrated heavily on the design and manufacture of aerospace equipment, with aftermarket activities being viewed as the “necessary evil” suggested by Lele (1997). Over the past ten to fifteen years, however, aerospace manufacturers began to recognise the financial opportunities provided by support and aftermarket activities. The long aftermarket life-cycle phase, relative to that of design and manufacture, provides significant revenue and profit opportunities with respect to in-service support and maintenance, especially with regard to the provision of spare parts. Despite this increased attention by aerospace manufacturers on aftermarket activities and services, manufacturing and in-service support were effectively considered separate businesses, with no real integration between the two. This resulted in a win/lose scenario, according to one respondent, with the manufacturer gaining significantly, particularly with respect to spares business, but the customer not receiving a comprehensive service over the
life of the equipment. Through-life management attempts to provide integrated customer solutions, thus promoting a win/win situation for both customers and manufacturers over the life of the equipment. Respondents recognise that the shift to a through-life management approach has the potential to threaten long-term revenues as a result of increased equipment reliability and the subsequent reduction in demand for spares and repairs. However, manufacturers expect to protect their revenue streams by capturing through-life business at the point where they sell the equipment, thereby increasing market share and avoiding direct competition with independent MRO and support providers to a large extent at a later stage of the life-cycle. Additionally, they intend to generate increased revenues from associated value-added service developments. In parallel, aerospace manufacturers are continuing to engage in significant cost reduction activities. The other factor to consider is that not all customers will choose to participate in through-life contracts and, in the case of mature or legacy equipment, this type of agreement is not deemed to be appropriate. Therefore, manufacturers still have scope to generate revenues and profits on spares and repairs business in the traditional way for some customers and/or equipment.

2.2.3 Increased Competitiveness
In addition to protecting future revenue streams, aerospace manufacturers have expressed a desire to maintain competitive advantage by protecting their intellectual property rights, their product integrity and their reputation in the marketplace. Historically, the concentration of aerospace manufacturers on design and manufacture resulted in the evolution of a strong independent MRO sector. Although independent MROs are still heavily dependent on OEMs for spare parts, there is an increased usage of PMA (Parts Manufacturer Approved; in other words, non-OEM) parts which aerospace OEMs believe compromises product integrity.

Aerospace manufacturers are confident that they are best positioned to provide a comprehensive through-life service due to high levels of investment in technological

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2 PMA parts are spare parts for aircraft, aero-engines and components manufactured and approved under US FAA regulations. For additional information on PMA parts, see AeroStrategy, 2004a).
development and an in-depth knowledge of their products. However, the large independent MROs have already begun to counterattack with the introduction of total support solutions, including maintenance planning and engineering (Pilling, 2005; O&M, 2005). While some respondents believe that independent MRO and support providers will be squeezed out of the market, the majority of respondents envisage a role for all. Aerospace manufacturers intend to compete on the basis of technical knowledge and expertise. In many cases, it is expected that collaborative business models, where independent MRO and support providers partner with OEMs to provide a comprehensive through-life solution, will become more widespread. However, this will only be done where the independent provider adds value to the OEM offering. Respondents also believe that independent MROs will increasingly specialise in niche markets, particularly with respect to legacy equipment. One respondent from an OEM-owned MRO company argues that while their company may not be able to match OEMs with respect to price, it will be capable of competing on turnaround time, for which many customers are willing to pay a premium.

2.3 The Increasing Requirement for Service Orientation

All of the drivers for through-life management are changing the environment within which aerospace companies must operate and compete. The emphasis on the provision of total customer solutions means that some aerospace companies now view the manufactured product as “incidental” and are attaching significant importance to the service and support activities associated with their products. Although high quality, reliable products are still essential to the overall offering, there is a need to seamlessly integrate products and services in order to provide through-life total solutions. Consequently, aerospace businesses are adopting strategies that emphasise service, re-organising processes to deliver the required levels of service and introducing business models and contracting arrangements to reflect these strategies and processes. Section 3 examines the implementation of service strategies to support through-life management, the development of advanced, value-added services and the transition of aerospace companies to total service providers.
Section 3: The Service Revolution

The shift to through-life management is being underpinned by the widespread adoption of service strategies within the aerospace industry. This increased service orientation is being promoted, not simply within areas of the business considered service businesses, such as Customer Support and MRO, but at enterprise level. This section highlights the service ambitions of the participating aerospace companies, identifies the services that are evolving to meet these ambitions and tracks the progress of companies towards total service providers.

3.1 Service Visions and Ambitions

This study reveals that through-life management is the catalyst for the development of advanced services, the adoption of service strategies and the promotion of a service culture in the aerospace industry. It is clear that all of the companies involved in the study are actively seeking to articulate their service visions, whether serving military or civil markets. Table 1 illustrates the stated ambitions of aerospace companies with regard to service orientation and vision.

<table>
<thead>
<tr>
<th>Company</th>
<th>Vision</th>
</tr>
</thead>
<tbody>
<tr>
<td>AviCo</td>
<td>&quot;Global Service Provider&quot;</td>
</tr>
<tr>
<td>MilSupp</td>
<td>&quot;Government Technical Support Solutions&quot;</td>
</tr>
<tr>
<td>EntCo</td>
<td>&quot;Total Service Solutions&quot;</td>
</tr>
<tr>
<td>ServCo</td>
<td>&quot;Customer Services and Support&quot;</td>
</tr>
<tr>
<td>MaintCo</td>
<td>&quot;Pro-active and Innovative Service to Customers&quot;</td>
</tr>
<tr>
<td>EngCo</td>
<td>&quot;Excellence in Customised Service&quot;</td>
</tr>
<tr>
<td>TransCo</td>
<td>&quot;Service-oriented Business&quot;</td>
</tr>
<tr>
<td>FlyCo</td>
<td>&quot;Total Capability Provider&quot;</td>
</tr>
<tr>
<td>ActCo</td>
<td>&quot;Excellent Customer Service&quot;</td>
</tr>
<tr>
<td>MilSupp2</td>
<td>&quot;Integrated Systems Solutions&quot;</td>
</tr>
<tr>
<td>EngCo2</td>
<td>&quot;Through-life Total Service Solutions&quot;</td>
</tr>
</tbody>
</table>

Source: Interview data supplemented by publicly available information.

However, having service visions and ambitions is not enough. It is important that companies develop services that not only match their visions and ambitions but also meet the customer’s through-life requirements. Furthermore, it is vital to develop service processes and customer service skills that will enable seamless service delivery to the customer. In the light of the through-life management concept, it is
also important that the service dimension is not divorced from the product dimension and that the focus remains on providing a fully integrated through-life solution to the customer. This will require higher levels of co-ordination and co-operation between different areas of aerospace businesses than ever before.

### 3.2 Service Developments

The service ambitions and visions of the aerospace companies involved in the study do appear to be matched by innovative service developments. Mathieu (2001a) suggests that services provided by manufacturers can be classified into two types:

1. **Services which support the product** – fits the traditional view of a service offering in the business market, the main goal of which is to ensure the proper functioning of the product and/or to facilitate the client’s access to the product.

2. **Services which support the client** – a more advanced perspective of the product services offer, where the manufacturer explores how its services support particular client initiatives and helps clients maximise their processes, actions and strategies associated with the product.

Services such as maintenance, repair and overhaul (MRO), spares provisioning, technical publications and technical support are traditional services that have been provided by aerospace manufacturers for many years. However, the provision of such services has not been necessarily accompanied by a customer service culture. For example, long lead times and high costs have often been associated with spares and MRO activities.

Traditional services will continue to be offered by aerospace companies. However, it is clear that many companies are enhancing the traditional services they offer or the means of delivering such services. For example, MRO services have been traditionally conducted on a time plus material basis for each individual repair as it arises. This is viewed as being a reactive strategy where the manufacturer or service provider has no real incentive to understand the customer’s operational needs and requirements. Over the past five years or so, the use of new types of agreements for MRO has become more common within the companies involved in the study. These
include fixed price repairs, spares inclusive contracts and preventative maintenance contracts. In those companies that have developed flight hour agreements, MRO services are included in the fixed monthly fees paid by the customer. Even service providers that cannot necessarily control or participate in through-life strategies, due to their position in the supply chain or within their corporate group, are developing innovative and enhanced services.

The enhancement of traditional services is being matched by the development of advanced, value-added services, including supply and support chain management, integrated logistics support, asset management, equipment health monitoring and reliability trend analysis. These services are specifically designed to align with the operational needs of the customer, to reduce duplication of effort in both customer and supplier organisations, and to reduce cost and risk. For example, in-service real-time equipment performance monitoring enables pro-active MRO as components or parts can be removed and replaced before failure occurs, thus minimising maintenance cost and disruption to the operating customer. However, these value-added services often depend heavily on the provision of data by the customer. Respondents claim that this can often be difficult to obtain, especially with respect to military equipment.

Through-life management is being developed for new aerospace equipment and is the most sophisticated, complex and comprehensive method of delivering integrated customer solutions, involving the delivery of a combination of product, traditional services and advanced services. In the words of one respondent, the shift towards through-life management is an “evolving service proposition” and is believed to be the “most efficient and effective way of delivering value”. One of the respondents provided a valuable example of how the service proposition evolves over time. For a certain product, the customer was experiencing a large number out-of-service units, was holding the wrong spare parts and was facing long lead times for repair from the OEM. Initially, the respondent company developed a spares inclusive contract. This was then further developed to include logistics management. Finally, the company moved to a complete support chain management model where unserviceable units are collected from the customer, repaired and send back to the appropriate customer
facility after repair. This approach significantly reduced the number of assets being held by the customer while simultaneously increasing equipment availability.

Table 2 summarises the enhanced and advanced services currently being offered by the participating aerospace companies as they move to support the through-life concept.

<table>
<thead>
<tr>
<th>Company</th>
<th>Enhanced and Advanced Services</th>
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<tbody>
<tr>
<td>AviCo</td>
<td>Performance-based Logistics</td>
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<tr>
<td></td>
<td>Fixed Price Maintenance Agreements</td>
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<td></td>
<td>Flight Hour Agreements</td>
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<td></td>
<td>Inventory Management</td>
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<td></td>
<td>Obsolescence Management</td>
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<tr>
<td></td>
<td>Reliability Trend Analysis</td>
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<tr>
<td>MilSupp</td>
<td>Through-life Support</td>
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<tr>
<td></td>
<td>Integrated Support</td>
</tr>
<tr>
<td></td>
<td>Logistics and Asset Management</td>
</tr>
<tr>
<td>EntCo</td>
<td>Asset Management</td>
</tr>
<tr>
<td></td>
<td>Reliability Data Analysis</td>
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<td></td>
<td>On-line Databases</td>
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<tr>
<td>ServCo</td>
<td>Spares Inclusive Contracts</td>
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<td></td>
<td>Preventative Maintenance Contracts</td>
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<tr>
<td>MaintCo</td>
<td>Component Management</td>
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<td></td>
<td>Stock Exchanges</td>
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<td></td>
<td>Support Chain Management</td>
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<tr>
<td>EngCo</td>
<td>Support Chain Management</td>
</tr>
<tr>
<td></td>
<td>Total Logistics Support</td>
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<tr>
<td></td>
<td>Fixed Price Repairs</td>
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<td></td>
<td>Project Management</td>
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<td></td>
<td>Spares Inclusive Contracts</td>
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<tr>
<td>TransCo</td>
<td>Fixed Price Repairs</td>
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<tr>
<td></td>
<td>Spares Inclusive Contracts</td>
</tr>
<tr>
<td>FlyCo</td>
<td>Integrated Logistics Support</td>
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<td></td>
<td>Integrated Operating Support</td>
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<tr>
<td>ActCo</td>
<td>Support Chain Management</td>
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<td></td>
<td>Logistics Management</td>
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<tr>
<td>MilSupp2</td>
<td>Integrated Systems Solutions</td>
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<td></td>
<td>Contractor Logistics Support</td>
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<tr>
<td></td>
<td>Integrated Operating Support</td>
</tr>
<tr>
<td>EngCo2</td>
<td>Total Care Agreements</td>
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<td></td>
<td>Equipment Health Monitoring</td>
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<td></td>
<td>In-service Support</td>
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<td></td>
<td>Inventory Management</td>
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<td></td>
<td>Flight Hour Agreements</td>
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</tbody>
</table>

Source: Interview data supplemented by publicly available information.

Despite a concerted effort by the participating companies to embrace through-life management, or at least develop advanced services, it is recognised that different solutions are required for different customers. The aerospace industry expects to
continue to support two different business models into the future – on the one hand, moving increasingly to a through-life management approach and, on the other, maintaining traditional business models for those customers that prefer it and for mature or legacy equipment. It is believed that traditional business models are appropriate for mature or legacy products as their behaviour and cost patterns are well understood. In addition, respondents with airline customers suggest that certain airlines cannot afford to do business using a total service or through-life approach. With regard to the military market, it is likely that different business models will also be employed for the UK MoD customer and for foreign customers. However, it is believed that all customers will benefit, either directly or indirectly, from the enhancements to traditional services and from the advanced services being developed to support through-life management.

3.3 Transition to Total Service Providers

It is evident from the stated ambitions of the aerospace companies involved in the study, the widespread promotion of the through-life management concept, and the development of business models and services to support through-life management, that a fundamental transition is underway in the aerospace industry. Oliva and Kallenberg’s (2003) process model for developing installed-base service capabilities is a valuable tool for understanding the stages of transition of the participating companies. This is shown in Figure 2.

All of the manufacturers involved in the study have engaged in support and aftermarket services for many years. In all but one case, Customer Support, Customer Services and MRO businesses operate separately from the rest of the enterprise. These entities are established as autonomous business units or as subsidiary companies which may even have to compete for business from their parent company. The preceding analysis of the drivers for through-life management, the promotion of service visions and the development of enhanced and advanced services demonstrates that aerospace manufacturers have progressed through Stages 1 and 2 of this model.
1. Consolidating product-related services

<table>
<thead>
<tr>
<th>Triggers</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Customer complaints</td>
<td>• Move services under one roof</td>
</tr>
<tr>
<td>• Competition</td>
<td>• Monitor effectiveness and efficiency of service delivery</td>
</tr>
<tr>
<td>Goals</td>
<td>• Add services to support quality initiative</td>
</tr>
<tr>
<td>• Improve efficiency, quality and delivery time</td>
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2. Entering the installed-base service market

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<thead>
<tr>
<th>Triggers</th>
<th>Goals</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Profitability potential</td>
<td>• Tap the revenues in the installed-base service market</td>
<td>• Definition and analysis of the installed-base market</td>
</tr>
<tr>
<td>• Competition</td>
<td></td>
<td>• Create separate organisation to market and deliver services</td>
</tr>
<tr>
<td>• Customer satisfaction</td>
<td></td>
<td>• Create infrastructure to respond to local service demands</td>
</tr>
<tr>
<td>• Management change</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3a. Expanding to relationship-based services

<table>
<thead>
<tr>
<th>Triggers</th>
<th>Goals</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Customer request</td>
<td>• Increase utilisation of service infrastructure</td>
<td>• Assume operating risk: pricing in terms of availability</td>
</tr>
<tr>
<td>• Utilisation of service infrastructure</td>
<td></td>
<td>• Achieve cost advantage through: economies of scale, learning curve, network effects</td>
</tr>
</tbody>
</table>

3b. Expanding to process-centred services

<table>
<thead>
<tr>
<th>Triggers</th>
<th>Goals</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Customer request</td>
<td>• Increase utilisation of product development and integration capabilities</td>
<td>• Develop consulting capability</td>
</tr>
<tr>
<td>• Utilisation of product development skills</td>
<td></td>
<td>• Create new distribution network</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Expanding to include other manufacturer’s products</td>
</tr>
</tbody>
</table>

4. Taking over the end-user’s operation

<table>
<thead>
<tr>
<th>Triggers</th>
<th>Goals</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>• ????</td>
<td>• ????</td>
<td>• ????</td>
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</tbody>
</table>
The focus for aerospace manufacturers in recent years has been on Stage 3 of the model which requires changing the focus from transactional to relationship-based services and from product-centred to process-centred services. With regard to switching from transactional-based services to relationship-based services, this involves, for example, moving from time and materials to fixed price contracts covering all services over a fixed period. Maintenance contracts begin to be priced in terms of operational availability and response time in case of failure, with the service provider assuming the risk of equipment failure. Close relationships are required between customer and service provider due to the need for high levels of data sharing. The key incentive for end-users to engage in such contracts is higher equipment availability. For the provider, profitability depends on accurate risk assessment.

Within the aerospace industry, it is clear from this study that all of the companies involved are enhancing their traditional services and underpinning them with new business models based on fixed price contracting and contracting for availability. Relationships have always been important within the aerospace industry due to the complex nature of aerospace equipment. However, the development of even closer relationships of trust between operators, manufacturers, service providers and associated supply chains is becoming increasingly important with the development of enhanced services and the shift to through-life management.

The other dimension of Stage 3 is the move from product-centred services to process-centred services. Essentially, this involves closely aligning with customer requirements and understanding how advanced services can add value to the customer’s processes. This study reveals that the majority of the companies involved in the study are focusing heavily on providing comprehensive through-life customer solutions which combine products, traditional services and advanced services. It is not possible for all of the companies to deliver such a comprehensive offering due to their position within the supply chain or within their corporate group. However, all companies recognise the need to engage in partnerships and networks aimed at proving through-life customer solutions.
The through-life management concept requires expansion into Stage 4, where the manufacturer or service provider assumes operating risk and takes entire responsibility for the end-user’s process. Oliva and Kallenberg (2003) suggest that this is “largely uncharted territory for manufacturers in most industries” (p170). This is, however, what several major aerospace manufacturers are currently undertaking. For example, Integrated Operating Support and Contractor Logistics Support contracts being introduced by the UK Ministry of Defence involve contractors, either manufacturers or independent support organisations, moving forward into their customer’s operations and taking responsibility for activities that would have been previously done by the customer. This enables the support provider to better understand the product operating environment and customer processes, thereby providing integrated customer value over the product life-cycle and identifying opportunities to reduce cost of ownership. Other examples include manufacturers and support providers taking responsibility for their customers’ engineering processes, maintenance planning and information systems for asset management.

3.4 Factors Affecting Transition

This study indicates that the aerospace industry as a whole is at Stage 3 of the model, expanding both relationship-based and process-centred services, with a small number of large manufacturers and support providers moving to Stage 4, assuming responsibility for end-user processes. One respondent argues that all of the aerospace manufacturers are improving their service levels at same rate and, therefore, no benchmark company exists. To some extent, this is true as all are facing similar customer demands, all are responding by developing value-added services, deploying process improvement initiatives and re-aligning their organisations to support the transition. However, this study reveals that the companies are not all in the same position with regard to their ability to actually deliver through-life management solutions. There are differences among the companies with respect to the sophistication of the communication of their through-life management service visions, the level of business that is currently based on the through-life concept and the maturity of lean implementation to deliver through-life value to the customer.
3.4.1 Communicating the Through-life Service Vision
Some of the companies are hugely pro-active in promoting a service culture, with their internal actions mirroring their publicly stated ambitions. One of the companies, for example, has embraced the through-life concept with conviction and is actively implementing a service strategy. This message is being effectively communicated both externally and internally. The company has a highly sophisticated web-site and all its advertising material promotes total service solutions. This is matched internally by a training programme aimed at introducing service theory and knowledge. This is further reinforced by recruitment policies which emphasise service skills.

For others, however, the approach is more one of reaction to customer demand for change and there appears to be confusion with regard to the design of service processes to deliver customer value in this new environment. Take the case of one of the manufacturers participating in this study. The manufacturer’s primary customer is exerting significant pressure with regard to the adoption of through-life management. The manufacturer is making efforts to respond positively and realign its processes to deliver customer value. Internally, the Customer Support organisation has increased communications to promote the through-life message and has begun to adopt lean tools and techniques. However, there does not appear to be a consistent, enterprise-level drive for the adoption of a service strategy to support through-life management. This lack of integration and focus appears to be making it difficult for Customer Support employees to design appropriate service processes and to envisage delivering services in a new way. In addition, there is no strong evidence that the through-life message is being promoted externally by the company.

3.4.2 The Level of Business Conducted under Through-life-type Contracts
There are different levels of business being conducted through the use of through-life-type contracts. Through-life and integrated support contracts are currently in place only on a limited number of aerospace programmes. However, it is expected that the through-life approach will continue to extend to other programmes in the future as new equipment comes on stream. For one company, over 50% of its revenues are generated from aftermarket services, a significant proportion of which are being conducted under through-life-type contracts. The company also has a
policy that agreements evolving towards a full through-life approach will be used where possible with respect to the sale of new equipment. Another company states that 20% of its Customer Services revenue is generated from performance-based logistics contracts.

3.4.3 Maturity of Lean Implementation

The move to a through-life management business model and the accompanying service developments requires a new approach to service delivery by aerospace manufacturers. This study shows that the extension of lean principles beyond manufacturing to encompass Customer Support and MRO activities is the primary route that aerospace manufacturers are taking to enhance the delivery of value to the customer. All of the companies involved in the study are adopting lean principles and practices, with one respondent emphasising that lean is “an essential part of the move to an integrated service business”. In general, lean practices have been widely applied to manufacturing activities. Due to the close parallels between manufacturing and MRO activities, lean principles have also been successfully applied to maintenance and repair. Developments with respect to the application of lean principles to Customer Support are less advanced. This will be further discussed in Section 4: Process Excellence in Customer Support and MRO.

3.5 The Increasing Strategic Importance of Customer Support and MRO

It is clear from this study that aerospace companies are moving to embrace service orientation to support through-life management concept. Service visions and ambitions are being matched by enhancements to traditional services and the development of enhanced services. Consequently, new business models are evolving to underpin these advances.

Although all the firms in the study have been providing services for many years, the service element is becoming increasingly important in the light of the through-life management concept. As part of enterprise-wide efforts to adopt through-life management and increase service orientation, it is vital that Customer Support and MRO businesses re-evaluate service design and delivery processes in order to address some of the current challenges and provide seamless customer value in this
new environment. Section 4 examines the process excellence requirements for Customer Support and MRO businesses.
Section 4: Process Excellence in Customer Support & MRO

The adoption of through-life management highlights the strategic importance of Customer Support and MRO activities. Through-life customer solutions require the alignment of Customer Support and MRO strategies with engineering and manufacturing strategies. Consequently, the business models underpinning the Customer Support and MRO activities of aerospace manufacturers are currently evolving to support through-life strategies. For the future, it is clear that Customer Support and MRO activities will need to be delivered differently than in the past.

This section highlights the value of the aerospace Customer Support and MRO markets. This is followed by an overview of the key elements of Customer Support, including MRO. Subsequently, the process improvement challenges facing Customer Support and MRO businesses as they become increasingly integrated into through-life solutions are examined. Finally, this section discusses the impact that complex organisational and group structures may have on the successful adoption of through-life management.

4.1 The Value of Customer Support and MRO Business

It is very difficult to estimate how much total Customer Support business is worth to the aerospace industry. Even at the corporate level, it is difficult to isolate support activities and services within company and group accounts. In addition, it may be the case that certain support services are included with the sale of new equipment and not charged for separately.

However, given that MRO represents a significant element of Customer Support activity and there are detailed statistics available with respect to MRO, an analysis of the available MRO market provides some indication of the contribution of support and services to the total revenues of aerospace companies. Aerostrategy (2005) has produced estimates for the size of the current MRO market, both military and commercial. These are shown in Table 3 below.
The MRO market available to the aerospace sector therefore currently exceeds $40 billion worldwide. However, it is difficult to obtain figures showing the market share for aerospace OEMs. With regard to the military MRO market, it is estimated that in the US less than 20% is outsourced to the private sector (Rosenberg, 2004). However, this is expected to grow in the future. In Europe, the majority of component-level, system-level and military engine MRO is conducted by OEMs and independent contractors (AeroStrategy, 2005).

The level of defence spending is a further indicator of the significance of Customer Support business. AeroStrategy (2005) claims that global defence spending is in the region of $1,109 billion, with “Operations, maintenance and personnel expenses/Logistics” representing 70%, or $776 billion, of the total. Figures available from the UK Ministry of Defence show that the Defence Logistics Organisation expects total costs for the 2004/2005 period to equal £8.6 billion (approx. $14.5 billion) (www.mod.uk/dpa).

These statistics demonstrate the significant size of Customer Support and MRO activities and it appears certain that aerospace manufacturers will become more heavily involved in service provision in the future. It is important, therefore, to understand the key elements of Customer Support, including MRO, and to address the challenges facing organisations as they move to the provision of support and services as part of integrated customer solutions.
4.2 The Elements of Customer Support

Customer support is traditionally viewed as all the activities conducted during a product’s in-service phase, ensuring that the product can remain operational over its life-cycle. Goffin (1999) identifies seven key elements of customer support:

1. Installation
2. User training
3. Documentation
4. MRO/ spares
5. On-line support
6. Warranty
7. Upgrades

Table 4 illustrates how these elements translate to the aerospace environment.

Many of these activities may be done within the one organisation. However, it is much more likely that high levels of co-operation are required between different entities, be they divisions within a large manufacturing company, other companies within a group of companies, other OEMs or other independent service providers. As a result, complex inter-dependencies, interactions and supply chains already exist to deliver Customer Support and MRO services. The further integration of these activities to support a through-life approach, in alignment with engineering and manufacturing strategies, represents a significant challenge.
### Table 4: The Key Elements of Customer Support

<table>
<thead>
<tr>
<th>Element</th>
<th>Aerospace Perspective</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Installation</td>
<td>At the aircraft level, this refers to entry-into-service with the aircraft operator. Below the aircraft level, this element equates to the integration of components and sub-systems into larger systems and aircraft assemblies.</td>
</tr>
<tr>
<td>2. User training</td>
<td>Due to the highly complex nature of aerospace products, most companies have developed sophisticated customer training capabilities as part of their customer support offerings.</td>
</tr>
<tr>
<td>3. Documentation</td>
<td>The high degree of regulation in the aerospace industry requires the production of detailed documentation related to the operation and maintenance of aerospace equipment and aircraft. As a result, the production and updating of technical publications, including flight manuals, maintenance manuals and service bulletins, is a key element of customer support.</td>
</tr>
<tr>
<td>4. MRO/Spares</td>
<td>Maintenance, repair and overhaul activities represent a significant element of customer support for aerospace companies, particularly considering the long life-cycle of aerospace products and the safety critical nature of many aerospace components. Spares business is also hugely important, both with regard to supporting aircraft operators and the MRO supply chain.</td>
</tr>
<tr>
<td>5. On-line Support</td>
<td>The complex nature of aerospace equipment, the vast array of parts, variants and specifications, in addition to the geographic dispersion of aircraft operators, requires comprehensive technical and engineering support. Aircraft manufacturers and independent service and support providers often co-locate personnel within the customer organisation to provide on-site support, as well as establishing spare parts and MRO facilities and teams of field service engineers around the world. Furthermore, aerospace companies provide technical assistance via telephone and are increasingly developing sophisticated web-based databases to provide technical data to the customer.</td>
</tr>
<tr>
<td>6. Warranty</td>
<td>Warranties in the aerospace industry are extremely complex. For commercial aircraft, there may be hundreds of warranties covering aircraft structure, engines, avionics and many other aircraft components (Warranty Week, 2004). The move towards through-life management, with the introduction of flight hour agreements and total service contracts, will make warranty claims unnecessary.</td>
</tr>
<tr>
<td>7. Upgrades</td>
<td>Due to the long product life-cycles that characterise aerospace products, there are often requirements to upgrade aircraft, systems and components. In addition, airworthiness and safety concerns may require modifications to be carried out. Furthermore, aircraft may be converted for use in other roles.</td>
</tr>
</tbody>
</table>

4.3 Process Excellence Issues for Customer Support and MRO

The challenges facing Customer Support and MRO businesses are acting as a catalyst for the re-evaluation and re-design of the processes by which such services are delivered. This study identifies three elements of process excellence for Customer Support and MRO. These are: (1) Lean thinking as applied within Customer Support and MRO environments, (2) Services management, and (3)
Information systems to support through-life management. Each of these three elements will now be discussed in more detail.

4.3.1 Lean Thinking in Customer Support and MRO Environments

As discussed in Section 3.4.3 above, the extension of lean principles and practices to Customer Support and MRO activities is the primary mechanism being used by aerospace companies to improve the delivery of total customer solutions. All of the companies participating in the study, whether manufacturers, support contractors or service providers, have embraced lean ideas. However, the study reveals that the companies differ with regard to the extent of lean implementation.

For the participating companies that have MRO businesses or are MRO service providers, there has been a trend towards the adoption of lean over the past ten years. There has been a particularly noticeable increase in the introduction of lean practices in the MRO environment during the past five years. For the majority of respondents, this was the result of extending lean beyond the manufacturing shop floor. Although many of the respondents suggested that lean tools and techniques needed to be adapted for the MRO environment, there was clear evidence that lean had been employed successfully. There was widespread use of tools such as Value Stream Mapping, 5S, kaizen activities and workplace organisation. The primary focus for lean MRO is delivery, with companies emphasising responsiveness, turnaround times and throughput times. For one company, this is specifically linked to supporting its OEM parent company in the provision of integrated support to aircraft operators. Cost reduction is another key driver. In addition, process improvement and the adoption of lean practices are seen as ways of growing the business. For example, at the time of the study, two of the companies were in the process of establishing new MRO facilities designed on the basis of lean principles.

The study highlighted a number of obstacles to the introduction of lean ideas to the MRO environment. Although the companies successfully adapted lean tools and techniques for their unique situations, the respondents suggest that initial implementation difficulties stemmed from the fact that there was no lean literature or training material available which focused on lean in MRO. Consequently, lean was viewed by employees as a “manufacturing philosophy”. In addition, repair and
overhaul processes are not as standardised as manufacturing processes. Other obstacles included resistance to change, particularly where an older workforce was involved, and mis-alignment of improvement initiatives across enterprises. However, these obstacles were not seen as being peculiar to the MRO environment but rather as general change management challenges.

For the Customer Support businesses of OEMs and for independent support contractors, it appears that lean implementation is proving more difficult. For example, in the case of one large aerospace OEM, FlyCo, lean ideas have been adopted by the manufacturing part of the business over many years. In addition, its subsidiary company, TransCo, which manufactures, maintains and repairs critical components, has adopted lean practices across both manufacturing and MRO activities. However, FlyCo’s Customer Support business is only now seeking to adopt lean ideas, driven by the military customer’s requirement for Integrated Operating Support and senior management’s request for it to “raise its lean capability” in line with the rest of the enterprise.

The key challenge with respect to the introduction of lean in a Customer Support environment appears to be related to the non-standard, highly customised processes that exist to match individual customer requirements. Respondents suggest that this makes it difficult to make waste visible, to introduce common systems and to measure productivity and performance. In addition, it has been argued that the application of lean in Customer Support is in many ways dependent on the customer also being willing to adopt lean processes. Again, similarly to MRO, the lack of lean training material specific to Customer Support is seen as a serious obstacle.

4.3.2 Services Management
The non-standard processes of Customer Support and MRO businesses are evidently presenting difficult challenges with regard to the introduction of lean ideas in those areas. However, for aerospace companies to compete effectively in this arena, there is a need to address performance improvement and customer service issues in Customer Support and MRO to match the evolution of through-life management and the development of advanced, integrated service offerings. The services management literature provides a valuable source of knowledge. Services
management has developed over the past 20 years in order to provide specific
guidance on marketing and operations to service industries. The basic underlying
premise of services management is that products and services are different and,
thus, require a different marketing and operational approach. Services are viewed as
having unique characteristics, including intangibility, inseparability, variability and
perishability (Zeithaml et al, 1985). Although Section 3 clearly demonstrates that
aerospace companies are promoting service strategies, developing their service
businesses and, in some cases, training employees in service skills, there is little
evidence that the participating companies are implementing well-established service
methodologies.

It can argued that with regard to through-life management maintaining a distinction
between products and services is not very helpful as providing an integrated
customer solution requires a complex mix of products and services with a consistent
approach to marketing and operations across the enterprise. However, many of the
tools, techniques and frameworks of services management have the potential to
make a valuable contribution to service and support parts of aerospace businesses
in their efforts to transform to the through-life approach. What aerospace companies
must ensure is that this is done in alignment with enterprise level change initiatives.

One of the key contributions of the services marketing literature is the concept of
Service Quality (Parasuraman et al, 1985; Gronroos, 1990). It is more difficult for
customers to evaluate their experience of services due to their intangible nature. In
addition, outputs are more difficult to control in a service environment as a result of
high variability, high levels of interaction, inter-functional dependencies and a
general lack of good service design. The Service Quality concept proposes that a
customer’s perception of service quality is based on the difference between their
expectations of a service and the actual quality of the service delivered. Therefore,
managing customer expectations represents an important part of Service Quality
(Gummesson, 1991).

There are two useful tools which can be used to measure and manage Service
Quality. The first is Gap Analysis which is a useful diagnosis tool to identify how gaps
between the company’s perspective and the customer’s perspective of service
quality arise (Parasuraman et al, 1985). Secondly, the SERVQUAL tool can be used to measure specific dimensions of service quality (Parasuraman et al, 1985; 1988).

Gap Analysis (see Table 5 below) proposes that the ultimate gap between customer expectations and perceived service (Gap 5) is a result of a number of gaps within the organisation (Gaps 1-4). Table 5 explains the nature of these gaps in more detail.

### Table 5: Gap Analysis

<table>
<thead>
<tr>
<th>Company Perspective</th>
<th>Market Intelligence Gap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gap 1</td>
<td>This is the gap between consumer expectations and management’s perception of those expectations. This may come about as the result of a company assuming it knows what the customer wants. In addition, poor internal communications may prevent customer requirements from being communicated effectively to the part of the business responsible for service design and delivery.</td>
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<table>
<thead>
<tr>
<th>Service Design Gap</th>
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<tr>
<td>Gap 2</td>
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<table>
<thead>
<tr>
<th>Production Gap</th>
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<tbody>
<tr>
<td>Gap 3</td>
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<table>
<thead>
<tr>
<th>Perceptual Gap</th>
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<tr>
<td>Gap 4</td>
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<table>
<thead>
<tr>
<th>Customer Perspective</th>
<th>Satisfaction Gap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gap 5</td>
<td>This is the gap between customer expectations and the customer’s perception of the service they received. This gap may be caused by any or all of the above internal gaps.</td>
</tr>
</tbody>
</table>


SERVQUAL is a tool that was subsequently developed to measure specific dimensions of Service Quality. The dimensions most commonly used are Reliability, Assurance, Tangibles, Empathy and Responsiveness (RATER).
- **Reliability** – this refers to the ability of the provider to perform the promised service dependably and accurately. Essentially, this means conformance to specification.

- **Assurance** – customers should be able to have trust and confidence in those delivering the service. Professional competence must be demonstrated to customers.

- **Tangibles** – these are any physical features which accompany a service, e.g., reports, communications materials, office environment etc. These represent indicators of professional competence.

- **Empathy** – this involves the provision of caring, individualised attention to customers. It implies treating customers as individual clients and being concerned with their longer-term interests.

- **Responsiveness** – this is the ability to react positively and in a timely time to customer requests and requirements. It requires flexibility.

In the context of this study, both Gap Analysis and the use of the SERVQUAL tool may help aerospace companies to assess the performance of Customer Support and MRO businesses. The concept of Service Quality also aligns with the emphasis on quality and customer focus within lean initiatives and so will complement, rather than conflict, with enterprise-level objectives.

In terms of service operations, the focus is on service design, service processes and service delivery. In many respects, service operations has been derived from production operations (Bowen and Youngdahl, 1998) and, therefore, Customer Support and MRO businesses can learn from the lean implementation experiences of their manufacturing colleagues. For example, service blue-printing, i.e. the mapping out of service processes to improve service design, equates to Value Stream Mapping. The transfer of lean practices, tools and techniques to the service businesses of aerospace companies will enable a common approach to operations to emerge, one that is equally valid for both products and services. This in turn will support evolving through-life management approaches.

A common approach across Engineering, Manufacturing and Support, and indeed across extended enterprises, is desired by the companies participating in the study.
The respondents recognise that customer awareness and a service culture are required throughout their enterprises, with the “voice of the customer heard by all”. It is also acknowledged that people with a broader range of skills and “the ability to see big picture” are needed to achieve service visions and support through-life management into the future. For example, several of the participating companies are now wishing to employ Value Chain Managers, Supply Chain Engineers and Logistics Engineers who will focus on the total supply chain and the flow of materials through the chain.

4.3.3 Information Systems to Support Through-life Management
The development of information systems to support advanced services, through-life contracts and Design for Supportability is a key issue facing aerospace companies. The design of new processes to deliver integrated through-life solutions requires parallel investment in information technology.

The move towards through-life management and the development of advanced services, such as equipment health monitoring, requires significantly higher levels of data sharing between customers, manufacturers and service providers. Contracts based on availability targets need detailed reliability, failure and usage data. Support chain management and integrated logistics support also require access to customer inventory data. However, respondents admit that data and knowledge sharing, whether within their own organisations or with customers and suppliers, could be improved.

One of the participating companies has introduced a Customer Relationship Management system to eliminate waste, increase visibility and provide easy access to all communications with customers. While this has been a positive improvement for that individual company, the respondent believed that further benefits could be derived from the more widespread use of such systems throughout the industry. Another respondent advocates the use of document management systems in the MRO environment to address the issues that arise due to non-standard repair processes and to achieve significant cost savings.
Through-life management will also require information systems that enable Design for Supportability and Maintainability. A number of respondents acknowledge that it is currently difficult for Customer Support and MRO businesses to feed back data to inform new design and future products. However, it is viewed as an important issue which the participating companies are seeking to address.

4.4 Organisational Structure to Support Through-life Management

The complex organisational and group structures of the participating companies appear to be a potential barrier to the seamless delivery of services and support to the customer. All of the companies participating in the study have different organisational and group structures, with different divisions providing elements of the overall customer solution. This is the result of factors such as ownership profile, geographic location and history. In most cases, individual aerospace companies are not in a position to deliver entire through-life solutions independently. Where partnering is required with other companies within a group, other manufacturers or independent MRO and support providers, some of whom may be competitor organisations, an extremely complex picture emerges.

Even within large organisations, Customer Support and MRO parts of the business are usually heavily reliant on their own engineering and manufacturing businesses for the provision of spare parts and technical information. This can cause problems because Customer Support requirements are not a priority within the Manufacturing business, often resulting in long lead times for spare parts. Apart from the fact that Customer Support and MRO businesses depend on their OE businesses for the supply of spare parts, they often are not in a position to deal directly with other suppliers. For a number of the participating companies, the Procurement function will deal directly with suppliers and the Customer Support organisation in turn deals with the Procurement function. This has significant logistics and cost implications, particularly where the OE business is located in a different country. It is evident, therefore, that where the part of the business that is actually delivering services or support is different to the part of the business acting as the interface to customers and suppliers, conflict, delays and inefficiencies can be the result.
An additional challenge is the different terminology used by different companies. For example, in one company, Customer Support may primarily be comprised of MRO activity. In another, MRO may represent a very small proportion of Customer Support activity. As a result, it may be outsourced and may not even be considered to be part of the Support offering.

An overview of the situation of one of the participating companies illustrates the levels of complexity involved and its impact on the effective delivery of through-life management. The company in question, ServCo, forms part of a large international group of companies. ServCo provides MRO and Customer Services for the products of three of the OEM companies within the aerospace equipment business of the group. It was established as a stand-alone entity within the group fifteen years ago. ServCo deals directly with the aircraft operators with regard to aftermarket services including spares, customer support, AOG\(^3\) situations, MRO and logistics. In addition, the three OEM businesses all have Customer Support functions which interact with the aircraft manufacturers. ServCo runs its MRO and Customer Services businesses separately. However, it is currently considering integrating the Customer Services part of the business back into the OEM companies to ensure the development of close relationships with aircraft manufacturers and to enhance its global geographic support infrastructure. Adding to the complexity is the fact that ServCo must compete for business from the OEM companies within its group while simultaneously relying heavily on the OE business for spare parts supply and technical data.

This complex set-up has significant implications for both through-life management and process improvement. For example, at the group level, there is an improvement initiative in place. However, due to the autonomous nature of the companies within the group, this initiative is not believed to be have been effectively deployed, with individual companies deciding on their own improvement direction. In addition, ServCo claims that the OEM businesses it supports are not promoting a through-life approach and continue to view MRO activities in the traditional way. The fact that ServCo is a separate entity which must compete for work from the OE business reinforces the traditional business model rather than supporting through-life management. ServCo suggests that as other aerospace manufacturers adopt the

\(^3\) Aircraft-on-Ground
through-life approach, its group’s OEMs will be forced to follow suit. However, this will be a reactive strategy rather than proactive through-life service development. Despite the fact that ServCo is not in a strong position to influence through-life management within its group, it itself is being innovative with regard to the services it provides. For example, it has developed preventative maintenance and spares inclusive contracts. In addition, it has added new capability to provide additional services and is seeking opportunities for 3rd party business.

Complex organisational and group structures like this are a common feature within the aerospace industry. However, the resulting web of interactions - financial, commercial, technical, logistical etc – is likely to make the design of effective Customer Support and MRO processes and the seamless delivery of through-life management very difficult.

4.5 The Process Excellence Challenge for Customer Support and MRO

Customer Support and MRO activity is hugely important within the aerospace industry, generating significant revenues. The move to through-life management solutions implies that aerospace manufacturers will increase their market shares for services in the future. The integration of Customer Support and MRO within through-life solutions requires enhanced processes for the design and delivery of Customer Support and MRO services. The process excellence challenges facing Customer Support and MRO businesses include the adoption of lean practices, the complementary use of service management tools and the development of information technology and systems to underpin the new business operating environment. In addition, organisational design represents a significant challenge that must be addressed if process excellence is to be effective and, ultimately, if through-life management is to be successful.
Section 5: Conclusions and Recommendations

The UK Lean Aerospace Initiative (UK LAI) supports the Aerospace Innovation and Growth Team (AeIGT)’s vision with regard to the development of world-leading capabilities in the provision of through-life customer solutions. The UK LAI, in particular, is the vehicle through which the AeIGT’s process excellence objectives are to be achieved. In light of the adoption of the through-life management concept throughout the industry, the need for the extension of performance improvement and process excellence initiatives to the in-service support phase of the life-cycle becomes increasingly clear.

Consequently, this exploratory study was conducted to provide an in-depth understanding of the industry-wide shift to a through-life management approach, how individual companies are implementing through-life strategies, business models and services, and what changes are required within Customer Support and MRO businesses as a result. The report has identified the drivers for through-life management in the aerospace industry and provided an insight into the increased strategic importance of services to aerospace manufacturers. It has also assessed the transition of aerospace companies to through-life total-service providers and highlighted the process excellence challenges for Customer Support and MRO businesses. This section outlines the key conclusions from the study and makes recommendations regarding the appropriate way forward for the aerospace industry.

5.1 Key Conclusions

A number of key conclusions can be drawn from this exploratory study. It is evident that the aerospace industry is experiencing a period of fundamental change as a result of its transition to through-life management, an increased emphasis on service orientation and the provision of integrated, long-term customer value. The through-life management concept is acting as a catalyst for innovative, value-added service developments, the promotion of service visions and the adoption of service strategies. The lack of a commonly agreed definition of through-life management does not appear to be inhibiting its adoption in practice. This study has demonstrated that all of the participating companies are aiming at transitioning to total service
providers in support of through-life solutions, as appropriate for their unique situations.

Three key drivers of through-life management have been identified – (1) customer demand, (2) increased revenues, and (3) increased competitiveness. While all aerospace companies are exposed to the drivers of through-life management, there is evidence that individual companies are in different positions with regard to their ability to effectively deliver through-life customer solutions. This ability to deliver is influenced by whether or not the company is responding proactively or reactively to customer demands, by their maturity with respect to the implementation of process improvement or lean initiatives, particularly within their service and support businesses, and by the complexity of their organisational and group structures.

As part of enterprise-wide efforts to adopt through-life management and increase service orientation, it is vital that Customer Support and MRO businesses re-evaluate service design and delivery processes in order to provide seamless customer value in this new environment. The process excellence challenges facing Customer Support and MRO businesses include the adoption of lean practices, the complementary use of service management tools and the development of information technology and systems to underpin the new business operating environment. This report concludes that there are significant process improvement opportunities within the Customer Support and MRO environments. Although a lean approach has been successfully transferred to MRO businesses, its implementation has been slower and more difficult in Customer Support businesses. In addition, there is no evidence to suggest that service tools, such as Gap Analysis and SERVQUAL, have been adopted to complement lean activities in service environments. Furthermore, current information systems do not appear to align with the requirements of the advanced services being developed for through-life management. Organisational design also represents a significant challenge that must be addressed if process excellence is to be effective.

The shift to through-life management also has widespread implications for intra-organisational and inter-organisational relationships. The provision of seamless through-life customer solutions depends heavily on collaboration, co-ordination and
co-operation between different parts of an enterprise, different companies within a group, other manufacturers, support contractors, service providers and all their respective supply chains. Consequently, the creation of highly integrated networks, the establishment of genuine partnering arrangements and the strengthening of relationships of trust are crucial to underpin the ultimate delivery of through-life customer solutions.

5.2 Recommendations

This report has highlighted the substantial challenges facing aerospace companies, and in particular Customer Support and MRO businesses, in the light of through-life management. The following recommendations are proposed as a way forward for the aerospace sector in its efforts to address these challenges.

1. The Extension of Lean Thinking to Customer Support and MRO

The UK Lean Aerospace Initiative (UK LAI) has been promoting lean principles and practices throughout the aerospace industry for many years. In parallel, many aerospace companies, including all of the participants in this study, have been implementing lean ideas. However, the UK LAI has primarily focused to date on the adoption of lean practices in Manufacturing and, more recently, in Engineering. This is mirrored in aerospace companies, where lean ideas have either not been adopted or have been more difficult to implement in Customer Support environments. Although lean has proved successful in MRO businesses, specific tools and techniques have had to be adapted for use in that arena. Consequently, it is recommended that:

- existing UK LAI guidelines and training materials are translated for use in Customer Support and MRO organisations.
- Customer Support and MRO-specific case studies and lean training materials are developed. Again, it is possible for this to be done under the auspices of the UK LAI, in partnership with individual aerospace companies and other interested parties, e.g. the Society of British Aerospace Companies (SBAC)’s MRO & Logistics Member Network.
- an increased number of Customer Support and MRO personnel from UK LAI member companies become more heavily engaged in UK LAI
activities. This can be achieved partly through SBAC promotional activities, the wider communication of UK LAI activities among relevant SBAC committees and the hosting of events of interest to Customer Support and MRO personnel. However, this should be reinforced by improvements in the transfer of lean knowledge within UK LAI member companies.

2. The Strengthening of Services Management and Customer Service Skills

The development of innovative and advanced services to support through-life management requires the parallel development of skills and capabilities in the areas of service design, service delivery, service quality and customer service. The service philosophy, while particularly important in Customer Support and MRO businesses, needs to be embraced throughout entire enterprises in order to support through-life management. It is, therefore, important that service skills are aligned with enterprise-level initiatives, including lean activities, to achieve overall enterprise goals. This report recommends that:

- individual aerospace companies place an emphasis on training and skills development in the areas of services management, service design, service quality and customer service. The need for skills development in this area should also be recognised and addressed by the SBAC’s Skills and People Management Board.
- the UK LAI investigates the compatibility of lean and service management ideas. In addition, it would be valuable for the UK LAI to conduct pilot activities to demonstrate the appropriateness of Gap Analysis and SERVQUAL in aerospace Customer Support and MRO environments.
- previous UK LAI research in the area of performance measurement be used as a foundation for developing appropriate methods to measure performance in the Customer Support environment (potentially integrated with the SERVQUAL methodology).
3. The Development of Information Technology and Systems that Support Through-life Management

The advanced services and the business models underpinning through-life management require the development of appropriate information technology and systems. For example, sophisticated cost modelling and forecasting abilities are needed for the development of flight hour agreements and for risk management purposes. In addition, accurate reliability and equipment usage data are required for advanced services such as equipment health monitoring and support chain management. Furthermore, Design for Supportability and Maintainability efforts will rely on access to such data as well. Consequently, higher levels of data-sharing between customers, service providers and internal organisational divisions will be required than ever before. This report recommends that:

- a more detailed investigation of the information technology and systems requirements to support through-life management is conducted. Responsibility for this should be assigned to the most appropriate SBAC committee.

4. The Re-evaluation of Organisational Design for Seamless Through-life Solution Delivery

Complex organisational and group structures are a common feature within the aerospace industry. Consequently, the intricate web of interactions required to deliver through-life solutions may result in inefficiencies, duplication of effort and ineffective processes. Some of these issues may be addressed by the adoption of lean thinking and the introduction of services management tools and techniques. However, it is important that the issue of organisational design, both internally and throughout extended enterprises, is addressed specifically in order to ensure that the organisational structure aligns with proposed through-life solution delivery processes. This report recommends that:

- individual aerospace companies carefully consider organisational design issues when developing advanced through-life services. Work currently being conducted by the UK LAI in the area of value chain dynamics may prove a valuable source of information.
The implementation of these recommendations has the potential to speed the transition of aerospace companies to through-life service providers, create an environment conducive to successful through-life management and generate significant process improvements in Customer Support and MRO. This report has highlighted the initial steps towards making the vision of a “world-leading ability in a complete through-life service provision” a reality.
Acknowledgements

The authors would like to thank the representatives of the eleven aerospace companies that participated in this research.

The authors also gratefully acknowledge the Society of British Aerospace Companies (SBAC) and the EPSRC Innovative Manufacturing Research Centre, Grant Ref. GR/R67491/01, who have provided funding for the UK Lean Aerospace Initiative research programme.
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