Engine maintenance contracts have evolved to the point where there are five main types for airlines to choose from. Airlines have to weigh up maintaining control & expertise of engineering, against investment in their own facilities and the financial merits and predictability of each contract type.

The evolution & characteristics of engine maintenance contracts

Industry statistics show that about 80% of engines are now maintained by independent maintenance repair and overhaul (MRO) shops, or by original equipment manufacturer (OEM) shops. Airlines can choose from a range of maintenance contracts, each with its own advantages and disadvantages.

In addition, supporting engines involves several other tasks, including: engine health monitoring (EHM); engineering management; line replaceable unit (LRU) component management; spare engine provisioning; on-wing maintenance; and aircraft-on-ground (AOG) support. Like shop maintenance, these functions have all been performed in-house by a large number of airlines. The trend towards outsourcing engine maintenance by most airlines means they have to decide whether to continue performing these functions in-house, or acquire each of these from other sources.

Engine management

The objective of engine management departments with respect to maintenance is to achieve the lowest cost per engine flight hour (EFH).

Probable or possible removal intervals, in both EFH and engine flight cycles (EFC), have to be considered against the remaining life of life-limited parts (LLPs), and the variation of shop-visit workscopes with accumulated time on-wing and the related cost. Moreover, achieving the lowest cost per EFH over the long term following several successive shop visits has to be planned for, while an operator continues to put the engine through shop visits and replace LLPs with new parts. Engine management therefore has to be kept at a high level.

When the fleet of a particular type reaches the stage when large numbers are being retired, an increasing number of used engines, with differing levels of maintenance status, and with LLPs with a varying number of EFC remaining, start to become available. This can reduce the value of engines, engine modules, LLPs and turbomachinery parts to levels low enough to give airlines the option of avoiding complete shop visits and LLP replacement.

As an engine fleet ages, the fleet can implode, and a surplus of engines and related material can mean it is cheaper to buy used parts, time-continued modules and even complete engines, than to continue with a strict regime of high-level engine maintenance and installing new LLPs. Airlines that are expecting to retire engines after a small number of years, or expect their market values to decline in a few years, will place more emphasis on acquiring maintenance or used engines on an ad-hoc basis at the lowest possible cost for the remaining years of operation. This is in contrast to maintaining an engine to a consistent high level so that it can be operated for a long period, and maintain a high market value.

Besides regular, planned shop visits after removal intervals that are close to predicted removal intervals, there are also unscheduled engine removals (UERs). These interrupt the planned pattern of shop visits, and incur extra shop-visit costs. These unpredictable events can be expensive.

This issue, and the age of an operator's fleet, will influence the type of engine maintenance and support contracts best suited to an airline.

While the shop-visit maintenance of a larger portion of the engine fleet is outsourced, many airlines still monitor and analyse EHM data, and retain their engine management departments and related capabilities. They also maintain a pool of LRUs, supply spare engines, and perform on-wing maintenance.

Smaller airlines will have limited abilities to perform these ancillary functions in-house.

Retaining these abilities incurs overheads and requires a substantial investment. Outsourcing more of these functions allows airlines to divest themselves of assets and realise cash, but it also means that they will lose the long-term ability to manage engines themselves, thereby reducing their choices in the future.

The types of maintenance contract available to airlines include time-and-material, fixed price, not-to-exceed, fixed rate per hour, and integrated services.

Time & material

Time-and-material contracts are the traditional offerings of airline shops and independent MROs. The three major elements of labour, parts and sub-contract repairs are charged in the amounts that are actually used.

The main features of this type of contract are that the operator: retains engineering management control of the engine; defines the workscope; takes on the risk of the size and cost of the shop visit; and is still exposed to risk of UERs as they occur.

"The advantages for an airline are that it can negotiate volume discounts for non-routine labour and parts costs with an engine shop. It also only has to pay as shop visits occur, rather than paying constantly, as is required with other types of contract," says Carlos Ruivo, vice president of marketing and sales at TAP Maintenance & Engineering (M&E).

About 40% of the global engine fleet is maintained under time & material, fixed-price and not-to-exceed contracts. These require the airline operator to perform engineering management and workscope definition functions. This requires experience with each engine type, particularly in estimating the shop visit costs of workscopes.

"The airline also retains an up-to-date technical knowledge of an engine type, and has complete control over an engine's engineering management. This means it has control over which service bulletins (SBs) to implement, while many can be enforced in other types of contract."

TAP M&E has several customers with time-and-material contracts, including Brussels Airlines, Ural Airlines, Air Europa, TAROM, and GOL for various CFM56 models. Ruivo explains that all these airlines have their own engineering departments, and decide on engine removal timing, shop-visit workscopes, and which airworthiness directives (ADs) and SBs to implement. "With long-term time-and-material contracts we help customers define and prepare workscopes," says Ruivo. "This includes inspecting piece-parts."

The key disadvantages of time-and-material contracts are that airlines can be surprised by larger and more expensive workscopes than they expected, and also that UERs, by their very nature, happen at random. "These surprises can be big if the airline is not capable of managing engines," says Derek Paterson, director of sales for Europe and Asia at MTU Maintenance. "This makes cashflow unpredictable. This is influenced by engine age and configuration, and maintenance status."

Time-and-material contracts are used less by airlines, mainly because of the higher degree of associated risk. "There is no upper limit for the final cost of a shop visit," says Alper Akay, manager of production sales engine services at Lufthansa Technik.

Airlines operating older engine types still use time-and-material contracts, probably because they give them the freedom to determine shop-visit workscopes, and the ability to minimise costs by acquiring used parts and time-continued modules.

Craig Richardson, sales, marketing and leasing director at Total Engine Support (TES), points out that if an airline knows how its engines perform, and how to predict workscopes and their costs, then it can still make sense for airlines to use an engine management IT system such as EFPAC *(see Structuring an M&E It system for engine maintenance management, Aircraft Commerce, December 20012/January 2013, page 41)* to help manage its engines, determine the best removal intervals, and optimise costs per EFH. "It then makes sense for an airline to accrue the costs, and use time-and-material contracts for younger and current engine types," says Richardson. "If an airline has retained the in-house engineering management capability, it works out cheaper to use time-and-material contracts in the long term."

Fixed-price contracts

It is the variability and unpredictability of time-and-material maintenance contracts that led to the evolution of alternatives to time-and-material contracts. Under a fixed-price contract, the airline and the maintenance provider pre-agree a fixed price. The airline or operator still performs engineering management, and so defines the workscope.

"The workscope will be agreed between the airline and engine shop, but the shop will give feedback on the condition of the engine before committing to a price," explains Paterson.

A fixed-price contract has the attraction of simplicity, although there are exclusion clauses. "For example, there are limits on the cost of a particular set of blades in the engine's turbomachinery," says Richardson. Additional charges are incurred if the actual costs exceed this limit.

The risk of fixed-price contracts is that operators still define the shop-visit workscope, and they can give unrealistic expectations, which results in nasty surprises. If the workscope is small or insufficient, then the subsequent removal interval will be short.

The other side of the risk is that the shop visit can cost less than the pre-agreed fixed rate, so the airline can pay more than necessary.

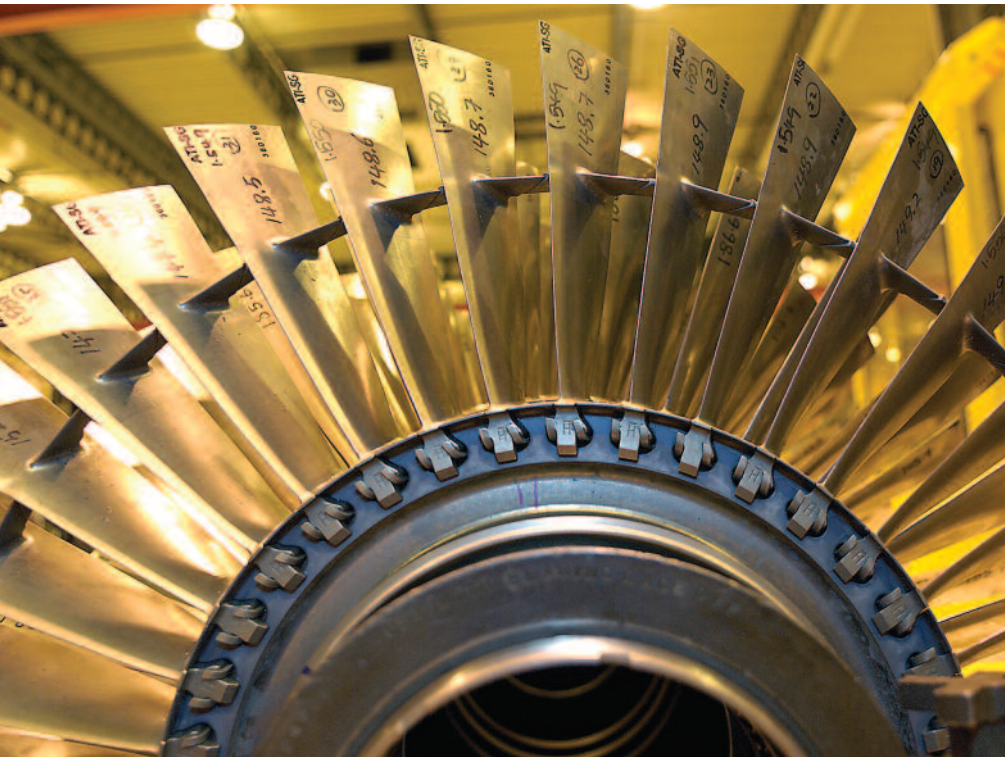
Airlines therefore need to have a lot of in-house engineering capability to minimise and manage the risks, so independent engineering consultants such as TES are good for these situations. The use of IT systems such as EFPAC is also a good management tool for such contracts, especially when estimating shop-visit costs and subsequent removal intervals.

"Fixed-price contracts are generally offered on older engines, because the engine shops know that they can acquire used material on the used market, which reduces their risk," says Richardson.

The OEM shops also offer fixed-price contracts. "We will agree a shop-visit workscope for a particular engine under a fixed-price contract," says Jim Pennito, director service programs at Pratt & Whitney (PW).

Besides regular fixed-price contracts, hybrids are also offered. GE Aviation Services offers shop-visit maintenance, plus a full range of ancillary services in its On Point portfolio. "Fixed-price contracts have exclusions, so the final price paid can be higher. We therefore also offer fixed-price-plus contracts," says Kathay MacKenzie, general manager services strategy and sales at GE Aviation. "These have fewer exclusions than the regular fixed-price contracts, so although fixed-price-plus can have a higher base cost, the chances are that the additional costs for excluded items will be lower than if a regular fixed-price contract were used."

Like time-and-material contracts,



While fixed-price and not-to-exceed contracts provide a degree of financial predictability for airlines, they still have non-exclusion clauses which can result in significant additions to the total cost of shop visits through the replacement of expensive airfoils.

fixed-price contracts are generally used more for older engine types, because operators are less focused on managing the maintenance status of engines over the long term, and concentrate more on maintaining the engine at the lowest possible cost until it retires from service.

Not-to-exceed

A variation on fixed-price contracts is not-to-exceed (NTE). NTE contracts have an upper limit or cap placed on the cost of the shop visit. The resulting cost can be lower, so the airline can sometimes pay less than with a fixed-price contract. As with fixed-price contracts, the operator performs engineering management and defines the shop visit workscope.

NTE contracts have exclusion clauses. These have the same basis as those clauses in fixed-price contracts.

"The cost of NTE contracts is traditionally about 15% lower than the fixed-price contracts, because fixed-price rates provide more risk coverage for higher shop-visit costs than a capped shop-visit cost," explains Richardson. "NTE contracts usually cover several engines, while fixed-price contracts are used more often for individual engines."

The cap on the cost of a shop visit has the advantage of reducing risk for an operator that a time-and-material contract carries. "This cap on the price means it is more attractive for an airline with a limited engine management team, and which is less able to predict shop-visit workscopes and their associated costs," says Paterson. "Airlines can still have to pay extra over the capped costs for non-exclusion items, which tends to occur more frequently with inexperienced engineering teams."

About 40% of the global engine fleet is maintained under a combination of time-and-material, fixed-price and NTE contracts.

Power-by-the-hour

Power-by-the-hour (PBH), or fixed-rate, contracts were introduced to allow airlines to pay a pre-calculated rate per EFH for engine maintenance to the maintenance provider, rather than paying a maintenance reserve for time and material, fixed price, or NTE contracts.

The rate per EFH is based on the cost of a projected series of successive shop visit workscopes being amortised over their related removal intervals. These contracts not only include planned shop visits, but also include a reserve for UERs. This provides a known and predictable engine maintenance cost, and also eases an airline's cashflow. The rate per EFH is fixed. The risk of higher-than-expected shop-visit costs is removed, and the onus of risk lies with the MRO. About 25% of the global fleet of engines is maintained under PBH-style contracts.

Fixed rates per EFH are offered by different providers with different names, but many use the term power-by-the-hour (PBH). TAP Maintenance & Engineering refers to them as maintenance-cost-per-hour (MCPH) agreements.

"We charge airlines for fixed-rate-per-hour contracts either on a monthly basis, or at the time of the shop visit," says Mackenzie.

PW calls its PBH contracts 'Fleet Management Programs' (FMP), and offers them for fleets of 10-400 engines.

Under PBH-style contracts, the airline relinquishes control of engineering management, since the maintenance provider has to determine the optimum removal intervals and shop-visit workscopes. The risk of actual costs is assumed to be higher than projected, so the maintenance provider therefore needs a lot of experience to manage PBH contracts. It still, however, requires the operator to provide it with expected and actual rates of utilisation, EFH:EFC ratios, other operating parameters, and the engine's maintenance status to be able to predict costs per EFH.

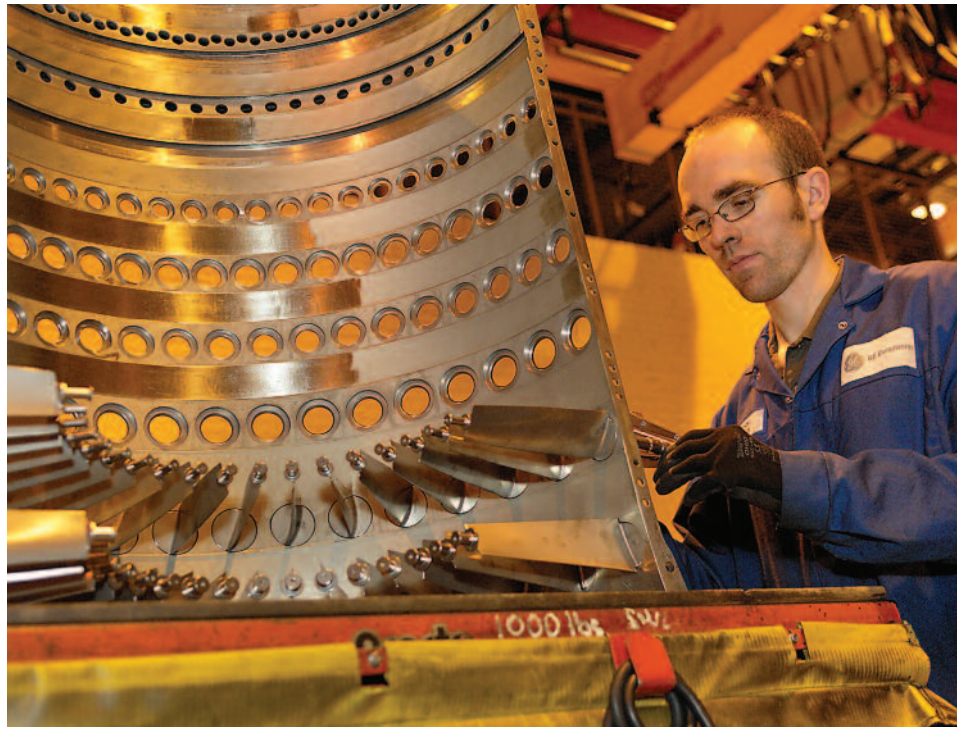
PBH-style contracts have some inherent disadvantages: they still only cover for shop-visit maintenance and engineering management; and they do not provide additional services such as spare engine and LRU component provisioning.

"Under some PBH-style contracts, airlines can pay the reserves monthly or at the time of the shop visit. Payment at the time of the shop visit is known as payment per event (PPE). Because of the very nature of these contracts, reserves have to be paid direct to the maintenance provider," explains Richardson. "This presents a problem for leased engines, whether they are spare engines or engines on leased aircraft, since lessors also want maintenance reserves, for both airframe and engines, to be paid to them. This is a typical requirement of a lease contract. This presents a conflict, since the airline is now required to pay reserves to both the maintenance provider and the lessor. This is in contrast to time-and-material, fixed-price and NTE contracts where, for leased engines, lessors require airlines to pay them the maintenance reserves. This provides funds to cover the cost of the shop visit when it comes due, and they are transferred from the lessor to the maintenance provider."

This caused problems for airlines when PBH-style contracts were introduced, since airlines ended up paying maintenance reserves twice for engines that were leased.

"This meant that regular PBH-style contracts were not an option for leased engines," says Akay at Lufthansa Technik. "This led to a need for a lease contract under which a lessor would refund the maintenance reserves to the airline after completion of the shop visit, in cases where reserves had also been paid to the maintenance provider, or

The cost per EFH of fixed-rate or power-by-the-hour contracts can be higher than an airline managing its own engines and using time & material and other contracts. Fixed-rate maintenance contracts nevertheless include an element for unscheduled engine removals and shop visits. Their regular cost per EFH provides predictability that is attractive to airline finance departments.



where the maintenance provider accepted that reserves were paid just to the lessor, which then passed them on to the maintenance provider."

One way to avoid the problem of the maintenance provider and lessor simultaneously being paid reserves is to use PPE contracts. A PBH rate per EFH is still calculated by the maintenance provider, and the reserves accrued over the removal and shop-visit interval are then paid as one sum at the time of the shop visit. "This type of contract gets round the problem of the operator paying the reserves twice, and the reserves are just paid to the lessor," says Paterson at MTU Maintenance. "This system has disadvantages, however, since the lessor requires the shop visit to meet a minimum workscope as part of the lease contract, such as a performance restoration. This removes flexibility from the MRO, which under normal PBH contracts can perform smaller workscopes if it wants to. An airline may have to pay for a smaller shop visit by itself. The airline also has to pay for UERs by itself, since reserves for these are not included in lease contracts."

The situation has evolved. "OEMs now have a system where a lessor can be comfortable with a lessee using a PBH-style agreement," says Richardson. "Agreements have been reached where lessors either do not have to receive reserves from airlines, or the lessors the reserves at the time of the shop visit once they are satisfied the engine has been maintained and that the OEM has been paid."

Paterson points out that such a tri-partite contract is necessary for leased engines. Lessors have an interest in PBH contracts, and also want a say in what maintenance is performed on the engine, and where the reserves are paid. If a tri-partite contract is not possible, then a PBH-style contract is not the right one for the operator.

Integrated services

Integrated services are a natural progression from PBH-style contracts. Integrated services include all the additional services of EHM data collection and analysis, engineering management, spare engine provisioning, LRU pool access and provisioning, and on-wing support. These items can all be included in a cost per EFH-style contract. These integrated services were initially provided by the OEMs, but some independent and airline-related MROs have started offering them. Integrated service contracts are often generically referred to as total-care contracts.

It is easier to manage these contracts from the start of the engine's life, since its maintenance status at the start of the contract is a key issue. They are also suited to a long-term contract, since all the services and full maintenance are required for new and young engines. They also suit smaller airlines with limited capabilities and facilities. PBH and integrated services contracts are not popular for mature engines because it is not known how long an operator will continue to operate the engine.

The main advantage of these all-inclusive packages is that they allow an airline to divest itself of much of its infrastructure. They also mean that an airline does not have to make an up-front investment when starting an operation with a new engine type.

PW's FMP programmes are offered for the PW4000 family, PW2000, PW1000G, and CFM56-3/-5/-7 family. "We do not really offer separate PBH and integrated programmes," says Pennito. "EHM, engineering management and support, and spare engine provisioning together with shop-visit maintenance are all part of our standard FMP package. We use our engineering expertise to get the right workscopes in relation to the airline's style of operation, whether the engines are owned or leased, the age of the engine, and its predicted remaining life of operation. The choice of a FMP really depends on where the engine is in the aircraft's lifecycle, and the lease return conditions. Long-term integrated programmes make more sense for new aircraft and engines."

Similarly, GE's On Point offers a range of additional service options on top of the maintenance paid for on a PBH basis. "An operator can choose which of these to include in a contract, so various permutations are available," says MacKenzie.

Lufthansa Technik provides an alternative to the OEMs for integrated services. "Besides maintenance and engineering management, we provide airline support teams for AOG situations, on-wing maintenance, and hospital repairs," says Akay. "In addition to spare engine provisioning, we provide failure analysis to develop procedures to avoid certain types of UERs in the future."

Similarly, TAP M&E offers shop-visit costs, EHM and engineering management, spare engines, field assistance, and LRU component support as part of its MCPH agreements.

SR Technics and MTU Maintenance are among the few remaining independent MROs offering integrated or total-care services. MTU Maintenance offers Total Engine Care, with the additional services previously described.

"The OEMs often use discounted rates to airlines as part of purchase contracts when competing for an order," says Richardson at TES. "As with PBH contracts, airlines like integrated services because they include a cost for UERs. A lot of airlines dislike the unpredictability and high costs of UERs, which is why they have switched from managing their own engines under time-and-material or fixed-rate contracts, to PBH and integrated services.

Integrated services are an evolution of fixed-rate contracts. Besides engine maintenance, fixed rate contracts include engineering management, spare engine support, LRU pool access, and on-wing support.

"Airlines do, however, end up paying a premium," continues Richardson. "The difference in $ per EFH rates between time-and-material and just maintenance under PBH was as much as 30% up to three years ago. OEMs have made more effort in recent years to offer portability. That is, offer more flexible contracts so that engines can change operators halfway through the terms of PBH and integrated contracts. More airlines are now taking up these contracts, so the PBH rates are coming down."

Paterson claims that it is possible for an operator to achieve a better price for each element of an integrated service when going to a specialist. "Airlines do not necessarily lose complete control, but they will lose expertise and knowledge of an engine type if they use integrated services," he adds.

Problems will arise for airlines when integrated contracts expire, or the aircraft changes operator halfway through the term. The first issue is that engine LLPs will have some of their lives remaining, and every engine will have a different maintenance status. This causes problems when transferring engines to a new MRO provider.

"Most total care contracts are 12-15 years old, or over a period of two or three planned shop visits," says Chris Pelly, senior vice president of commercial at TES. "Issues could arise when a total care contract expires. There are several scenarios that can be anticipated, and these should be considered before an operator signs a contract. One particular issue is a contract expiring after a pre-determined calendar time and an engine is between shop visits, and the engine is due to be sold or re-leased to another operator."

Under this situation the operator will have paid reserves to the MRO provider since the last shop visit. The operator needs to be in a position where it can claw back those reserves, either from the total care provider or the new operator, or receive a credit for them.

"A clause that will allow this should be included in the total care contract at the start," advises Pelly. "Many total care providers attempt to get a new operator to continue the payment of reserves until the next shop visit, and get the engine put through their shop. If the shop is used, there are two mechanisms for compensating the first operator. The first is for it to claw back the reserves it has paid, and the new operator to then pay the full price of the next shop visit, which could be on a time-and-material basis. An alternative is for the total care provider to transfer a credit for the reserves paid with the engine. The operator would be paid a value for the engine that reflects its maintenance status. With the paid reserves transferred with the engine, the new operator would only have to pay the remaining reserves to the next shop visit, rather than pay the full amount for the next shop visit.

"This transfer only works if the new operator is prepared to use the total care provider's engine shop," continues Pelly. "If the new operator does not want to use the total care provider's facilities then the first operator needs to have a mechanism where it can claw back the reserves it has paid from the last shop visit to the expiry of the contract."

Pelly advises that operators should consider all possible scenarios that could affect them at the end of a total care contract, and include appropriate clauses before signing them.

Ageing engines

There are further considerations for younger generation engines that have been maintained almost exclusively through total-care contracts. "The problem is that very few of the first total-care contracts signed have actually expired," explains Pelly.

Many widebody engines like the Trent 700, Trent 800, PW4000 and CF6-80E1 have been managed under total-care contracts by the OEMs. Certain assumptions about the values of aircraft equipped with these engines have been made. "The problem is that the oldest A330s are now 20 years old, and at this stage operators want more flexibility and choice of where to maintain their engines and how to manage issues such as the LLPs," says Pelly. Some of the OEMs' total-care contracts do not provide this flexibility, and require the operators to rigidly remain with the same conditions that were set for young engines. This means old engines would be forced to incur the high cost of total-care contracts, when items such as LLP reserves no longer need to be paid. If an OEM's total care contracts remain inflexible then it will have a negative impact on the value and remarketability of their engines.

Summary

The use of total-care contracts is growing, and airlines therefore do not have sufficient data and engineering knowledge to manage their engines. As Richardson at TES advises, it is still economic over the long term for airlines to manage their engines with the aid of IT systems such as EFPAC and use time-and-material, fixed-price and NTE contracts. This is despite the unpredictability of UERs that incur additional costs, and the convenience and predictability of total-care contracts. AC

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