

D O C U M E N T E D B R I E F I N G

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*Analytics of Third-Party
Claim Recovery for Military
Aircraft Engine Warranties*

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*Prepared for the
Office of the Secretary of Defense*

National Defense Research Institute

PREFACE

Congress in 1998 authorized a pilot program under which commercial firms might demonstrate the ability to recover significant value from additional warranty claims overlooked in aircraft engine maintenance records. The Services have been reluctant to participate in the pilot program for several reasons, despite the General Accounting Office's criticism of their respective warranty oversight efforts. The Office of the Secretary of Defense (OSD) commissioned this study in the spring of 2001 as a short-term overview of the issue.

This research was conducted for OSD within the Forces and Resources Policy Center of RAND's National Defense Research Institute (NDRI). NDRI is a federally funded research and development center sponsored by OSD, the Joint Staff, the unified commands, and the defense agencies.

SUMMARY

This briefing reports findings on whether commercial warranty recovery firms could be employed effectively to assist the armed forces with their warranty claims for aircraft engines. The project had three primary objectives: assessment of the likely efficiency of employing civilian firms to file and recover warranty claims for military aircraft engines, provision of a framework with which to evaluate associated proposals, and rough estimation of the effect on engine prices attendant upon a significant increase in warranty claims.

Following a 1997 proposal to the Air Force from a private firm specializing in such warranty recovery claims—which was declined by the Air Force—Congress authorized a pilot program the following year. Each of the Services declined to participate, citing several concerns despite the General Accounting Office’s periodic criticism of the Services for poor warranty claims oversight. OSD commissioned this study in the spring of 2001 on a broad, overview basis. Three central questions were addressed: (1) could commercial methods be applied effectively in the service environment? (2) could commercial methods be applied without disrupting military activities? and (3) could commercial methods be applied in a cost-effective way under current conditions?

Warranty recovery firms fall into two categories: clerical companies that file and track claims, and forensic auditors that have extensive experience in the aircraft and aerospace sectors and also specialize in the examination of records already closed out. Such firms sometimes employ proprietary software and/or expert auditors, and some claim to be able to detect fraud, changed specifications, and other irregularities. The relevant trade literature suggests that the airlines find and file only about 30 percent of the legitimate warranty claims to which they are entitled. Such airlines as United Airlines find the services offered by the forensic auditing firms valuable, and procure those services annually. Airlines have found that they must offer their first-line mechanics incentives programs in order to induce systematic identification of warranty claims; and operational demands tend to lead military maintenance personnel to ignore warranty claims. Developing an effective incentives program for military aircraft engine mechanics might prove difficult because of long hours and the immediate demands of preserving air operations.

Other differences between the Services and the airlines are also important. Airlines often lease their engines, while military aircraft engines are procured as government-furnished equipment, and thus often are delivered six months before the aircraft themselves are accepted into service. These differences may be reduced by ongoing efforts by the Services to shift toward power-by-the-hour plans similar to that in place for the C-17, and toward contractor logistics support arrangements. Even for the airlines, the current trend is toward guaranteed performance provisions in contracts. The far greater intensiveness of airline engine use also may yield a richer environment for warranty claims. Moreover, airlines operate far fewer maintenance facilities than the Services do.

The Services have expressed five central concerns about the use of third-party warranty claims services:

- The Services' maintenance records are scattered and poorly automated.
- The contractors' personnel would interfere with military personnel and impose additional burdens on them.
- The contractors largely would recover "low-hanging fruit" that the Services would recover in any event.
- The contractors might gain access to proprietary information.
- Few engines remain under warranty: Future recoveries will be substantially in parts and services rather than cash, so that the method for compensating the contractors is unclear, and in any event, financial reimbursements go to the U.S. Treasury rather than to the Services.

Our research indicates the following: Major airlines rely on extensive paper records, which can be scanned into electronic form. The number of contractor personnel in one major proposal is too small to create "interference" problems for the Services, and the claims firms are accustomed to "working around" airline personnel. Except for possible "campaign problems" affecting all engines of a given model, the low-hanging fruit prediction is not supported by the anecdotal evidence. Many contractors work for the Department of Defense (DoD) and handle highly sensitive information. And the terms of warranties—

goods and services rather than dollars—should not matter as far as finding and filing claims, particularly in the larger context of the taxpayers' interests. More broadly, the Services are moving away from traditional engine warranties as the preferred means of shifting quality risks toward the engine producers.

The data necessary for effective warranty management by the Services are scattered widely, a factor that may be declining in importance as the military use of engine warranties decreases. Using data from General Electric (GE), we find that in fiscal year 2000, the average cost to GE of warranty reimbursements was about \$4,600 per engine (over all engines). Extrapolating linearly for Pratt & Whitney and Allison yields an estimate of \$9.7 million in total warranty claims for fiscal year 2000. Under the assumption that one-third of the engines under warranty leave warranty status each year, about 634 engines would remain under warranty in 2003, with a total claims value of about \$2.9 million. Even a 30-percent increase in claims engendered by a third-party warranty claims program would yield only about \$875,000.

An increase in warranty claims would raise engine production costs, and thus, presumably, engine prices. Even under a "worst-case" set of assumptions, the price increase would be about \$15,000, only 0.3 percent of a typical \$5 million engine price. Bargaining between DoD and the engine producers would likely reduce that even further. Also, the increase in production costs, even if borne by the producers, is sufficiently small as to obviate the potential for any resulting exit from the industry.

In principle, it seems that the use of contractors for engine warranty recoveries is feasible, and would be likely to yield increased claims. But a new program along those lines is unlikely to prove practical under current conditions because relatively few engines remain under warranty, the Services are moving away from the use of warranties, and the potential increase in recoveries is small.

ACKNOWLEDGMENTS

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ACRONYMS

ARG	Amphibious ready group
CV	Carrier vessel
DoD	Department of Defense
DTIC	Defense Technical Information Center
FAR	Federal Acquisition Regulation
GAO	General Accounting Office
GE	General Electric
GFE	Government-furnished equipment
IG	Inspector General
NAVAIR	Naval Air Systems Command
NDRI	National Defense Research Institute
O&M	Operations and Maintenance
OSD	Office of the Secretary of Defense
SAT	South African Technical
USNI	United States Naval Institute

Analytics of Third-Party Claim Recovery for Military Aircraft Engine Warranties

**John E. Peters
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This documented briefing reports on research investigating whether commercial warranty recovery firms could be employed effectively to assist the armed forces with their aircraft engine warranty claims.

Research Objectives

- **Help OSD assess the efficiency of employing civilian firms to file and recover warranty claims**
- **Provide OSD with a reasonable basis for evaluating proposals to perform warranty recovery**
- **Assist OSD in understanding the impact of engine warranties on the price of engines**

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The project had three primary objectives. First, it sought to help the Office of the Secretary of Defense (OSD) assess the efficiency of employing civilian firms to file and recover warranty claims for military aircraft engines. Second, since firms in the business occasionally submit proposals offering to perform warranty recovery and administrative services, the project intended to provide OSD with a reasonable basis for evaluating these proposals. Finally, in response to Service concerns that increased warranty activity might lead to large increases in aircraft engine prices, the project sought to estimate how much engine prices might rise if the value of warranty claims were to increase significantly.

Background

- **In 1997, the U.S. Air Force received an unsolicited proposal from a firm offering to perform warranty recovery**
- **Congress chartered a pilot program to test the concept, but it was not implemented because the short duration of the program made it impractical**
- **GAO has criticized some of the Services for poor warranty claims oversight**
 - GAO/NSIAD-87-122
 - GAO/NSIAD-89-57

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The origin of this project dates to 1997 when an Oklahoma-based firm sent the Air Force an unsolicited proposal offering to perform its aircraft engine warranty recovery work. In its proposal, the firm asserted that it had special expertise that would allow it to find additional legitimate warranty claims in engine maintenance records that the Air Force's own personnel were likely to miss. The Air Force declined the offer, noting that the unsolicited proposal did not satisfy Federal Acquisition Regulations criteria for such proposals.

In 1998, Congress authorized a pilot program that would allow an opportunity for commercial firms to prove the principle that they could recover additional significant value from previously overlooked warranty claims buried in engine maintenance records. Each of the military Services declined to participate in the pilot program, citing a host of concerns. First, too little time was available for the program to reach fruition. Second, the Services feared that in the end they would find themselves paying for claims that they would have discovered. And, third, they feared that they would be subject to lawsuits if the additional claims proved less lucrative than expected.

The General Accounting Office (GAO) has periodically criticized the Services for poor warranty claims oversight. These criticisms first emerged in 1987 and again in 1989. More recently, in October 1999,

GAO released a report calling for a pilot program to test the concept of commercial warranty recovery firms working in the military aircraft engine environment.

Finally, OSD commissioned this study in the spring of 2001 to investigate the issue on a short-term, broad overview basis.

Research Questions

- **Can commercial methods—those typically employed by warranty recovery firms—be applied effectively in the Service environment?**
- **Can commercial methods be applied without disrupting military activities?**
- **Can commercial methods be applied cost-effectively in the military departments?**

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The research team concluded that there are three basic questions that must be answered. First, can commercial methods be applied effectively in the Service environment? The team learned that some of the warranty claims firms thrive in the commercial aircraft market; at issue was whether there are factors specific to the military aircraft engine maintenance environment that would undermine a commercial firm's normal way of doing business.

Second, can commercial methods be applied without disrupting military activities? Is there anything about the business practices of warranty recovery firms that would interfere with such military activities as engine maintenance and flight operations?

Third, can commercial methods be applied cost-effectively in the military departments? This question asks whether there is anything unusual about military aircraft engine maintenance and maintenance management that would render commercial methods non-cost-effective: for example, the potential need to visit dozens of maintenance facilities both in the continental United States and overseas.

Research Outline

- ➡ • **What are warranty recovery firms?**
 - **How do they function with commercial clients?**
 - **What is the experience with commercial airlines?**
 - **How do DoD and airlines compare?**
 - **What are the concerns of DoD officials about employing warranty recovery firms?**
 - **What can OSD reasonably expect from a good warranty recovery firm?**

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The questions above form the roadmap for the rest of the presentation. The briefing begins with a quick look at warranty recovery firms and the services they provide.

There Are Two Main Types of Warranty Recovery Firms

- **Clerical**
 - File and track claims
 - Used for companies or organizations that want to outsource their warranty work
- **Forensic auditors**
 - Have deep expertise in aircraft/aerospace industry
 - Sometimes equipped with specialized, proprietary software
 - Able to identify reimbursable entries in records that in-house and outside clerical firms would miss
 - Some claim to be able to detect fraud, changed specifications, and other irregularities from the records

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There are two main types of warranty recovery firms. The first are principally clerical in nature. They provide such routine services as filing and tracking warranty claims. Such companies do not generally specialize in the aircraft industry per se, but instead market their services to any firm that wants to outsource its warranty work.

The second type of firm can best be understood as forensic auditors. These firms are few in number, with extensive experience in the aircraft and aerospace industries, and specialize in examining closed-out records—those that the client believes already have been thoroughly processed for warranty claims—and finding additional legitimate claims. These firms sometimes come equipped with their own proprietary software but not always; some rely solely on their expert auditors.

These firms have developed special expertise in culling through a client's maintenance records. Some even claim that they can detect fraud, changed specifications, and other irregularities from their record audits.

Forensic Auditors Look for Reimbursable Events Overlooked by Others

- **Claim airlines file for only about 30 percent of all warranty claims to which they are legitimately entitled**
- **Recovery firms seek to:**
 - **Audit processed records to discover overlooked warranty claims**
 - **Train client's warranty staff to be more effective**
 - **Provide staff assistance and follow-up on new claims they discovered**

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According to the trade literature, verified in interviews with commercial airlines employing the services of warranty recovery firms, airlines' warranty personnel typically find and file only about 30 percent of the legitimate warranty claims that are to be found in the companies' maintenance records. The forensic auditors look for the balance.

The most advanced warranty recovery firms offer their clients a three-part service. First, they audit the processed claims records to discover overlooked warranty claims. Second, they train the client's warranty staff to make the staff more effective. In some instances, they even operate specialized training facilities at their corporate offices and take the client's personnel there for training. Finally, these firms provide staff assistance and follow-up on the new claims they discovered, helping the client ensure that these claims are settled.

Some airlines, such as United Airlines, find this suite of services valuable and invite the warranty recovery firm to come back annually. The return visits let the warranty recovery firm review the United claims performance and provide refresher training to the United staff.

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The next section summarizes warranty recovery firms' relationship with their commercial airlines customers.

Industry Reporting Indicates Forensic Auditors Find Many Sources of Extra Value

- **30 percent found by the airlines**
- **27 percent lie in unfiled claims**
- **12 percent lie in claims denied for incomplete information**
- **6 percent found in unreconciled overcharges**
- **12 percent lie in unwanted material replacements**
- **9 percent found in filed but unresolved cases**
- **4 percent remain in expired claims**

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The chart above indicates the industry's findings on where additional warranty value is to be found. Assuming that airlines find 30 percent of the legitimate claims lurking in their paperwork, another 27 percent are available in unfiled claims never identified by the airlines' warranty staff. Forty-three percent await in the other categories shown in the figure. Forensic auditors help their clients find these additional sources of warranty value and claim them.

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So, how have the airlines fared? Are the claims of warranty recovery firms borne out?

The Team Contacted These Air Carriers Known to Have Been Giro Clients

- **United** { Operates 619 aircraft compared to 667 the project team estimates to be under warranty in DoD. Budgets \$20 million per year from warranty recoupment
 - **UPS** { Both claim to have had positive experiences but neither would disclose the value of the additional recoveries
 - **Varig** }
 - **Air Express** }
 - **Alaska** }
 - **Burlington/BAX** }
 - **Virgin** }
- Did not respond to RAND inquiries

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Giro, Inc., the firm that originally approached the Air Force in 1997, has many commercial airline clients. The research team contacted these airlines to learn how Giro performed for them.

United Airlines has maintained a long-term relationship with Giro that continues today. United reports that it budgets \$20 million annually in reliable warranty recoupments, in large part from Giro's audits, training, and assistance. UPS and Varig also claim positive experiences, but neither airline would disclose the value of the additional warranty claims recovered with Giro's help.

South African Technical Reports Major Recovery Efforts

- **According to reports in *MRO Management*, SAT recovered an additional \$5 million in overlooked claims in its first four months**
- **Over the next 56 months, recovered an additional \$3 million**

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One airline that has been explicit about its additional recoveries is South African Technical (SAT), the maintenance subsidiary of South African Airways. Corporate officials quoted in trade journal *MRO Management* indicate that SAT recovered an additional \$5 million in overlooked claims in the first four months of its relationship with Giro. Over the longer term, SAT recovered an additional \$3 million that its internal staff otherwise would not have found.

Airlines Must Offer Their Mechanics Incentives to Identify Warranty Items

- **Even with forensic auditors training their staffs, airlines rely on mechanics**
- **Warranty managers offer bonuses to mechanics who identify possible warranty items when servicing aircraft**
 - Tickets to professional sports events
 - Complimentary meals at premium restaurants
- **Without incentives, mechanics ignore warranties and simply service the aircraft**

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Although the airlines seem generally to have benefited significantly from Giro's assistance, interviews with internal warranty administrators indicate that the airlines still must depend on the first-line mechanics to identify warranty claims as they service the aircraft. The airlines interviewed for this project indicated that the only way they could get the mechanics' support was by offering them an attractive incentives program, without which the mechanics tend to give low priority to warranty items and simply service the aircraft.

Naval Air Systems Command (NAVAIR) officials interviewed during the course of the project noted that Navy aircraft maintenance personnel often ignore warranty claims as they are under pressure to return the aircraft to operational status. If a forensic auditing firm were engaged by the Services, the military would probably also have to develop an incentives program for its aircraft mechanics in order to take full advantage of the commercial firm's assistance. Developing an effective incentives program for military aircraft mechanics might prove difficult for front-line personnel who often must contend with long hours and the immediate demands of air operations. Such incentives are needed for effective warranty claims implementation by United, taking the form of tickets to sporting events and the like, despite shorter hours and a more moderate work tempo. The prospective utility of such incentives programs in the military context is unclear at best as commanders rarely have access to similar premiums and because they exert their leadership in pursuit of the primary mission—operational readiness.

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Among the central considerations in determining whether a commercial forensic auditing firm could help with military aircraft engine warranties are the similarities and differences between airline and armed Services aircraft maintenance organizations. The next section considers this question.

Basis for Comparing DoD and the Airlines

- **Ownership of engines**
- **Structure of aircraft engine warranties**
- **Utilization rates (flying hours)**
- **Number and location of maintenance sites**
- **Flexibility of business practices and vulnerability to liability**

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In addition to the operational differences already discussed, comparison of the Department of Defense (DoD) with the airlines rests on five primary areas, shown in the figure above. The next five figures address each area, respectively.

Services Own Their Engines, but Airlines May Not

- **Airlines often lease engines**
 - Firm leasing the engines must find replacements when engines fail
 - Offers greater flexibility than engines furnished as GFE
- **Service engines often delivered six months before aircraft are accepted into service**
 - Time element of engine warranty already decaying
- **Government efforts toward power-by-the-hour may eventually give Services similar flexibility**

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The airlines and DoD take different approaches to engine ownership. The airlines often lease their aircraft engines, while military aircraft are powered by engines procured as government-furnished equipment, which means the engine warranties begin to expire before the respective aircraft are accepted into service. Accordingly, these engines typically are on hand six months before the aircraft they will power are accepted into the military inventory. The engine warranties, as a result, have already begun to elapse when they are installed on the aircraft. Power-by-the-hour plans—a guarantee of a given number of hours of propulsion like that in place for the C-17—may reduce the distinction between airline and military engine ownership approaches.

Warranty Structures Vary Within DoD and in the Airlines, and Both Are Moving Away from Traditional Warranties

- **Within DoD:**
 - Traditional component warranties are fading in Air Force and Navy
 - Warranty terms often differ by engine lot
 - Performance warranties are more typical
 - But power-by-the-hour (C-17) and contractor logistics support arrangements are supplanting warranties
- **At the airlines:**
 - Even fewer traditional component warranties remain for engines
 - Airlines seek guaranteed performance

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Warranty structure and terms vary widely, both within DoD, where even different lots of the same engine type may have different terms, and for the airlines, where, if their engines have warranties at all, they guarantee a certain amount of performance, in the form of power-by-the-hour propulsion guarantees or engine leasing arrangements.

Both in the airlines and in DoD, aircraft engine component-based warranties (e.g., “this fan guaranteed for 500 clock hours or 24 months, whichever comes first”) are becoming rare. Both the Services and airlines seek guaranteed performance from their engines.

Airline Engines Log Many Times the Flying Hours of Military Aircraft Engines

- **United Airlines aircraft in domestic service fly ~20 hours per day**
 - United officials noted their engines would “fly through” a military engine warranty in months
- **Military combat aircraft operate much less: 200–300 hours per year at current rates**
- **High usage rates among commercial airlines provide potential for more warranty claims**

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The airlines' aircraft fly much more than military combat aircraft. United Airlines domestic passenger aircraft, for example, may fly as many as 20 hours per day. In contrast, military combat aircraft fly much less: typically 200 to 300 hours per year, or less than one hour per day. The much higher usage rate of airlines provides a potentially richer opportunity for warranty claims.

Airlines Typically Operate Far Fewer Maintenance Facilities Than Services

- **United Airlines operates only three maintenance facilities**
 - Warranty administration is an organic function
- **Airlines sometimes contract with other carriers for maintenance overseas or otherwise beyond the reach of their own facilities**
- **Services have maintenance facilities overseas and aboard ships**
 - Service facilities often operated by younger, less technically proficient personnel
 - Warranty administration is an additional task

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One distinct difference between airlines and the armed forces is the number of maintenance facilities they operate. Domestic airlines may have only one or two maintenance facilities. United Airlines, for example, even though it operates overseas routes, has only three maintenance facilities. Within these facilities, warranty administration is an organic function. For example, the first-line warranty administrators at United Airlines have offices right in the maintenance hangar where the mechanics service the aircraft.

The airlines also enjoy the flexibility of being able to contract with other carriers for maintenance support overseas or in locales otherwise beyond the reach of their own maintenance infrastructure.

In contrast, military aviation maintenance facilities exist worldwide, including overseas and aboard aircraft carriers and large-deck amphibious ships. These facilities are often operated by younger enlisted personnel with less training, experience, and formal certification than is true for their civilian counterparts. Because these facilities are often undermanned and nevertheless taxed by high-operational tempos, the work is grueling. There is no warranty administrative unit. Instead, warranty administration is an additional task for the maintenance crews. This relative decentralization of Service maintenance activities deprives the Services of the economies of effort enjoyed by the airlines in terms of warranty administration.

Airlines Enjoy More Flexible Business Practices Than the Services

- **Can use unpaid warranty claims for leverage with engine manufacturers in subsequent negotiations**
 - Make claims settlement an issue in selecting engine supplier for subsequent aircraft purchases
 - DoD, under rules of the FAR, cannot take this tactic, according to DoD officials
- **Services face special requirements for contract awards to small, disadvantaged businesses**
 - May yield less-productive business relationships than experienced by airlines

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Another area where airlines differ from the Services is in flexible business practices. Airlines routinely use unpaid warranty claims for leverage with engine manufacturers when negotiating new engine deals. Typically, the airlines will insist that outstanding claims be settled as part of the negotiation to select an engine provider. In contrast, under the Federal Acquisition Regulation, DoD agencies may not use this tactic. Moreover, DoD is required to enter contractual relationships with small and/or disadvantaged businesses that the airlines can avoid if justified by expected performance factors. This requirement for DoD may yield lower returns from third-party warranty recovery efforts than realized by the airlines.

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During the course of the project, the research team interviewed OSD and Air Force, Army, and Navy officials on the question of engaging a commercial firm to implement a program for aircraft engine warranty recoveries. The next section summarizes the concerns these officials voiced and the research team's attempts to scrutinize and test their concerns.

Main Concerns Voiced by Officials About Third-Party Warranty Recovery

- **Service maintenance records underautomated and scattered—unsuitable for a warranty firm**
- **Contractors would be in the way, impose extra work on military personnel**
- **Contractor would mainly recover “low-hanging fruit”**
- **Contractor personnel might have access to proprietary information**
- **Few engines remain under warranty and those that do**
 - **Reimburse in parts and service, less cash-focused**
 - **Financial reimbursement does not benefit the Service directly; goes to U.S. Treasury**
 - **Unclear how contractor would be compensated**

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DoD officials had five major concerns. First, many officials feared that Service maintenance records are underautomated and scattered over many locations. They believed that warranty recovery firms would seek to examine their records electronically and that their paper files would prove not to be usable.

A large number of interviewees were concerned that the commercial firms’ personnel would be unfamiliar with military records and that they would make additional demands on military personnel to help them find and understand necessary paperwork.

The most frequently cited concern was that the contractor, for the most part, would find “low-hanging fruit”—obvious claims the Services would find for themselves—and charge a fee for doing so. The Services therefore would have to pay out Operations and Maintenance (O&M) dollars for the fee without having recovered any additional value from their engine warranties.

Other officials feared that the presence of warranty recovery personnel might compromise the security of proprietary information. Most of the concern seemed to focus on safeguarding engine manufacturers’ proprietary data rather than government information.

Finally, some officials asserted that few aircraft engines remain under warranty today, and for those under warranty the terms call for

reimbursement in goods and services; the cash reimbursement portion of the warranty is minor. Since the cash reimbursement component of the warranty is small, these officials doubted commercial firms would be interested. Moreover, they noted that any financial reimbursement would go to the U.S. Treasury and not back to the Services. While they acknowledged that cash recoveries would still return value to the government, they would have been more enthusiastic if there were an easy way to get the money restored to their O&M accounts.

There was also the question of the contractor's fee. The officials were uncertain about how a contractor might be compensated. They were also worried that the fee might come out of their maintenance accounts, putting further pressure on scarce resources.

The next five figures consider each of these concerns.

Service Maintenance Records Underautomated and Scattered

- **Major airlines still have extensive paper records**
- **If recovery firm uses computer-based tools, they scan paper files into digital form**
- **Air Force veterans in the industry claim their methods are compatible with Service maintenance records**
 - **Have trained personnel to collect records, process data**
 - **Willing to go where the records are**
 - **Examination of CV- and ARG-based records would have to wait for redeployment of their squadrons ashore**

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The research team toured one of the three United Airlines primary maintenance facilities. The team found that even in the United state-of-the-art maintenance system, paper records remain extensive. The United Aircraft Basic Maintenance System maintenance tracking system is automated and has the ability to identify and track warranty items. As a practical matter, however, the first-line warranty administrators at United use photocopies of the paper files to begin their warranty claims.

The research team also talked with warranty recovery firm corporate leadership to try to understand their business practices. Some of these officials are Air Force veterans intimately familiar with that Service's maintenance records. From these interviews, the team learned that these companies have trained data collection personnel, and if a warranty recovery firm wants to use automated tools, it will likely use a digital scanner to transfer client records into its files.

These same corporate officials also asserted that their methods were completely compatible with Service maintenance records. Asked whether the Services' scattered maintenance facilities and records presented a problem, they expressed their willingness to "go where the records are" in order to complete their jobs.

That said, there are clearly some maintenance sites where contractors would not operate, such as aboard ships at sea. Engine records for

aircraft aboard these ships would be examined ashore once their squadrons left the ships; examples are records for carrier vessels and amphibious ready groups.

Contractor Personnel Would Be in the Way, Impose Extra Work on Military

- **Giro's proposal for the Air Force involved 13 staff members to examine one engine model at one site**
- **Personnel would not have to be in the maintenance facilities—can work off-site**
- **Firms have trained staffs for record collection and data extraction—accustomed to working with airlines that are also sensitive to additional demands on their personnel**

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The defense officials interviewed for the project imagined a significant on-site presence from any warranty recovery firm. They were concerned that legions of contractors would be on hand, competing with mechanics to look at log books and other maintenance records, and in need of the military's help to understand the available records and data.

The research team looked carefully at Giro's original proposal to the Air Force. In it, Giro listed only 13 staff members. Later, interviewing senior Giro personnel, it became clear that the bulk of work can be done off-site and that a good recovery firm does not need a large presence in maintenance facilities to do its job.

In touring United Airlines' maintenance facility in San Francisco, we learned that airlines are also quite sensitive to extra demands placed on their personnel. Indeed, union contracts make taskings on mechanics and others especially problematic. Therefore, successful warranty recovery firms have trained their staffs to work in this environment. They are accustomed to collecting data and doing their job *around* maintenance workers without disturbing their routines.

The research team could find no reason that warranty recovery personnel, accustomed to working in the commercial airlines environment complete with union rules and a high operating tempo, would interfere with or impose extra burdens on military personnel.

Contractor Would Gather Mainly “Low-Hanging Fruit”

- **Not supported by anecdotal evidence found in industry reporting**
 - SAT recovered an additional \$5 million in its initial audit
 - Varig and UPS claim similar results, though they will not disclose the exact amounts
 - United Airlines has long-term relationship with Giro
- **But Services’ “campaign problems” with engines might be low-hanging fruit**
 - Agreement would have to be structured in a way to exclude systemic, engine modelwide failures

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The concern about low-hanging fruit is not supported by the anecdotal evidence. As noted, several airlines have enjoyed significant additional recoveries. United remains in a long-term relationship with Giro despite the fact that the manufacturers have become increasingly strict, enforcing the time limit within which United has to file warranty claims.

Enough firms in the private sector employ the services of these firms to suggest that doing so is worthwhile. There appears to be some potential for efficient specialization here, along with the potential for additional gains in warranty claims.

That said, there is at least one area where caution in negotiating a business arrangement with a warranty recovery firm is in order: so-called “campaign problems” in which all the engines of a given model suffer from the same defect. (Such a problem occurred in the F-14 engine program.) The Services routinely find these problems themselves and require the manufacturer to take appropriate action. Unless the terms of the business agreement are drawn specifically to exclude campaign problems from the warranty recovery firm’s domain, the fee, typically calculated as a percentage of the value of the claim, could be large.

Contractor Personnel Might Have Access to Proprietary Information

- **Contractors work in other parts of DoD and handle very sensitive information**
- **Represents an extra complicating factor**
 - **Services would have to manage some parts of program where data could not be disclosed to warranty firm**
- **If there were compelling reasons to hire a warranty firm, proprietary information issues could be dealt with**

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Concerns about revealing proprietary information to warranty recovery personnel were more difficult to evaluate because none of those interviewed offered very specific examples. Nevertheless, it seems to the research team members that this should not be a serious obstacle for DoD. The military has a long, solid record safeguarding classified information. There are also plenty of legal arrangements, including nondisclosure agreements, that could be used to protect proprietary information. In addition, the research team knows that contractors work in many of the most sensitive parts of DoD and other federal agencies—designing and building nuclear weapons, for example—suggesting that there clearly are effective vehicles with which to overcome the proprietary information issue.

Nevertheless, obtaining security clearances—perhaps unnecessary if the contractors work only with maintenance records—and signing nondisclosure agreements represent an additional administrative burden. The Services would have to work with the contractor to manage some parts of the program where proprietary information is highly sensitive.

If there were otherwise compelling reasons to hire a warranty recovery firm, the research team believes proprietary information issues could be dealt with.

Few Engines Remain Under Warranty

- **Only the engine program managers know for sure**
- **Warranty terms—goods and services rather than dollars—should not matter for recovery purposes**
 - Contractor still has to identify reimbursable item, file claim, follow-up
- **But the Services are moving away from engine warranties**
 - DoD IG and GAO have told NAVAIR its aircraft engine warranties are ineffective
 - Contractor logistic support arrangements, power-by-the-hour replacing traditional performance warranties

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On the final issue which addresses that there are few engines under warranty, that the terms of those warranties are largely goods and services rather than cash, and that officials assume the Services do a reasonable job of making claims on their own, the research team found the following.

First, only the engine program managers know how many engines they have under warranty, or the rate at which they leave warranty coverage. Interviewees, especially in Army Materiel Command, explained that they once had data collection and management oversight of their warranty programs, but successive personnel reductions and base closings drove those capabilities from their management structures.

Second, it is the view of the research team that warranty terms should not matter for recovery purposes. Whether the primary reimbursement from a warranty is cash or goods and services, the process of finding and filing the claims is the same. The warranty terms, therefore, should not matter to the recovery contractor. The Services, however, should be very interested in maximum recoveries on warranties that reimburse goods and services because goods and services are recouped by the military, whereas dollar reimbursements disappear into the U.S. Treasury general fund. Obviously, this is irrelevant from the viewpoint of the taxpayers.

The Services, however, are moving away from aircraft engine warranties. Only the Army continues to regard warranties as valuable. Both the DoD Inspector General and GAO have told NAVAIR that its aircraft engine warranties are ineffective because of such practical considerations as operations at sea.

Finally, the Services are moving toward new methods of guaranteeing aircraft performance. Power-by-the-hour and contractor-provided logistics support are just two of the alternatives for assuring aircraft availability that the Services are embracing. Both would sharply reduce the need for warranty administration on the part of the Services.

Research Outline

- **What are warranty recovery firms?**
- **How do they function with commercial clients?**
- **What is the experience with commercial airlines?**
- **How do DoD and airlines compare?**
- **What are the concerns of DoD officials about employing warranty recovery firms?**
- ➡ • **What can OSD reasonably expect from a good warranty recovery firm?**

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The research team concluded that the concerns and fears expressed by DoD officials during interviews do not present insurmountable obstacles to employment of a warranty recovery firm. Industry literature, interviews with warranty recovery firms, and site visits and interviews with airlines suggest that the Services have little to fear in engaging a forensic auditing warranty recovery firm. Accordingly: What can OSD reasonably expect from a good warranty recovery firm? The final section addresses this question.

OSD Recognizes Data Necessary for Warranty Management Are Widely Scattered

- **DTIC records have made this point since 1985**
 - Naval Postgraduate theses
 - Air University theses
 - Air Force Institute of Technology theses
- **GAO reports have been critical of warranty administration since 1987**
- **Services lack the aggregated data...**
 - To support a top-level study such as this
 - To support oversight of warranty programs above the item manager level
 - To know reliably above item manager level whether warranties are cost-effective

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OSD has long been aware that the data necessary for effective warranty management are scattered widely. Military students' theses from the Naval Postgraduate School, the Air Force Institute of Technology, and the Air University (listed under various authors in bibliography), as published by the Defense Technical Information Center, have called attention to this since 1985, when Congress mandated warranties. Likewise, GAO has long been critical of some Services' warranty claims programs.

Although managers for individual items and for Service programs know many of the details of their aircraft engine warranty programs, critical information is not collected and aggregated at a level with which the individual military Services could manage their aircraft engine warranty programs effectively. As a result, the Services lack the information they need for important oversight functions. Because the Services are reducing the use of aircraft engine warranties, an absence of high-level management and oversight does not seem critical.

Given the Dispersed Condition of Official Data, We Relied on Data Provided by GE

Inputs:

- **Proprietary data from GE**
 - **Nonproprietary summary of four military aircraft engine types under warranty:**
 - F-700-GE-701C
 - F-118-GE-100
 - F-404 (all models)
 - F-414-GE-400
 - **802 of 13,403 engines delivered remain under warranty**
 - **FY 2000 warranty expenditures = \$3.7 million, or \$4,600 per engine**

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The research team used proprietary data from General Electric (GE) as the basis for estimating how many aircraft engines are under warranty and the potential value of warranty claims against those engines.

At a nonproprietary summary level, the chart above indicates that only 802 of 13,403 engines delivered to the U.S. military by GE remain under warranty. In fiscal year 2000, GE reimbursed its DoD customers \$3.7 million dollars in cash, parts, and services under the terms of these warranties equaling about \$4,600 per engine.

We Extrapolated from the GE Data to Estimate the Value of Engine Warranties

- **Based on USNI Periscope data, GE represents approximately 38 percent of the military aircraft engine market**
 - Pratt & Whitney = approximately 30 percent
 - Allison = approximately 30 percent

$$\text{Total military aircraft engine warranty value} = \frac{\$3.7 \text{ million}}{38 \text{ percent}} \approx \$9.7 \text{ million}$$

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Using data from the United States Naval Institute Periscope database, the research team estimates that GE represents approximately 38 percent of the military aircraft engine market, while Pratt & Whitney and Allison represent another 30 percent each. If this is so—and assuming similar experience in terms of claims rates and average costs—the total value of DoD engine warranty claims in fiscal year 2000 would have been about \$9.7 million. The following figures present data for GE; comparable data for Pratt & Whitney and Allison were not available, and so were imputed.

If One-Third of the GE Engines Under Warranty Leave Coverage Each Year...

- **GE would have 537 under warranty in 2001**
 - With warranty claims worth approximately \$2.5 million
- **360 under warranty in 2002**
 - With warranty claims worth approximately \$1.7 million
- **241 under warranty in 2003**
 - With warranty claims worth approximately \$1.1 million

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The figure above extrapolates from the GE data for 2000 to estimate the number of GE military aircraft engines likely to be under warranty for the years shown, and the approximate value of warranty claims.

The Total Warranty Value Estimate, Assuming GE Represents 38 Percent of the Market

Year	Number engines under warranty	Value of claims against warranties
2001	1,413	\$6.5 million
2002	947	\$4.4 million
2003	634	\$2.9 million

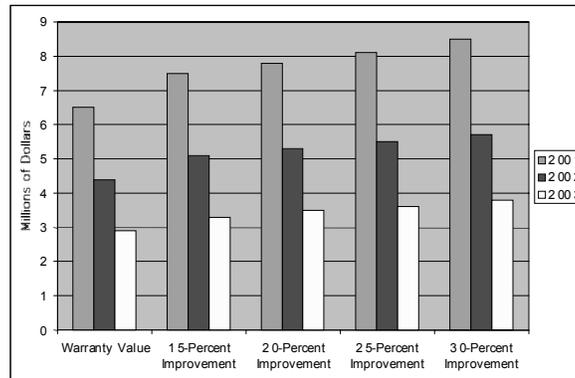
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If GE represents 38 percent of the market, then the total number of aircraft engines under warranty would fall from about 1,413 in 2001 to 634 in 2003. We assume linearity with respect to the GE engines in terms of the rate at which engines leave warranty protection. The aggregate value of the aircraft engine warranties would drop from roughly \$6.5 million to \$2.9 million over the same period.

A Recovery Firm with Good Forensic Tools Might Recover Some Additional Value

Firms claim they can recover 15–100 percent more than their clients would without them



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In Giro's original proposal to the Air Force, the firm claimed it could recover between 15 and 100 percent more value than the Air Force was getting from administering its own aircraft engine warranty programs. Anecdotal evidence from the airlines, as reported in the trade literature, indicates that some air carriers have experienced increased recoveries of up to 220 percent.

Interviewees for this project stressed that the military aircraft maintenance environment is different from that of the commercial airlines. Therefore, the research team decided to limit its expectations of additional warranty recoveries. The team asked how much additional value might a warranty recovery firm find if it found only 15, 20, 25, or 30 percent additional legitimate claims? The figure above answers the question based on the number of engines estimated to be under warranty in 2001, 2002, and 2003.

Remaining Issues to Be Resolved

- **Basis for fee:**
 - Services do not know their baselines
 - Rate and basis for calculating it should be negotiated
- **Payment of fee—may require congressional action**
- **Potential impact of improved warranty recovery on engine prices**

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If the Services were to decide that they want the assistance of a high-quality warranty recovery firm, some issues would have to be resolved. The first is the basis for the firm's fee. The Services do not know their "baselines"—the amounts that they recover themselves by filing their own warranty claims. Since most firms expect to be paid a percentage of what they recover above the baseline, the Services would have to either establish this figure or negotiate a starting point, particularly since the Services ordinarily file some nontrivial dollar value of claims themselves simply in the course of ordinary operations. Such negotiations should be the basis for establishing the entire structure of the business relationship, in that decisions must be made with respect to the specific engine types and the time periods subject to warranty claim evaluation and, again, the baselines above which a fee would be paid. Collectively, the Services are an attractive client and should be able to negotiate favorable terms.

The next issue is the payment of the fee. Whether it is paid out of base operating accounts or whether a special line must be created within the O&M account, the details of payment should be manageable. Even if congressional action is necessary, the Services should not let this dissuade them from pursuing more-efficient management of their warranty programs.

Third, an increase in warranty claims would be likely to affect engine prices, an issue addressed below.

Increased Warranty Claims Will Affect Engine Production Costs

- **GE experience is about \$4,600 per engine under warranty**
 - So the average actual warranty claim is larger since claims are not made for all engines
- **Expected marginal production cost includes \$4,600 expected warranty cost**
 - 15 percent additional claims: \$5,290
 - 20 percent additional claims: \$5,520
 - 25 percent additional claims: \$5,750
 - 30 percent additional claims: \$5,980

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Increased warranty claims and recoveries obviously would increase expected marginal cost for engine production for the manufacturers. For the \$4,600 average claim per engine under warranty, as discussed above, engine prices would include that expected cost of \$4,600. (Since warranty claims are not made for every engine under warranty, the average claim actually made is higher than \$4,600.) This figure shows the expected marginal warranty cost if the number of claims rises by 15, 20, 25, and 30 percent, respectively. Note that an engine costs about \$5 million.

**Expected Increases in Engine
Production Costs
(\$4,600 average claim baseline)**

Percentage increase	\$4,600 average claim	\$50,000 average claim
15	690	7,500
20	920	10,000
25	1,150	12,500
30	1,380	15,000

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These figures show the marginal increases in engine production costs for the range of percentage increases in warranty claims, assuming average baseline claims experience for all engines of, alternatively, \$4,600 and \$50,000. The latter figure is intended to provide a crude “upper bound” (or worst case) for analytic purposes.

Short-Run Share of Cost Increase Borne by DoD (percentage)

Supply elasticity	Demand Elasticity					
	0.1	0.5	1.0	1.5	2.0	3.0
0.1	50	17	9	6	5	3
0.5	83	50	33	25	20	14
1.0	91	67	50	40	33	25
1.5	94	75	60	50	43	33
2.0	95	80	67	57	50	40
3.0	97	86	75	67	60	50
Infinite	100	100	100	100	100	100

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Under a simplifying assumption of competitive conditions in the market for aircraft engines, the portion of increased marginal cost borne by the purchaser is determined by the price elasticities of demand and supply.

As shown in the table, the greater the demand elasticity (in absolute value) relative to the supply elasticity, the smaller the proportion of the cost increase that will be borne by the customer. For DoD, the worst theoretical case is that in which the supply elasticity is infinite, in which case the engine buyer would bear the entire increased cost in the form of a higher engine price.

Even in a sole-source environment, demand and cost conditions shape the bargaining response to an increase in costs. In any event, the next chart assumes the worst case (for DoD) for the purpose of estimating the attendant increase in engine prices.

Worst Case Expects Short-Run Increase in Engine Prices

- **Assumptions:**
 - Average claim per engine of \$50,000
 - 30-percent increase in claims rate
 - Least-favorable elasticity assumptions
- **Yields engine price increase of \$15,000**

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With an average per-engine claim of \$50,000, an increase in the number of claims of 30 percent, and the elasticity assumptions least favorable to DoD, engine prices would be expected to rise by \$15,000.

Bargaining More Likely to Yield Division of Costs

- **DoD is an important engine buyer**
- **Even at expected \$15,000 per engine and no price increase, cost increase is not likely to induce exit from industry**
 - 0.3 percent of \$5 million engine price
- **Bargaining likely to yield net benefits for DoD**
- **United experience:**
 - Increased warranty recoveries
 - No engine price increases
 - Stricter adherence to warranty claim time limits

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Since engine prices are the result of bargaining between DoD and the producers, the increased marginal production costs caused by greater prospective warranty recoveries would likely be shared in some proportion by DoD and the respective producers. This is partly because DoD is an important customer. Moreover, even if all of the increased costs were borne by the engine producers, the increase under our worst-case assumptions would be only 0.3 percent of an assumed \$5 million engine price; this is very unlikely to cause exit from the industry and thus price increases in the longer run. The experience of United Airlines is suggestive: The implementation of a third-party warranty claims recovery process yielded increased recoveries, no increase in engine prices, and stricter adherence to the time limits specified in the warranties.

Conclusions (1)

- **Results of this study are largely congruent with results from earlier research**
- **At a macro level the Service environment seems generally suitable for employing a warranty recovery contractor**
- **But at a detailed level, the issue is whether prospective additional recoveries would be significant**
- **Engine-by-engine analysis would yield more-definitive conclusions**

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In principle, our findings suggest that the use of contractors for additional engine warranty claims recoveries is feasible for some parts of DoD. The issue therefore is empirical: Do sufficient engines remain under warranty so as to make such a prospective undertaking reasonable? Our discussions with Giro indicated that it did not have an accurate estimate of the magnitude of the gains to be derived from such a program, despite the company's original proposal. Our own projections of the number of engines remaining under warranty suggest that there will be very few.

Conclusions (2)

- **At Service-level perspective, contracting for warranty recovery makes less sense**
 - Only ~634 engines under warranty by 2003
 - Services leaving warranties for other methods to assure flight performance
 - Using contractors to identify campaign problems with engines could be costly
 - Additional savings from increased warranty recoveries marginal by 2003: ~\$875K at 30-percent improvement in warranty claims recoveries
 - Given the maintenance environment, difficult to motivate mechanics to identify warranty items

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The declining number of engines under warranty suggests that the likely potential for increased financial recoveries by a claims contractor is small. Given the number of engines remaining under warranty by 2003—about 634—the potential additional dollars available is only about \$875,000, even under an assumption of a 30-percent increase in recoveries. This condition is exacerbated by the time needed to negotiate contractual arrangements, organize the contractor's presence at maintenance facilities, etc. Moreover, abstracting from the possibility that large new engine acquisitions may be programmed in the future, the Services are moving away from warranty arrangements for new engines in any event. Accordingly, it is our view that while a third-party warranty claims process in principle might be sound for DoD, current trends are likely to minimize the potential benefits of such an arrangement.

Conclusions (3)

- **Use of a commercial firm is feasible but impractical**
- **If the Services intended to maintain current warranties on engines, some additional savings might result**
- **Marginal potential gains and the move away from current warranties argue against hiring a commercial firm**

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BIBLIOGRAPHY

- Andrews, Melissa S., **Analysis of Navy Aircraft Engine and Engine Component Warranties**, Thesis, Naval Postgraduate School, DTIC AD-A276 936, December 1993.
- Arvai, Ernest, "Hidden Gold: Finding Lost Dollars in Warranty Claims," **MRO Management**, March 2001, pp. 16–18.
- Caldwell, Kent G., **Integration of Warranties into an Aircraft Engine Acquisition Strategy**, Thesis, Naval Postgraduate School, DTIC AD-A283 381, June 1994.
- Committee on Armed Services, United States Senate, **Warranties on Weapons Systems**, hearing, February 28, 1984, U.S. Government Printing Office, 1984.
- Defense Systems Management College, **Warranty Guidebook**, DTIC AD-A262 788, October 1992.
- Grossman, Sanford J., "The Informational Role of Warranties and Private Disclosure About Product Quality," **Journal of Law and Economics**, Vol. 24, December 1981, pp. 461–483.
- Kuenne, Robert, et al., **Warranties in Weapon System Procurement**, Boulder, Colo.: Westview Press, 1988.
- Lonsdale, Chris, "Locked-In to Supplier Dominance: On the Dangers of Asset Specificity for the Outsourcing Decision," **Journal of Supply Chain Management**, Spring 2001, pp. 22–27.
- Office of the Inspector General, Department of Defense, **Warranties for the Navy F-404 Jet Aircraft Engine**, Department of Defense, Report No. 94-041, February 14, 1994.
- Pickarz, Eugene J., Jr., **The C130 Hercules Acquisition Program, A Case Study of the Potential Impact of a System Level Warranty Application**, Thesis, Air Force Institute of Technology, DTIC AD-A174 340, September 1986.
- Priest, George L., "A Theory of the Consumer Product Warranty," **Yale Law Journal**, Vol. 90, No. 6, May 1981, pp. 1297–1352.
- Reiff, Sharon K., **The Effects of Warranty Legislation on Procurement**, Thesis, Naval Postgraduate School, December 1994.

Savage, Robert Willard, **Aviation Warranties: The Costs and Risks**, Thesis, Naval Postgraduate School, DTIC AD-A162 183, September 1985.

Stucker, James P., and Giles K. Smith, **Warranties for Weapons: Theory and Initial Assessment**, Santa Monica, Calif.: RAND N-2479-AF, April 1987.

United States General Accounting Office, **DoD Warranties: Improvements Needed in Implementation of Warranty Legislation**, Washington, D.C.: GAO/NSIAD-87-122, July 1987.

_____, **DoD Warranties: Effective Administration Systems Are Needed to Implement Warranties**, Washington, D.C.: GAO/NSIAD-89-57, September 1989.

_____, **Weapons Acquisition: Warranty Law Should Be Repealed**, Washington, D.C.: GAO/NSIAD-96-88, June 1996.

_____, **Contract Management: Pilot Program Needed to Improve DoD Identification of Warranty Claims**, Washington, D.C.: GAO/NSIAD-00-3, October 1999.

_____, **Defense Logistics: Air Force Report on Contractor Support Is Narrowly Focused**, Washington, D.C.: GAO/NSIAD-00-115, April 2000.

Van Der Stelt, Jay L., **The Feasibility of a Cost-Effectiveness Assessment of Weapon System Warranties: A Case Study of the F-16 Reliability Improvement Warranty (RIW) Program**, Thesis, Air Force Institute of Technology, DTIC AD-A174 588, September 1986.

White, Kevin L., **Issues in Navy Management of Major Weapon System Warranties**, Thesis, Naval Postgraduate School, DTIC AD-A178 795, December 1986.