JOURNAL OF PUBLIC PROCUREMENT, VOLUME 5, ISSUE 2, 164-186 2005

MEASUREMENT ISSUES IN PERFORMANCE-BASED LOGISTICS

Kenneth Doerr, Ira Lewis and Donald R. Eaton*

ABSTRACT. Performance Based Logistics (PBL) is an acquisition reform that is intended to improve weapon systems logistics by reducing cost, improving reliability, and reducing footprint. PBL is an extension of a broad process of rationalizing and, in many cases, outsourcing government services. As with other examples of governmental service outsourcing, measurement issues arise in the gap between governmental objectives and service measurement, and in the contrast between clear profit-centered vendor metrics, and more complex mission-oriented governmental metrics. Beyond this, however, PBL presents new challenges to the relationship between governmental agencies and their service vendors. In many cases, weapons systems logistical support involves levels of operational risk that are more difficult to measure and more difficult to value than other government services. We discuss the implications of operational risk and other measurement issues on PBL implementation.

INTRODUCTION

Attributes of the New Public Management (NPM) reforms include disaggregation and decentralization of public services, as well as an emphasis on the adoption of private sector management practices within

---

* *Kenneth Doerr, Ph.D., and Ira Lewis, Ph.D., are Associate Professors, and Donald R. Eaton, Rear Admiral (Retired), U.S. Navy, is a Senior Lecturer and Arthur Chair of Logistics, Naval Postgraduate School. Dr. Doerr's research interests include work design, decision making, and integrated risk management. Dr. Lewis's research interests include transportation, public policy, and the impact of information technology on logistics. RADM Eaton's research interests include enabling the Future Logistics Enterprise and the increased effectiveness of reliability management in the acquisition logistics process.*

the public sector (Osborne & McLaughlin, 2002). Accordingly, the NPM literature often addresses the establishment of alternative forms of service delivery, including outsourcing or privatization of government functions (Borins, 2002). It has been argued that where changes in institutional arrangements for service delivery are designed to give organizations specific mandates to focus on providing greater benefits to specific groups of users, responsiveness and the quality of service should improve (Aucoin, 1998). In addition, it has been asserted that reductions in information costs have led to an increase in the effectiveness of process-oriented structures, such as independent organizations with focused service delivery responsibilities, relative to functional structures with a wide scope of responsibilities such as large government departments (Jones & Thompson, 1999, p. 29).

Advocates of NPM also have leveraged the concept of the minimalist state, where government arranges for specific services but does not necessarily provide them (Jones & Thompson, 1999, p. 18; Savas, 2000, p. 65; Pollitt, 2002). In contrast to traditional public administration, NPM also is concerned with implementation rather than solely with policy prescriptions (Kelman, 2003). The focus is therefore more on the operation of management systems and techniques, and associated outcomes. Often these approaches cannot be decided upon or implemented unilaterally, but require some type of cooperative relationship between stakeholders (Jones, 2003). Such relationships fall within the scope of public procurement, whose nature and scope reflects the policy making and management functions of government (Thai, 2001). In particular, the management of relationships between government and suppliers during contract implementation has been suggested as a fruitful area for research, given the shift from a "transactional" to a "relational" philosophy (Wang & Bunn, 2004).

Performance Based Service Acquisition is a U.S. Department of Defense (DoD) acquisition reform that is intended to reduce the cost of non-core government services (Office of the Deputy Under Secretary of Defense – Defense Acquisition Reform [OSD-DAR], 2000). The guiding principle in Performance Based Service Acquisition is that when an outside vendor exists that can perform a service more effectively than a government user could organically (i.e., in-house), the government client should specify measurable outcomes to a service vendor, and allow the vendor to best determine the appropriate processes (the "how") of delivering the service. In adopting this reform, DoD has been

influenced by the perceived success of outsourcing in the private sector. Firms have witnessed gains from devolving non-core activities to suppliers, while achieving high levels of transparency so that visibility of inventory and information is maintained throughout the supply chain (Spekman & Davis, 2004). Performance Based Logistics (PBL) is an extension of Performance Based Service Acquisition aimed at improving support for major weapon systems such as ships, aircraft, or vehicles. The Quadrennial Defense Review mandated DoD to implement PBL, in order to "compress the supply chain and improve readiness for major weapons systems and commodities" (Office of the Secretary of Defense, 2001, p. 56). PBL is intended to reduce lifecycle cost, increase readiness, improve reliability and reduce the logistical footprint of weapon systems (Candreva et al., 2001; Camm, Blickstein & Venzor, 2004).

This paper will not re-examine the core questions of whether PBL works, or why it works, as those questions have been examined extensively elsewhere (e.g., Berkowitz et al., 2003). Rather, we take as our starting point the question of how best to measure the degree of the success of a PBL initiative. In support of our prescriptions for measurement, we will draw not only on successful best practices, but also on the underlying logic and justification of outsourcing, as laid out in the economics and management literature. While PBL prescriptions from the Office of the Secretary of Defense (OSD) are always careful to explain that a PBL initiative may result in the selection of an 'organic contractor' (i.e., another DoD organization), some of the same measurement issues arise regardless of the blend of private sector and organic resources.

While measuring the performance of ongoing PBL initiatives is our starting point, we also intend this paper to inform about valuation questions. From the initial question of whether to bring forward a weapon system or a major component of a weapon system as a candidate for PBL, to later contract design questions such as how to craft contractor incentives, or evaluate contractor performance, measurement issues are endemic. After all, the logistics services to be outsourced will be priced contractually, and for some services, there is no clear market to determine that price. Absent a clear market, prices must be negotiated, and the basis of that negotiation must be the value of the logistic service to the objectives of the organization.

For example, when discussing the transportation of freight within the U.S., prices are perhaps not difficult to determine by reference to a market for commercial transportation services. However, when discussing a service such as intermediate-level maintenance of a deployed weapon system such as an aircraft, on which the DoD has a monopsony and the number of qualified bidders is quite limited (and may indeed be only one or two), the market paradigm clearly breaks down, and market prices are not available. In such a case, the Department of Defense (DoD) must understand the value of intermediate maintenance on this aircraft to its overall objectives, in terms of availability of the aircraft to fly sorties; they must be able to measure and value increments of improved availability and use that value as the basis for pricing services.

In discussing whether a case could be made for the privatization of a particular governmental service, Bendick (1984) emphasized the importance of comparing private and 'nonmarket' (i.e., in-house) alternatives, and that the private sector should only be employed if it could reasonably be expected to be more efficient. Bendick (1984, pp. 153-154) listed.

> Four aspects of market efficiency [that] are important to examine:
>
> - In producing the services … do the private sector's production processes and input costs allow it to generate output at a lower total cost than could the public sector?
> - Are the administrative costs incurred by government to mobilize and control the private sector less than the cost savings from more efficient production?
> - Is the supply side of the market sufficiently responsive that private firms enter markets rapidly and smoothly?
> - Are purchasers sufficiently rational and careful, and the quality of the service sufficiently definable and measurable, that effective, informed consumer sovereignty can be exercised?

Each of these considerations is potentially problematic when examining PBL initiatives. When considering the first of the above factors, the existence of PBL contracts in which the private sector vendor has hired back organic resources (i.e., DoD maintenance employees) as subcontractors to do the actual work puts in question exactly what

services are being outsourced – logistics or management? When considering the third factor, the consolidation of the defense industry and the decline of the number of independent companies that might act as potential bidders raise concern about the responsiveness of the supply side of the market. However, this paper is primarily concerned with the second, and especially the fourth of the above factors. In particular with regard to the fourth factor, we agree with Bendick that good measurement is necessary to 'consumer sovereignty' when purchasing logistics services, and makes the difference between an environment of 'let the buyer beware' on the one hand, and 'the customer is king' on the other.

The rest of the paper will be organized as follows. First, we will establish a structural framework upon which measurement issues will be developed. Upon that framework, we will then develop questions about how measurement informs which sorts of candidates are best suited for PBL. Finally, we will discuss how measurement issues should be considered in the management of ongoing PBL contracts. We are not attempting to clearly delineate between good and bad measures, or good or bad candidates for PBL. Rather, we are attempting to surface imbedded measurement-related issues that may make the difference between a problematic implementation and an easy one. Thus, this paper is not intended as a guidebook for implementation, but rather as a framework for further investigation.

A MEASUREMENT FRAMEWORK FOR PBL

When describing the acquisition of logistics support for a weapon system as an economic game, it is important at the outset to note the dissimilarity between the two players – the vendor and the government. The vendor has a clear objective of maximizing its owners' wealth, and a clear profit incentive (again, we assume throughout the paper that we are dealing with a private-sector vendor). The objective of the government in acquiring the service is not so easy to state, and far more difficult to assess. Ambiguities in goals and a lack of linkage between services acquisition goals and strategic objectives are intrinsic aspects of the services acquisition process (Camm, Blickstein & Venzor, 2004; Ausink, Baldwin, Hunter & Shirley, 2002).

DoD efforts to reform acquisition, particularly through increased private sector involvement, can best be characterized as a tapestry of

initiatives that share common characteristics and major distinctions. In particular, the consensus seems to have emerged that while encouraged by the top leadership of DoD (the Office of the Secretary of Defense [OSD]), none of the documented reform initiatives can be traced back to OSD policy direction (Camm, Blickstein & Venzor, 2004, p. xvii; Gansler, Luby & Kornberg, 2004, p. xi).

What seems to have occurred is a case of emergent policy rather than explicit or deliberate policy, with little relationship between actual reform and strategic goals (Mintzberg, 1994, pp. 24-27). The Defense Business Board, a senior advisory council appointed by the Secretary of Defense, confirmed the lack of standard guidance on PBL and expressed the need for a "business case analysis" to determine if PBL is even the most suitable approach for a given weapon system (U.S. Department of Defense, 2003, p. 4)

Maximizing national security would be one way to state the objective, and the incentive (at least at the organizational level) might be understood in the same terms – to gain more security for the nation. At the outset then, the game has a measurement and a translation problem – measuring the services in terms of their contribution to the objectives and incentives of the DoD, and translating that measure into the dollar measurement used by the private sector.

Of course, it might be claimed that business does not really have such clear objectives and incentives either. There is a venerable literature pointing out that maximization of shareholder wealth should not be (and is not in practice) the sole aim of a public corporation. Stakeholder analysis, which examines the roles and rights and responsibilities of non-shareholder stakeholders in public firms, has its roots in this observation that the firm has obligations beyond maximizing shareholder wealth (Donaldson & Preston, 1995). But even stakeholder analysis (in narrow form at least) does not deny the centrality of profit as a corporate incentive; rather the discussion centers on rights of resource holders, and equitable distribution of profits.

The management fashion of Balanced Scorecards has demonstrated the willingness of corporate executives to look beyond profit in analyzing performance (Kaplan & Norton, 1992). Balanced Scorecards are a popular method of assessing performance using non-financial, as well as financial data. The name 'Balanced Scorecard' comes from the notion of a scorecard with various scaled factors, which are weighted (or

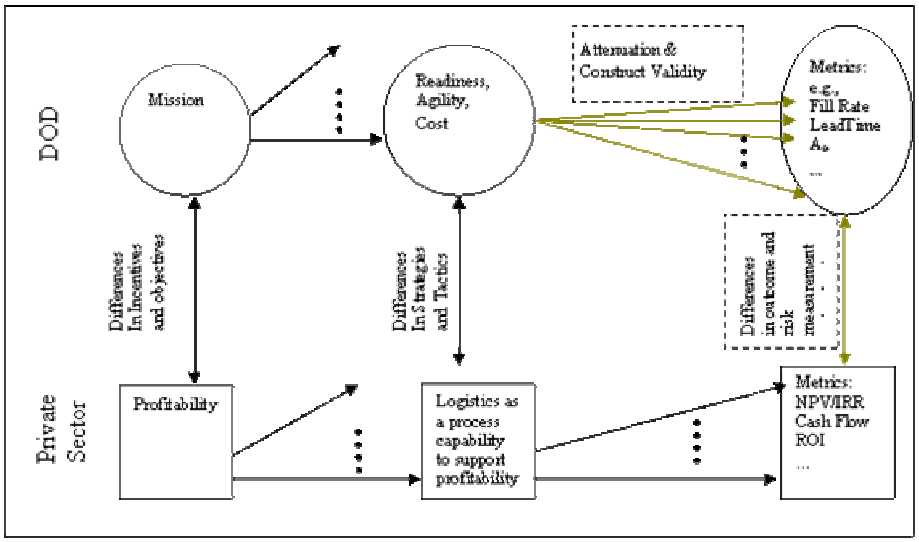
balanced) and aggregated to determine an overall performance score. But it would be a mistake to take the current proliferation of Balanced Scorecards as evidence that corporations suffer under the same sorts of fundamental measurement problems with their objectives and incentives as the DoD. The Balanced Scorecard is clearly meant to be a *diagnostic tool* to inform management decisions beyond retrospective financial figures about the long-term viability of the firm (i.e., it is meant in part to help predict and control *future* financial performance).

Kaplan & Norton (1992) discuss the shortcomings of financial performance measures in terms of their ability to guide (1) the innovation necessary to obtain future profitability, (2) the diagnosis of internal process problems that limit current and future profitability and (3) the relationship with the customer necessary to sustain future profitability. Their main criticisms of current financial measures (which are a part of the Balanced Scorecard) are that they are historical and external to operations. They tell a firm how well it has performed, not why, or what to do next to maintain or improve future performance.

But measurement-related differences between the DoD and the corporate world exist not only in the incentives and objectives of each, but also in the process capabilities that are important in developing logistics tactics to meet those objectives (See Figure 1). In translating the high-level objectives and incentives of the organization into concrete metrics, private sector organizations again have an advantage. The process capabilities private sector firms are investing in to provide logistic services are relatively easy to relate to profitability. The services to be outsourced, however, are more difficult to measure, and more difficult to relate to high-level DoD objectives.

For example, in reviewing essential dimensions to be considered in logistics performance analysis in the commercial sector, Mentzer & Konrad (1991) developed a matrix in which five core logistics functions (transportation, warehousing, inventory, order processing and administration) could be measured along six dimensions (cost, labor, facilities, equipment, time and energy). Contrast those six dimensions with the four "overarching goals of PBL … to compress the supply chain, eliminate non-value added steps, reduce Total Ownership Cost and improve readiness for weapons systems…"[1] (Department of Defense – Defense Contract Management Agency [DoD-DCMA], undated).

FIGURE 1
A Hierarchical Framework of Measurement Issues



These four factors seem to have little in common. But all of the commercial sector factors can be translated into dollars, and can be understood as the essential dimensions that must be managed efficiently and effectively, in order to facilitate logistics support of the firm's profitability objective. The DoD factors, on the other hand, do not all translate so readily into dollars, and fall into three categories or dimensions that demonstrate how logistics support is intended to improve warfighting capability: improved readiness (facilitated both directly by a focus on readiness and indirectly by a focus on reliability), increased agility (reducing logistical footprint, eliminating non-value-added steps, supply chain compression, and improved reliability) and reducing cost (by freeing capital for other warfighting priorities).

These measures highlight a significant difference in how logistics is viewed. The concept of readiness shows up as 'equipment' to commercial firms, who view the maintenance and functioning (and depreciation) of their operating capital primarily as a financial question – when will it become so expensive to maintain that I will have to replace it? Since DoD weapon systems are often quite old, very expensive and difficult to re-capitalize (lacking a depreciation mechanism,

recapitalization is often driven by technological obsolescence or budget constraints), readiness is a much more central issue. Improvements in readiness, of course, improve warfighting capability; but marginal improvements are quite difficult to value in dollar terms. Commercial firms, on the other hand, view improvements in readiness in terms of maintenance and reliability. A proposed engineering change to improve reliability will be weighed, not against a constrained budget available for such improvements, but against the increased profit obtainable from reduced maintenance down time, etc.

The idea of 'agility' is increasingly important to commercial firms, but agility in a commercial operation means, for example, the flexibility to quickly change production volumes or quickly changing production technology. It shows up in the list above as 'time', because changing production volumes, models, or technology often involves expensive process down time. DoD operations on the other hand are mobile, and mobility directly impacts their effectiveness. Agility is not a newly discovered competitive dimension in the DoD – it has always been an operational necessity. Once again, however, the operational effectiveness derived from a marginal improvement in logistics agility is very difficult to translate into dollars.

These differences in organizational objectives and the consequent logistics objectives further devolve into differences in process measurement. Caplice and Sheffi (1994), in a classification and review of corporate logistics process metrics develop three categories: utilization, productivity, and effectiveness (see Table 1). Utilization measures simply address the question of how much of a resource is used, compared to what has been made available. While these sorts of measures may be useful in assessing the efficiency of a narrow segment of a process (e.g., space utilization may be useful in assessing the efficiency of a facilities layout manager), they have virtually no contribution to the understanding of the role of logistics in meeting organizational objectives, primarily because they do not measure outputs at all.

It might be claimed that they measure waste, but even this is not true – all they measure is activity, not whether that activity is directed toward some valued outcome. What Caplice and Sheffi (1994) have called effectiveness measures, on the other hand, beg the question in an

TABLE 1
Corporate Logistics Metrics

Dimension	Form of Metric	Logistics Examples
Utilization	Actual Input / Input Norm	- Labor hour used / labor hours budgeted - Area of warehouse occupied / total area - Hours machine used / machine capacity
Productivity	Actual Output / Actual Input	- Ton-miles delivered / costs incurred - Orders processed / hours of labor - Pallets unloaded / hour of dock time
Effectiveness	Actual Output / Output Norm	- Items filled / items requested - Shipments on time / shipments sent - Transactions w/o error / total transactions

Source: Caplice and Sheffi (1994).

essential way – those measures are only as good as the norms one establishes for outputs. They may be useful for historical comparison of a single process, but their value in comparing across processes or in guiding resource allocation decisions is quite limited, because the norms established are not necessarily comparable across processes.

Productivity measures, on the other hand, incorporate both outputs and inputs. For the corporation, assessing the contribution of an activity to its objectives is a matter of relating those inputs/outputs to profits. While of course this is not necessarily easy (e.g., single factor productivity measures do not capture a comprehensive cost picture), at least the examples given by Caplice and Sheffi (1994) can be measured or translated to dollars (e.g., dollars paid for orders processed, or shipments made), and this is broadly true of metrics proposed in other reviews of corporate logistics performance measurement systems as well (e.g., Chow, Heaver & Henriksson, 1994; Lambert & Burduroglu, 2000; Mentzer & Konrad, 1991), with the important exception of customer satisfaction metrics.

The importance of the 'customer view' has already been mentioned in relation to balanced scorecards, is often mentioned by authors on logistics performance measurement (e.g., Mentzer, Flint & Kent, 1999). Customer satisfaction is an important predictor of future success, as dissatisfied customers are unlikely to return. It is also a way to gauge the quality of service delivery, which is difficult to measure through direct observation of the process. However, it is also worth noting that

Lambert and Burduroglu (2000) list "reliance on management outside of logistics to identify the impact [of customer satisfaction] on revenues, which typically does not happen" as a primary *disadvantage* of customer satisfaction measurement. Hence, beyond simple utilization measures, corporate logistics performance measures can, or are desired to be, understood in terms of their impact on profitability.

Compare those corporate logistics measures to what might be proposed as a productivity ratio for weapons systems logistics:

$$A_o = \frac{\text{Fully mission capable hours available}}{\text{Total deployed hours}}$$

Where:

A_o: Operational Availability
A_{mch}: Fully mission capable hours available
T_{dh}: Total deployed hours

For example, if 10 aircraft are deployed in a squadron in a given month, and nine of them are fully mission capable for the whole month while the 10^{th} is down for maintenance the whole month, that squadron would report an A_o of 90%. At first glance, this looks like a utilization measure, not a productivity measure – but A_o is often used as a surrogate for readiness in the military context, which is typically given as a primary *outcome* objective of military logistics. The denominator translates to dollars in a budget (whether or not they could be translated to an actual cost is another issue). But the numerator is not and should not be translatable to dollars, because profit is not the objective. While measurable, it should not be valued solely in terms of the dollars that might be spent to increase it, or relinquished in order to pursue other priorities. That is, while the cost of making a weapon system fully mission capable may be estimable, the benefit (which is what should be gauged in the numerator) is far more difficult to assess in dollar terms.

Another problem is that A_o is only a surrogate for readiness because it is a 'single factor' measure. It is also not fine-grained enough for many resource allocation decisions we wish to make. Hence, the distinction is between a mission capable system (which can perform some missions) and a fully mission capable system (which can perform any mission reasonably expected of the platform). And finally readiness itself, after all, is only a surrogate for the organizational objectives of the

DoD (i.e., ready for what?). Note that if A_o were really the objective, it could be maximized by parking equipment, because then it would almost never break. Hence, logistics performance of weapon systems is more difficult to measure than commercial logistics (at least in terms of productivity), and perhaps more attenuated from DoD objectives than are commercial logistics measurement systems.

How do these measurement issues inform the decision to bring forward a weapon system or component as a candidate for PBL? First, again considering only outsourced PBL solutions, we must consider the economic logic behind outsourcing. One basic economic justification of outsourcing is the tradeoff of economies of scale with reduction in transaction costs. If the outsourced service can be performed by an organization that offers similar services to a number of other customers, that organization gains economies of scale, and should be able to offer the service more cheaply than if it were done by the outsourcing organization in-house. The price that is usually paid for such outsourced services is usually in terms of increased transaction costs to negotiate price and services, and monitor performance (Gustafson, Aubert, Rivard & Patry, 1996).

When economies of scale are difficult to obtain, as with a unique weapon system requirement, some of the underlying justification for outsourcing disappears. On the other hand, high internal transaction costs, due to constraints such as onerous reporting requirements or inefficient internal controls make outsourcing relatively more attractive. If high internal transaction costs are part of the justification for outsourcing a PBL contract, then it is important that the system or component being outsourced avoid some of those transaction costs. As measurement of logistics outcomes (readiness, agility and cost) is more difficult, it means higher transaction costs, because performance-monitoring systems will have to be more elaborate, and fair prices will be more difficult to determine and negotiate.

One way to make pricing and performance monitoring easier is by reference to a market for similar services. Hence, in prescribing a methodology for the analysis of performance-based contracts for contract managers, market research is indicated as a required step (OSD-DAR, 2000). For comprehensive weapon system logistical support, or for weapon system-unique components, there will likely be no ready market for maintenance, or many other logistical support functions. In those cases, the implementation of an outsourced PBL solution will require

more cost and effort to develop appropriate metrics, and negotiate appropriate prices. It is our sense, based on anecdotal evidence, that this is currently done through a qualitative process involving budget constraints on the one hand, and the cost estimates provided by private sector bids on the other. But neither of these mechanisms necessarily correlates with the value of the outsourced service in terms of DoD objectives.

In summary, measurement issues are endemic to the relationship between commercial sector vendors and the DoD. From the point of view of measurement, the best PBL candidates are those with external markets for services, and clear outcomes that are easy to relate to mission objectives. When markets are not available, or when components or logistical elements to be outsourced are so deeply embedded in a weapon system that support services are difficult to tie to warfighting outcomes, better tools and guidance are needed to support valuation decisions and contract negotiations.

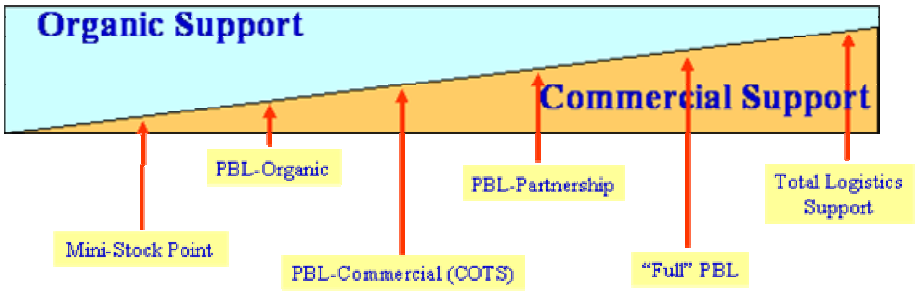
MEASUREMENT, THE PBL SUPPORT SPECTRUM AND THE MANAGEMENT OF ONGOING CONTRACTS

One of the features of PBL is that general characterizations are hard to make. The top-level guidance for the initiative always has caveats such as:

> There is no one-size-fits-all approach to PBL. Several programs have started the move to PBL under initiatives designed to meet the programs' specific requirements. Each program has tailored the PBL application to its unique circumstances taking into account cost, schedule, or product integrity to meet warfighter capability. (DoD, 2001, p. 2-2)

In reviewing implementations, a wide variety of approaches can be found, in terms of measurement and incentives, and in terms of the level at which the PBL contract is written: from a complete weapon system such as a destroyer, to component level stock support, as with a specific type of aircraft engine. The spectrum of choices is usually described in terms of the degree of commercial support involved, and a frequently encountered graphic (which we have been unable to track to its original source) is shown in Figure 2. The range of commercial involvement in logistics services is intended to demonstrate that PBL may be used from

FIGURE 2
The Performance Based Logistics Support Spectrum



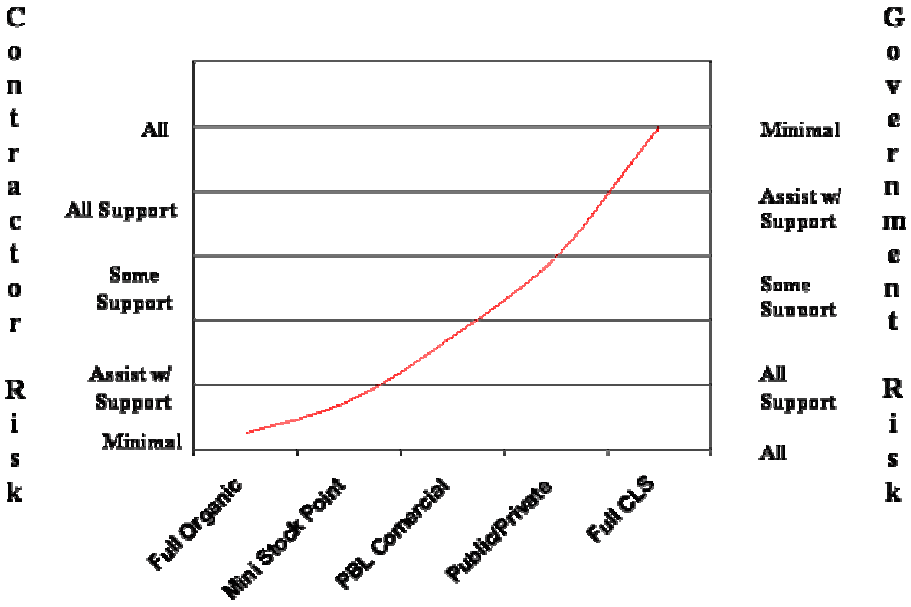
Note: COTS means "Commercial off-the-shelf."

the platform level (so that all logistics services for an entire weapon system are outsourced) to the outsourcing of a single logistical element of a single component (e.g., training material for intermediate maintenance of a radio). While examples of systems are often given in association with this chart, and definitions of the various anchor points (e.g., a Mini-Stock Point, or consolidated inventory warehouse) are offered, very little guidance can be found for the government contract manager as to what characteristics of a weapon system should inform the choice of the degree of commercial involvement, and whether the contract should be offered at the system, or component level. It is our position that measurement issues should inform this choice.

A primary aspect of measurement informing the choice of commercial involvement, which we have not discussed yet, is risk. The notion of risk is receiving greater attention in research on logistics (Spekman & Davis, 2004). Private sector vendors will be primarily interested in reductions of financial risk (i.e., a long term contract), because investments in capital required, for example, to improve is provided only for a single year. However, the DoD is primarily concerned with operational risk, because that relates directly to its ability to meet mission objectives. The tradeoff of these two kinds of risk is central to the logic of PBL outsourcing. PBL contracts are almost always offered across multiple years (lowering financial risk for the vendor), with the expectation that the vendor will assume some degree of operational risk. Figure 3 shows the expected assumption of operational

risk by the vendor. The DoD intends to 'transfer risk' to vendors under PBL contracts, but to our knowledge the nature of the risk to be transferred has not been made explicit, nor has the mechanism for transferring risk been explained.

FIGURE 3
Intended Risk Transfer under PBL



Note: CLS means "Contractor Logistics Support."
Source: DoD-DCMA (undated).

When discussing risk transfer in the private sector, one typically refers to an arrangement in which downside process variance, or unexpected operational problems are remedied by the organization that has assumed the risk, without recourse to the firm that has transferred it (and paid for that transfer). For example, a firm undertaking to deliver a package overnight assumes the operational risk of, for example, a truck

breakdown, and must make contingency plans by having additional trucks or an alternative carrier available.

Thus, the intent of 'risk transfer' for the DoD must involve responsibility and accountability for operations in the ongoing performance of a PBL contract. However, although risk is clearly indicated as a factor to consider when developing a PBL strategy (ASN-RDA, 2003; Office of the Assistant Deputy Under Secretary of Defense – Logistics & Material Readiness [OSD-LMR], Undated, pp. 28-29), this factor is rarely mentioned as a candidate for measures of ongoing performance in PBL contracts. Indeed, it has been said that

> Minimal contract management involvement is anticipated as long as the contractor meets contractually specified performance metrics. However our involvement may increase if the contractor systems and processes are not functioning correctly and end users are not appropriately supported (DoD-DCMA, undated, pp 28-29).

This is a curious form of risk transfer. If the DoD is to 'increase involvement' whenever problems occur, in what way can it be said that the responsibility and accountability of the vendor has increased? We do not claim that this is risk transfer in name only, but that the degree of risk that vendors are assuming is apparently quite limited because the DoD is ready to assist when 'processes are not functioning correctly'.

THE ROLE OF RISK IN DETERMINING OUTSOURCING STRATEGY

It is our view that the degree of operational risk a contractor can assume is limited in many cases by the nature of military operations. It is unrealistic, for example, to assume that contractors will easily be able to perform operational level maintenance on a ground combat weapon system; difficult issues relating to the physical risk, insurance, and liability of non-military personnel in or near combat need to be addressed. The legal issues are beyond the scope of the current paper, but the difficulty of valuation alone may make the private sector reluctant to assume such risk. Activities such as heavy maintenance at a contractor facility, or the management of inventories of spare parts involve less operational risk. In these circumstances, risk is also in a form that is easier to measure and less costly for a vendor to assume. We therefore believe it is likely that the more operational risk involved in the

logistical support of a particular system, the more organic resources will need to be involved:

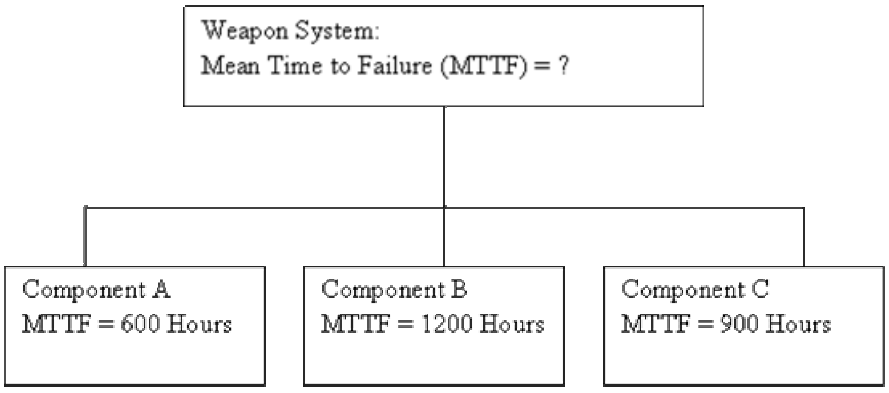
Proposition 1. When operational risk is high or difficult to measure, PBL strategies should seek less commercial sector involvement.

Within the context of a price negotiation, it is also key to understand the benefit we provide by eliminating financial risk, as this is part of what we are paying to potential vendors. Especially if interest rates rise and the difference between the cost of capital and risk-free rates increase, what the DoD offers in terms of financial risk mitigation is highly valuable. This valuable benefit is not free for the government to offer and should be incorporated into pricing and contract negotiations. If the vendor assumes less operational risk (or if that risk is difficult to assess), less financial risk should be mitigated – meaning contract terms should be reduced:

Proposition 2. When commercial sector vendors assume less (measurable) operational risk under a PBL contract, the term of that contract should be less.

On the other hand, the outcomes of PBL strategies involving only certain components, or only depot-level support, are more difficult to tie to weapon system outcomes. Consider Figure 4, which shows a highly stylized and simplified version of a weapon system and its major

FIGURE 4
Need for Integrated System Model to Judge Impact of Component Outcomes



components, along with the failure rates (mean time between failures) of each of the components. Assuming failure of any of the components cause the weapon system to become non-mission capable, the failure rate of the overall weapon system can then be obtained through a known formula (an order statistic), using the *distributions* of the time to failure of *all* of the components. Now consider the problem faced by a contract manager who has decided that his or her best PBL strategy involves outsourcing only component A (the one with the highest failure rate).

To properly value the impact of, for example, a proposed incentive to improve the reliability of component A by 10%, the program manager would need not only distributional information about the time to fail of all the other components, but also a working model which imbeds the entire weapon system in mission requirements. After all, the final value of an improvement in reliability of a component (to readiness – of course there are other benefits in terms of reduced life-cycle cost of spares, and improved agility through reduced footprint) rests in the increased likelihood of mission success in the deployed weapon system. The sort of integrated simulation model needed to properly assess the impact of improved component reliability would be expensive, and more importantly, time consuming to build. Nonetheless, we think such models should be necessary conditions of outsourcing at the component level.

Proposition 3. PBL strategies involving less than comprehensive logistical support of a weapon system (e.g., for a component) should nonetheless have integrated weapons system models in support of their business case analysis.

In summary, measurement issues exist across the PBL spectrum (Figure 2), but present different sorts of challenges at either end. Ultimately there are at least two core measurement issues that should be referred to when deciding on an appropriate level of support within the PBL spectrum. The first is the valuation of outcome-related performance, and the second is valuation of operational and financial risk. While outcomes are easier to measure at the right end of the spectrum, one is less likely to find a relevant market to support price and value decisions. On the left end of the spectrum, markets may well exist that essentially duplicate, for example, the services of a mini-stock point. However, the valuation of those isolated services in terms of weapon systems performance is even more difficult.

CONCLUSION

The Department of Defense faces major challenges in establishing a coherent logistics support strategy for its weapon systems. While Performance-Based Logistics has been decreed as a preferred implementation strategy, real questions remain unanswered about objectives and measurability. The disaggregation of logistics support and the emphasis on an increased role for the private sector in logistics also raise major issues related to the assumption of risk. In making sourcing decisions, DoD must act as a "knowledgeable client" and avoid simplistic decisions that may lead to critical systems being left unsupported.

This paper has presented a framework and propositions related to the impact of risk and measurement on performance-based logistics. None of the propositions have the status of fully supported hypotheses, or fully developed theorems. All need further investigation. Some of the propositions are empirical, and need to be investigated in the field. Others are prescriptive, and need to be supported by modeling and analysis. Our hope is that we have furthered the discussion of metrics for PBL and added to the momentum for improved implementations of logistics outsourcing.

NOTES

1. One should probably add "increased reliability and reduced logistics footprint" as two additional goals of PBL (Office of the Secretary of Defense [OSD], 2003).

REFERENCES

Assistant Secretary of the Navy – Research, Development and Acquisition [ASN-RDA] (2003). *Performance Based Logistics Guidance Document* (Unpublished manuscript). Washington, DC: Author.

Aucoin, P. (1998). "Restructuring Government of the Management and Delivery of Public Services. In B. G. Peters & D. J. Savoie, eds., *Taking Stock: Assessing Public Sector Reforms* (pp. 310-347). Montreal, Canada: McGill-Queens University Press.

Ausink, J., Baldwin, L. H., Hunter S., & Shirley, C. (2002). *Implementing Performance-Based Services Acquisition (PBSA): Perspectives from an Air Logistics Center and a Product Center* (Report No. DB-388). Santa Monica, CA: RAND Corporation.

Bendick, M. (1984). "Privatization of Public Services: Recent Experience." In H. Brooks, L. Liebman & C. Schelling (Eds.), *Public-Private Partnership* [pp. 153-171]. Cambridge, MA: Ballinger Publishing Company.

Berkowitz, D., Gupta, J. N.D., Simpson, J.T., McWilliams, J., Delayne, L., Brown, B., Cameron, D., & T. Sparks (2003). *Performance Based Logistics*. Huntsville, AL: Center for the Management of Science and Technology.

Borins, S. (2002). "New Public Management, North American Style." In K. McLaughlin, S. P. Osborne and E. Ferlie (Eds.), *New Public Management: Current Trends and Future Prospects* (pp. 181-194). New York: Routledge.

Camm, F. A., Blickstein, I., & Venzor, J. (2004). *Recent Large Service Acquisitions in the Department of Defense: Lessons for the Office of the Secretary of Defense* (Report No. MG-107). Santa Monica, CA: RAND Corporation.

Candreva, P., Hill, B., Marcinek, B., Sturken, B., & Vince, B. (2001). *Auxiliary Power Units Total Logistics Support Case Study* (Working Paper). Athens, GA: Tench Francis School of Business, Navy Supply Corps School.

Caplice, C. & Sheffi, Y. (1994). "A Review and Evaluation of Logistics Metrics." *The International Journal of Logistics Management*, *5* (2): 11-28.

Chow, G., Heaver, T. D., & Henriksson, L. E. (1994). "Logistics Performance: Definition and Measurement." *International Journal of Physical Distribution & Logistics Management*, *24* (1): 17-28.

Department of Defense [DoD] (2001, November). *Product Support: A Program Managers Guide to Buying Performance*. Arlington, VA: Author.

Department of Defense – Defense Contract Management Agency [DoD – DCMA] (undated). *Performance Based Logistics Support Guidebook*

(In DCMA Directive 1, Chapter 2.3, Acquisition Logistics). Arlington, VA: Author.

Donaldson, T., & Preston, L. E. (1995). "The Stakeholder Theory of the Corporation: Concepts, Evidence, and Implications." *Academy of Management Review*, *20* (1): 65-91.

Gansler, J. S., Luby, R. E., Jr., & Kornberg, B. (2004). "What is Supply Chain management." In J. S. Gansler & R. E. Luby, Jr. (Eds.), *Transforming Government Supply Chain Management* (pp. 3-17). Lanham, MD: Rowman & Littlefield.

Gustafson, K., Aubert, B. A., Rivard, S., & Patry, M. (1996). "A Transaction Cost Approach to outsourcing behavior: Some empirical evidence." *Information & Management*, *30* (2): 51-90.

Jones, L. R., & Thompson, F. (1999). *Public Management: Institutional Renewal for the 21st Century*. Stamford, CT: JAI-Elsevier Press.

Jones, L. R. (2003). "The M in Management: How Do We Define Public Management?" *International Public Management Review*, *4* (2): 1-19.

Kaplan, R. S., & Norton, D. P. (1992). "The Balanced Scorecard – Measures that Drive Performance." *Harvard Business Review*, *70* (1): 71-79.

Kelman, S. (2003). "The M in APPAM: Holding on to a Prescriptive Past as we Grope Towards a (Multi-) Disciplinary Future." *International Public Management Review*, *4* (2): 2-5.

Lambert, D.M. & Burduroglu, R. (2000). "Measuring and Selling the Value of Logistics." *The International Journal of Logistics Management*, *11* (1): 1-17.

Mentzer, J.T., Flint, D.J., & Kent, J.L. (1999). "Developing a Logistics Service Quality Scale." *Journal of Business Logistics*, *20* (1): 9-32.

Mentzer, J.T., & Konrad, B. P. (1991). "An Efficiency/Effectiveness Approach to Logistics Performance Analysis." *Journal of Business Logistics*, *12* (1): 33-62.

Mintzberg, H., 1994. *The Rise and Fall of Strategic Planning*. New York: The Free Press.

Office of the Assistant Deputy under Secretary of Defense – Logistics & Material Readiness [OSD-LMR] (undated). *DOD Template for Application of TLCSM and PBL in the Weapon System Life Cycle*. Arlington, VA: Author.

Office of the Deputy Under Secretary of Defense – Defense Acquisition Reform [OSD-DAR] (2000). *The Guidebook for Performance-Based Services Acquisition (PBSA) in the Department of Defense*. Arlington, VA: Author.

Office of the Secretary of Defense [OSD] (2003, May 29). *Designing and Assessing Supportability in DOD Weapon Systems*. Arlington, VA: Author.

Office of the Secretary of Defense [OSD] (2001, September 30). *Quadrennial Defense Review Report*. [Online]. Available at www.defenselink.mil/pubs/qdr2001.pdf (Retrieved July 6, 2004).

Office of the Secretary of Defense, Undersecretary for Acquisition, Technology & Logistics [OSD-ATL] (2004). "PBL Purchasing Using Performance Based Criteria." paper presented at the 2004 DoD Procurement Conference, May 25-28, Orlando, Florida.

Osborne, S. P., & McLaughlin, K. (2002). "The New Public Management in Context." In K. McLaughlin, S. P. Osborne, & E. Ferlie (Eds.), *New Public Management: Current Trends and Future Prospect* (pp. 7-14). New York: Routledge.

Pollitt, C. (2002). "The New Public Management in International Perspective: An Analysis of Impacts and Effects." In K. McLaughlin, S. P., Osborne & E. Ferlie (Eds.), *New Public Management: Current Trends and Future Prospects* (pp. 274-292). New York: Routledge.

Savas, E. S. (2000). *Privatization and Public-Private Partnerships*. New York: Seven Bridges Press.

Spekman, R. E., & Davis, D. E. (2004) "Risky Business: Expanding the Discussion on Risk and the Extended Enterprise." *International Journal of Physical Distribution & Logistics Management*, 34 (5), 414-433.

Thai, K. V. (2001). "Public Procurement Re-Examined." *Journal of Public Procurement*, 1(1): 9-50.

U.S. Department of Defense (2003, October 15). *Defense Business Board. Report to the Senior Executive Council, Department of Defense: Supply Chain/Performance-Based Logistics Task Group* (Report FY03-4). [Online]. Available at www.defenselink.mil/dbb/pdf/Supply-Chain-Report.pdf (Retrieved on September 7, 2004).

Wang, S., & Bunn, M. D. (2004). "Government/Business Relationships: Insights into Contract Implementation." *Journal of Public Procurement*, *4* (1): 84-115.