Contracting for Product Support under Information Asymmetry

Key words: service contracts, product support, reliability, MRO operations, information asymmetry, screening, game theory

1. Introduction

With increasing competitiveness and shrinking margins in the product market, maintenance, repair and overhaul (MRO) services have become more lucrative and continue to grow. In the US, the aftermarket is four times larger than the original equipment business and accounts for 8% of GDP (almost $1 trillion) (Cohen et al. 2006). The boom in the MRO market stems from increased outsourcing of product support and it is reported that MRO outsourcing can realize cost savings in the range of 10% - 20% (Gupta and Menon 2012). However, over and above cost concerns, product availability and reliability are often the most important considerations for both customers and suppliers when building the contractual relationship (Yoo 2012), as system failures impact the supply chain partners’ short-term payoffs as well as long-term customer satisfaction. In this regards, the service provider typically does not have access to equipment usage data or failure history, whereas the customer, i.e., the long-term owner and user of the product, has more accurate information about the product failure rate before signing the contract.

Two forms of service contracts are widely employed in such settings — transaction-based contracts (TBC) and performance-based contracts (PBC). TBC, also called Time & Material Contract, is a more traditional service agreement, under which the supplier is compensated based on consumption of manpower and components during the service transaction (repairs). PBC is more recent, and allows the customer to pay for the outcome of deploying the product, rather than for the resources used in sustaining the product. Thus, system failures drive the supplier’s charges for MRO operations under TBC, while the supplier receives payment based on system uptime under PBC.
Clearly, TBC and PBC create different incentives for the supplier. In the literature, the advantages of PBC are strongly advocated. PBC is claimed to better align the incentives between the customer and the supplier (Cohen et al. 2006), improving product availability (Guajardo et al. 2012), and reducing maintenance costs (Kim et al. 2007, Anastasopoulos et al. 2010). However, those findings are not completely in line with observations in practice, where we do not see a complete dominance of PBCs, and rather, TBCs are still widely adopted by companies when providing product support services. Hence, in this paper, we aim to explain how the choice of MRO contracts is impacted by information asymmetry. Specifically, we try to answer the following managerial questions: If the MRO service provider faces information asymmetry about equipment failure rate, how can he design the pricing terms as well as make capacity investment under different contracts? Can these service contracts achieve efficiency? Does one contract type have a higher efficiency than the other in the presence of privately-informed customers?

2. Methodology and Assumptions
We build a stylized adverse selection model to capture the above setting, where the MRO service supplier lacks information about product reliability when contracting with the equipment user, i.e., the customer. The supplier makes contingent decisions about the service price (i.e., the price for each failure restoration under TBC or the price per uptime use of equipment under PBC) and optimal repair capacities which are proposed as a menu of contract terms; and then the customer makes a contract choice based on their (private) type of product failure rates. The customer only accepts the contract if its utility derived from the supplier’s service during the contract period is no less than an outside option. In addition, investing in service capacity incurs costs. Hence, the supplier faces a tradeoff between realizing high product availability and maximizing its profit.

We assume that product failure occurs randomly and that the repair process is an $M/G/\infty$ queue. To capture information asymmetry, we assume that the product failure rate has two types – high and low, and that the supplier has an ex-ante estimate of the probability of these two types of product quality.

3. Main Results
We analyze the screening equilibria and compare the outcomes under each contract. We find that both TBC and PBC can enable the supplier to achieve separation of product
reliability by transferring information rents to the customer. However, they differ in the way the information rent is realized - under TBC, pricing and capacity decisions are decoupled, and no efficiency is lost with regards to capacity investment; by contrast, PBC entangles pricing with capacity setting, which leads to over-investment in capacity.

In addition, we find that no contract is dominant. Instead, the magnitude of information rents under both contracts relates to the customer’s reservation payoff in different ways, and the customer and the supplier tend to have opposing preferences regarding contract types. Specifically, under TBC (PBC), the amount of information rent decreases (increases) with the customer’s reservation utility. Given a low outside option, TBC results in higher information rent than PBC, so the customer prefers TBC due to increased surplus, while the supplier prefers PBC due to lower screening costs. On the other hand, if the customer’s reservation utility is high, the result is reversed.

Our research brings new insights to MRO outsourcing management and provides a new viewpoint for contract choices. Our findings suggest that performance-based business models may not always achieve win-win for all supply chain partners. PBC may lead to higher screening costs for the supplier if the customer has superior information on product reliability and high outside options. Overall, our results suggest that the superiority of PBC contracts as advanced in previous studies might be somewhat overstated: there may be good reason to continue using TBC contracts in practice.

References


