

Research Proposal for 2008 Russel Ackoff Doctoral Student Fellowship

**Project Title: "Incentive Contracting to Manage
Low-Probability, High-Consequence Events"**

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In this research, we analyze a contractual relationship between a customer organization and a service provider(s) in an environment where the demands for services arrive infrequently but have high consequences. Some examples of service outsourcing scenarios that fit into such settings include containment of hazardous events such as natural disasters and restoration of mission-critical equipment downtimes. Just recently, Samsung Electronics, the world's largest manufacturer of NAND flash chips, experienced a brief but detrimental power outage that shut down its 6 production lines. This outage, which lasted less than 24 hours and which a local power company was responsible for, cost Samsung an estimated \$54.1M and caused a drop in the stock prices of both Samsung and Apple, a major customer of the flash chips that go into its popular iPod and iPhone products. Such scenarios raise an important research question: if the events that require immediate and rapid actions occur infrequently, how can the customer ensure that the service provider prepares adequate capability to provide such actions?

One possible remedy is subjecting the service provider to a financial award/penalty based on a realized service outcome, which may be the speed of the response or the perceived quality of service. In the Aerospace & Defense industry, this approach is now gaining wide

acceptance. Under a government-mandated policy called Performance Based Logistics (PBL), the providers of after-sales product support are getting compensated based on the service metrics such as fill rates or product availability, rather than the spare parts that they used to sell to the customers. Notice that after-sales service business is another area in which low-probability, high-consequence events routinely occur, as the service demands are triggered by product failures, which happen very occasionally but can jeopardize critical missions. Motivated by PBL practices, we study the effectiveness of performance-based contracts in incentivizing the service provider's capacity choice and their impact on management of risks.

The main methodological building block of this research is the principal-agent model. We investigate the tradeoff between incentives and insurance against risk that is inherent in low-probability, high-consequence settings. Our preliminary results indicate that interesting and sometimes non-intuitive dynamics are at play. For example, we find that optimal decisions on service capacity differ significantly between the "Intermediate Demand Regime" (i.e., at least one demand is likely to arrive) and the "Very Low Demand Regime" (i.e., at most one demand can arrive), because of qualitatively distinct risk characteristics in each regime. We are currently extending this base model, whose analysis is complete, to more complex settings.