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Military Acquisition

Research Project Descriptions

Index

Angelis, D., Ford, DN, and Dillard, J. "**Real options in military acquisition: the case study of technology development for the Kingfish Unmanned Underwater Vehicle**", Military Cost-Benefit Analysis: Theory & Practice. Francois Melese, Ed. Routledge Press (Taylor and Frances). New York. 2015.

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Ford, D.N. and Dillard, JT "**Modeling the Integration of Open Systems and Evolutionary Acquisition in DoD Programs**" 5th *Acquisition Research Symposium*. Naval Postgraduate School. Monterey, Ca. May 14-15, 2008.

Real options in military acquisition: The Case Study of Technology Development for the Kingfish Unmanned Underwater Vehicle

Diana I. Angelis, David Ford and John Dillard

The Unmanned Undersea Vehicles under development by the US Navy required several immature technologies to fully develop the required anti-mine capabilities. Primary among them was a sensing technology to detect and classify Underwater Improvised Explosive Devices (UWIEDs). A real option valuation model is developed to determine how much an organization should pay for technology development options when the benefits of the option cannot be measured in dollars. The expected value of a measure of effectiveness is used to select the prefered alternative. The value of an option is calculated based on the cost to implement the prefered alternative. When more than one option is available, a method for allocating the option value based on the relative risk of option alternatives is presented. The methodology is illustrated using the Navy's Kingfish UUV development program.

Angelis, D., Ford, DN, and Dillard, J. "Real options in military acquisition: the case study of technology development for the Kingfish Unmanned Underwater Vehicle", Military Cost-Benefit Analysis: Theory & Practice. Francois Melese, Ed. Routledge Press (Taylor and Frances). New York. 2015.

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Real Options in military Systems Acquisition: A Retrospective Case Study of the Javelin Anti-Tank Missile System

Diana I. Angelis, David Ford and John Dillard

Three different technologies were considered in the technology development phase of the Javelin anti-tank missile system: a laser-beam riding system, a fiberoptic system, and a forward looking infrared system. The Army awarded three "Proof of Principle" contracts to three competing contractor teams to develop and conduct a "fly-off" technology competition. The current work analyzed the three alternatives using measures of effectiveness (MOE) to combine performance across nine acquisition objectives. These MOEs were compared with development and procurement cost estimates. No alternative dominated. Marginal benefits analysis was next used to define the trade–off space among the alternatives. Differences in the likelihood of successful development of the alternatives were evaluated, resulting in one technology appearing to dominate. However, the acquisition approach created a real option for the best alternative that could differentially add value to the alternatives. A real options model was used to analyze the value provided by investing in this competitive option. Results indicate the Army paid less than the total value of the three options, but could have increased net savings by paying different amounts to test each alternative. The analysis method provides a logical and defendable approach to the analysis of alternatives during technology development uncertainty.

Keywords: Real Options, Analysis of Alternatives, Technology Development, Javelin

Angelis, Diana I, DN Ford, and J. Dillard, (2015) "Real Options in military Systems Acquisition: A Retrospective Case Study of the Javelin Anti-Tank Missile System" accepted in Francois Melese, A. Richter, and B. Solomon (Eds.) *Military Cost-Benefit Analysis: Theory & Practice*. Routledge Press (Taylor and Francis). New York.

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Valuation of Real Options as Competitive Prototyping in System Development

Angelis, D., Ford, DN, and Dillard, J

A Real Options Valuation Model is developed to recommend how to valuate technology when benefits cannot be measured in monetary value. Expected values of effectiveness are used to select the preferred alternative. The methodology is illustrated using three guidance system technologies in the Army's Javelin program. The strategy created multiple real options that gave the Army the right (without the obligation) to select one guidance system technology based on the outcome of technology development tests. Results indicate the Army paid less than the total value of the options, but could have increased net savings by paying different amounts to test each alternative. The analysis method provides a logical and defendable approach to the analysis of alternatives under technology development uncertainty.

Angelis, D., Ford, DN, and Dillard, J. "Valuation of Real Options as Competitive Prototyping in System Development", Defense Acquisition Research Journal. Vol. 21, Issue, 3, pp. 668-694. July, 2014.

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Modeling Open Architecture and Evolutionary Acquisition: Implementation Lessons from the ARCI Program for the Rapid Capacity Insertion Process

John T. Dillard and David N. Ford

Providing system interoperability and evolving technologies in major DoD systems are two important acquisition challenges in preparing the military to meet current and future demands. The Acoustic Rapid COTS Insertion (ARCI) program successfully addressed many of the associated challenges. That program was studied as the basis for modeling the planned Rapid Capability Insertion Process (RCIP) approach for continuous, reduced-cost upgrading of assets. ARCI used atypical methods in the face of atypical program requirements and conditions. A previously developed acquisition program model was adapted to reflect ARCI and used for model validation. This model was then changed to reflect the basic conditions expected to be faced by RCIP programs. The model demonstrated the potential of RCIP to significantly improve program performance. However, implementation risks are identified that may degrade potential performance, including increased oversight, the use of more new development, and the resulting integration scope and risk. When incorporated into the model, these risks were shown to significantly decrease RCIP performance. Means for successfully managing the RCIP design based on the ACRI program and RCIP operations are suggested for use in addressing the identified implementation risks.

Ford, DN and Dillard J "Modeling Open Architecture and Evolutionary Acquisition: Implementation Lessons from the ARCI Program for the Rapid Capacity Insertion Process" Acquisition Research Program. Naval Postgraduate School. Monterey, Ca. Report #NPS-AM-09-043. April 22, 2009.

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The Logistics Support Resource Strategy Map: A Design and Assessment Tool

John T. Dillard and David N. Ford

Design of a resource strategy for logistics support requires decision-makers to choose to use contracted, blended, or organic support, or a combination thereof, for acquisition products. Non-cost issues have received much less attention than cost in resource strategy design—even though policy requires the incorporation of many non-cost issues. This lack of attention is partially due to the large number of issues that can impact strategy design, the diversity of issue features and impacts, and the diversity of characteristics of programs, their environments, and potential strategies. Although many issues that should be included in logistic planning have been identified, little guidance is provided for how program management teams can incorporate them into logistics support resource strategy design. Tools that facilitate describing logistics requirements and the impacts of resource strategies on program success can potentially improve resource strategy design, assessment, and documentation for review. The structure and use of the Logistics Support Resource Strategy Map for helping program management teams consider a broad range of logistics support resource strategy design issues are described. An example application illustrates the Map's use. Implications for practice and potential future developments tool are discussed.

Keywords: Logistic support, resource strategy, strategy design and assessment

Ford, DN and Dillard J. "The Logistics Support Resource Strategy Map: A Design and Assessment Tool" Acquisition Research Program. Naval Postgraduate School. Monterey, Ca. Report #NPS-AM-09-021. April 22,, 2009.

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From Amorphous to Defined: Balancing the Risks of Evolutionary Acquisition

John T. Dillard and David N. Ford

The DoD policy for evolutionary acquisition mandates multiple product releases via spiral (i.e., amorphous & unplanned) or incremental (i.e., defined & deferred) development methodologies for all programs. While all amorphous spirals eventually become definitive increments, incremental development entails the deliberate deferral of work to a subsequent period. Curtailment of scope by the exclusive use of mature technology is also fundamental to the policy. We illustrate that this enables more effective delivery of the first increment with a comparison of two major system case studies. But there are some inherent risks in an evolutionary approach, and we caution that excessive concurrency, variety and complexity can be challenges in the management of successive increments. We also suggest that certain attributes of hardware products might help determine the suitability of these development methodologies. Mutable products with costless production, continuous requirements, low maintenance, or time criticality may be more likely to reap advantages from evolutionary approaches. Products that are nearly immutable, have binary requirements for key capabilities, require man-rating, or are maintenance-intensive may not be best candidates for incremental development. While modular open systems architecture facilitates system adaptation, modularity itself does not necessarily create evolutionary advantages, due to relative modular interdependency. We recommend that program managers be aware of the inherent risks of these agile acquisition methods and take additional steps to balance them with careful analysis and planning, disciplined change-control measures, and organizational accommodations, including accountability for configuration management.

Keywords: evolutionary acquisition, spiral development, incremental product development, risk, Javelin, ATACMS.

Dillard, JT and Ford, DN. “From Amorphous to Defined: Balancing the Risks of Evolutionary Acquisition” *Defense Acquisition Research Journal*. Vol. 16, No. 3, pp. 236-52, Oct., 2009.

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Modeling the Integration of Open Systems and Evolutionary Acquisition in DoD Programs

John T. Dillard and David N. Ford

Open Systems and Evolutionary Acquisition are two recent innovations designed to improve program performance with flexibility. The full potential of these approaches has not been captured, partially because of integration challenges during implementation. The current work investigates the impacts of open systems and evolutionary acquisition on DoD development programs. Changes required to use both Open Systems and Evolutionary Acquisition are used to identify and describe impacts of implementation on program process and management. A dynamic simulation model of a program using both Evolutionary Acquisition and Open Systems is described and used to map the impacts. Simulation results generally support previously suggested impacts and provide a possible explanation for changes in program performance. Implications for practice relate to changes in the types and timing of risk and a potential trading of design obsolescence risk for standards obsolescence risk

Keywords: Open Systems, Evolutionary Acquisition, DoD development programs

Ford, D.N. and Dillard, JT “Modeling the Integration of Open Systems and Evolutionary Acquisition in DoD Programs” 5th *Acquisition Research Symposium*. Naval Postgraduate School. Monterey, Ca. May 14-15, 2008.

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