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RESEARCH CENTER

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# Quarterly Research Forums - Acquisition Innovation Research Center and the Defense Acquisition University

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**Cleared for Public Release.**

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## Research Team

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## Acronyms and Abbreviations

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|       |   |
|-------|---|
| AI    | Artificial Intelligence                   |
| AIRC  | Acquisition Innovation Research Center    |
| CLPs  | Continuous Learning Points                |
| DoD   | Department of Defense                     |
| DAU   | Defense Acquisition University            |
| LLM   | Large Language Models                     |
| ML    | Machine Learning                          |
| PI    | Principal Investigator                    |
| Q&A   | Question and Answer                       |
| QRT   | Quarterly Research Forum                  |
| SERC  | Systems Engineering Research Center       |
| UARC  | University Affiliated Research Center     |
| VTNSI | Virginia Tech National Security Institute |

## Acknowledgements

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The Acquisition Innovation Research Center (AIRC) acknowledges the support of the Defense Acquisition University (DAU) in sponsoring and co-hosting this series of Quarterly Research Forums (QRFs).

## Executive Summary

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As part of the Systems Engineering Research Center's (SERC) ongoing relationship with the Defense Acquisition University (DAU) and the newly codified statutory requirement for acquisition workforce educational partnerships (10 U.S. Code 1746a(a)(1)), DAU is seeking an explicit Quarterly Research Forum (QRF) for engaging relevant experts from academia with the leadership and faculty of DAU. This engagement is bidirectional to (i) make DAU faculty and the Defense Acquisition Workforce aware of relevant research in the multi-university Acquisition Innovation Research Center (AIRC) partnership, and (ii) engage academia experts on DAU's strategic curricula initiatives and challenges, informing the assessment and modification of DAU curricula to enhance the capabilities of DAU to support educational, training, and research activities in support of acquisition missions of the Department of Defense (DoD).

In the QRFs, AIRC researchers presented relevant research and received feedback from faculty and practitioners in the field, while also providing DAU with expert views on its curricula initiatives and challenges. To provide consistent engagement, AIRC established a small team of leading academia experts from broad disciplines such as law, policy, business, management, education, engineering, and data science that relate to the breadth of acquisition functions. AIRC worked closely with the sponsor on the agenda for each QRF. As appropriate, the QRFs included presentations, discussions, and question and answer (Q&A) sessions on research, strategic educational challenges, initiatives, current curricula, and training opportunities. All QRFs were held virtually with continuous learning points (CLPs) were provided.

These quarterly engagements were so well received by the defense acquisition community that DAU is contracting with AIRC to collaborate on an additional set of briefings in the 2023-2024 academic year focused on Mega-Projects. This area of future research effort focuses on data visualization, artificial intelligence (AI), and machine learning (ML), as well as other topics to aid in the management of large DoD programs. The Virginia Tech National Research Center, as a member of AIRC, conducted a series of brainstorming sessions with its research faculty to develop ideas for content and focus in the upcoming academic year. Several ideas surfaced and four specific focus topic recommendations were made to enable a continued strong set of forum discussions with DAU in the coming year.

## Quarterly Research Forums

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AIRC in collaboration with DAU held four (4) virtual QRFs throughout the 2022-2023 academic year, as described below.

### **1.1 Quarterly Research Forum #1 (September 15, 2022)**

AIRC and DAU partnered to provide both insight and the ability to influence AIRC research. In the first QRF, AIRC's principal investigators (PIs) presented on topics relevant to defense acquisition and delivering warfighting capability. Speakers and topics included:

***Acquisition Innovation Research Center (AIRC) Overview***

*Dr. Phil Anton, Chief Scientist for AIRC*

***Systems Engineering Research Center (SERC) Overview***

*Mr. Tom McDermott, Chief Technology Officer for SERC*

***Research Topic #1: Innovative, Data-Enabled Acquisition Strategy***

*Dr. Phil Anton & Dr. Laura Freeman, Virginia Tech*

***Research Topic #2: Systems Engineering Modernization***

*Mr. Tom McDermott*

***Research Question, "Future Trends in Acquisition"***

*Dr. Glenn Lamartin, DAU*

***New Certification Overview and Challenges***

*Mr. Scott Bauer, Human Capital Initiative*

***Closing Remarks***

*Dr. Dennis McBride, Director of AIRC*

The first QRF recording and slide deck can be found on the [DAU website](#).

### **1.2 Quarterly Research Forum #2 (December 9, 2022)**

In the second QRF, AIRC PIs presented research findings and recommendations on defense workforce training through gamification. DAU presented on its Kobayashi Maru Pilot and next steps. Speaker information is listed below:

***AIRC Presentation on Workforce Training through Gamification***

*U.S Air Force Lt Col Daniel J. Finkenstadt, PhD, Naval Postgraduate School*

*Dr. Rob Handfield, North Carolina State University*

***DAU Presentation on Kobayashi Maru Pilot Overview and Next Steps***

*Mark Steblin, DAU Professor of Program Management*

*Brian Schultz, DAU Professor of Program Management*

The second QRF recording and slide deck can be found on the [DAU website](#).

### **1.3 Quarterly Research Forum #3 (March 13, 2023)**

In the third QRF, AIRC PIs presented their research findings and recommendations on the Requirements Definition Process in Defense Acquisition. DAU faculty presented learning and development opportunities in support of the Requirement Definition Process. Speaker information is listed below:

***AIRC Presentation on “Improving the DOD Requirements Process”***

*Dr. Mike McGrath, AIRC Fellow*

***DAU Presentation on Requirements Management Curriculum Training***

*Professor Greg Prothero, DAU*

The third QRF recording and slide deck can be found on the [DAU website](#).

### **1.4 Quarterly Research Forum #4 (June 23, 2023)**

The fourth QRF focused on understanding how increasing government access to the models and AI algorithms used in system design might decrease the need for and expense of testing and increase confidence in results. Speaker information is listed below:

***AIRC Presentation on Digital Engineering Informed Test & Evaluation***

*Dr. Laura Freeman, Virginia Tech*

***DAU Presentation on Digital Engineering Courses, Credentials, Workshops & Resources***

*Dr. Jim Roche, DAU*

The fourth QRF recording and slide deck can be found on the [DAU website](#).

## **Conclusions and Next Steps**

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During the 2022-2023 academic year, AIRC and DAU successfully held four (4) research forums that covered a variety of disciplines such as law, policy, business, management, education, engineering, and data science. The quarterly forums were so well received by the defense acquisition community that DAU is contracting with AIRC to collaborate on an additional set of briefings in the 2023-2024 academic year focused on Mega-Projects (WRT-1082: The Future of Managing Mega Projects; period of performance 11 September 2023 to 10 September 2024). This future research effort is further discussed in Appendix A and B.



## **Appendix A. The Future of Managing Mega Projects (WRT-1082) Scope**

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### **Executive Summary**

Large acquisition programs within the DoD have historically experienced execution and management challenges due to the complexity of the systems that have been developed and the complexity of the organizations required to execute the development. Tightly coupled systems of systems that receive extreme pressure to accelerate capability delivery to the warfighter coupled with multiple layers of contracting through government agencies and defense contractors have placed extreme pressure on program executive office. “Mega-Projects”, those that employ state of the art technologies across a complex system of systems development, typically Major Capability Acquisitions, (ref. DoD 5000.02) necessitate new methods of performance management and programmatic oversight to meet the needs of the changing DoD acquisition landscape. Further, these programs must contend with the need to be responsive to the National Defense Strategy and counter evolving threats, which can change faster than DoD acquisition processes for requirements generation and contracting. This research effort explores several applications of advanced methods to aid DoD acquisition professionals and was focused on preparing for a series of DAU virtual forums to share these methods with the DoD acquisition community.

In 2022-2023, AIRC led a series of research forums discussing large projects and technologies that would enable programs and processes to scale with emerging technologies and evolving threats. These quarterly engagements were so well received by the defense acquisition community that DAU is contracting with AIRC to collaborate on an additional set of briefings in the 2023-2024 academic year focused on Mega-Projects. This area of future research effort focuses on data visualization, AI, and ML, as well as other topics to aid in the management of large DoD programs. The Virginia Tech National Research Center, as a member of AIRC, conducted a series of brainstorming sessions with its research faculty to develop ideas for content and focus in the upcoming academic year. Several ideas surfaced and four specific focus topic recommendations were made to enable a strong set of forum discussions with DAU in the coming year.

### **Research Summary**

In order to serve and up-skill today’s DoD acquisition professional, the DAU has hosted a series of virtual forums to brief topics on new practices in managing large DoD acquisition programs, Mega-Projects. The goal of the forums is to alert program office personnel on findings from research in acquisition innovation that have developed from the AIRC University Affiliated Research Center (UARC). Four forums were conducted during the 2022-2023 academic year. In these sessions leading AIRC researchers briefed a variety of topics, such as applying advanced techniques to program oversight and execution. Based on the positive response that resulted from the forums, DAU has requested AIRC to plan for additional forums in the 2023-2024 academic year.

In response a small group of research faculty from the Virginia Tech National Security Institute (VTNSI) brainstormed forum topics for the upcoming year. The team was focused on developing a roadmap of topics that would aid acquisition professionals in performing

better execution data visualizations and exploring application of ML/AI to aid the acquisition community. In addition, the team explored other trends and research to share with DoD acquisition professionals in forum sessions.

The team used the following definition of “Megaproject” for scoping the topic:

“A megaproject is a project that is enormous in scope. Though a megaproject can have well-defined beginning and ending conditions, the sheer size makes for lengthy development schedules, with many ancillary subprojects, and many stakeholders who will judge success based on their own sets of criteria.”

With the above definition framing the focus, the team embarked on what learning objectives should be pursued for the DoD acquisition community and how these objectives might be logically organized for sharing. Below is a list of objectives that the team developed:

1. Provide a big picture of application of leading technologies in support of DoD program execution and oversight.
2. Highlight lessons learned from recent megaproject successes and failures.
3. Share methods for data analytics and performance visualizations that leverage ML and AI algorithms.
4. Describe methods of utilizing Large Language Models (LLM) to capture the current state of megaprojects.
5. Describe strategies for integrating emerging technologies in large system of systems developments with dynamic performance requirements.
6. Explore the human behavioral tendencies in decision making and management of mega projects, and describe how awareness of these tendencies can be leveraged for improved program execution.

With these learning objectives, several specific topics were explored and ultimately distilled into four potential forums for the 2023-2024 quarterly forums. These four recommended topics are as follows.

1. AI/ML Program/Portfolio Management
2. LLM Utilization to Capture State of Megaprojects in Time
3. Integrating Emerging Technologies to Address Dynamic Requirements
4. Understanding and Managing Bias, Cognitive and Political/Power

These topics link together as some of the most pressing issues for major acquisitions. Knowing what technical capabilities exist and how they can be leveraged is of extreme importance to DoD program offices. Also understanding current human and cultural aspects that influence execution in this technical environment is important. Abstracts for these potential topics are contained in Appendix B of this report and will require further maturation by the greater AIRC team. The team will work with the DAU and partner universities to mature the content for the next year of forums to ensure information provided is current and relevant to the large programs that are in work or on the near horizon.

## Conclusion

This brief exploration of research topics influencing the execution of megaprojects has yielding very relevant information that is valuable to the DoD program offices across all the services. Four recommended topics have been identified and can be further matured in collaboration with the DAU and AIRC partner universities to provide relevant and valuable information to those responsible for developing and fielding the very complex systems that are needed by US warfighters.

## **Appendix B. Topic Abstracts**

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### **1. AI/ML Program/Portfolio Management**

There are many opportunities to improve cost efficiency and success rates of large-scale projects with the help of Artificial Intelligence (AI) and Machine Learning (ML) algorithms. Such algorithms can process data and detect patterns to exceed human prediction capabilities by a large margin, helping with initial evaluations, risk assessments, and success predictions, even before a program starts. AI assistants may also suggest adjustments to the project schedule and budget, based on past performance of a team. The caveat is that such predictions are based on past observations, so consistent data collection is a pre-requisite to enjoy some of the benefits. Besides predictive capabilities, AI may support more efficient program management with tools to monitor progress, track dependencies and deadlines, and even help with the preparation of documents, reports, and viewgraphs. Advanced testing and evaluation systems will also become more affordable, enabling tests, audits, and in some cases even self-correcting measures, helping program managers throughout the program's life cycle.

### **2. Strategies for Integrating Emerging Technologies to Address Dynamic Requirements**

Defense projects have little analogue in the commercial world – three generations of airmen have flown the same B-52, which is now over 50 years old. That aircraft remains relevant to today's conflicts through changes to its capabilities that we not imagined at its inception. Other platforms have not fared as well – the Crusader self-propelled howitzer disappeared along with the Soviet threat. The commercial market for the JPATS training aircraft never materialized. Ships have been retired before the end of their service life because they could not be adapted to meet current needs. This talk will discuss methods gauging how quickly technologies will evolve, methods to design for adaptability, and introduce real options analysis as a method for evaluating tradeoff decisions. This talk will also address practical steps to accommodate these changes, such as data rights, standard interfaces and model-based engineering.

### **3. Understanding and Managing Bias, Cognitive and Power**

Multiple biases influence programmatic decisions. Program managers must be aware of these biases and learn to leverage them in program decision making. Power bias comes from the influential, and often external stakeholders in all programs. Power bias is present in programmatic decision making whether specifically recognized or not. This DAU forum will explore what power bias is and how it influences technical and programmatic decision making in major capability acquisitions. Program managers can learn how to recognize the power biases in decisions and leverage these biases to benefit the performance of the program.

#### **4. Large Language Models to Capture State of Mega Projects in Time**

LLMs (Large Language Models) offer substantial potential for knowledge capture and transfer in megaprojects, notably through their adeptness at capturing and aiding interpretation of historical context. These models can comprehensively document project information, distill lessons learned, and highlight best practices from previous megaprojects. Their unique capability to process and generate natural language enables them to contextualize current decisions and actions within the evolution of the project's history. This helps project teams and stakeholders understand how past choices have influenced the project's trajectory, allowing for more informed decision-making and a deeper appreciation of the project's development over time. However, it's essential to acknowledge that while LLMs facilitate context understanding, human expertise and context-sensitive insights remain vital for accurate interpretation and application of historical context in megaproject management.