Translating the Digital Engineering Vision to Reality: A Process for Defining a Suitable Digital Engineering Scope for DoD Acquisition Programs

Sarah Scheithauer[1], David Chudy, LTC[2], Gerald Byrd[2], Brady Juelson, MAJ[3], Dalton Clark[1], Craig Arndt[1]

[1]Georgia Tech Research Institute (GTRI) – ELSYS / SERD, Atlanta, GA
[2]PM Maneuver Combat Systems (MCS), Warren, MI
[3]U.S. Army Mission and Installation Contracting Command (MICC), San Antonio, TX

ABSTRACT

Digital Engineering (DE) has been a prevalent topic across the Department of Defense (DoD) since the Office of the Deputy Assistant Secretary of Defense for Systems Engineering – now the Office of the Undersecretary of Defense for Research and Engineering [OUSD(R&E)] - re-leased the DoD Digital Engineering strategy1 in 2018. Since then, there has been a major push to incorporate DE into the DoD acquisition process and for programs to use DE, including Mod-el-Based Systems Engineering (MBSE), in system development. This paper focuses on where the DoD stands today with adoption of digital acquisition, the challenges of implementing DE on major programs, and the approach used by the Army's Optionally Manned Fighting Vehicle (OMFV) program to define a realistic pathway to effectively implement a DE strategy from Re-quest for Proposal (RFP) to prototype acquisition.

Citation: S. Scheithauer, D. Chudy, G. Byrd, B. Juelson, D. Clark, C. Arndt, "Translating the Digital Engineering Vision to Reality: A Process for Defining a Suitable Digital Engineering Scope for DoD Acquisition Programs," In *Proceedings of the Ground Vehicle Systems Engineering and Technology Symposium* (GVSETS), NDIA, Novi, MI, Aug. 15-17, 2023.

1. Introduction

The transformation from the historical, document-based acquisition system to DE is resulting in some of the most significant changes to the way the DoD has engineered and developed weapon systems in decades. The shift to the use of DE will not only impact the DoD but the entire military industrial complex. Coined by President Eisenhower in a 1961 address to the American people, the "military-industrial complex" includes the contractors that develop and manufacture the nation's combat systems [1].

In some ways, the transition to DE is the DoD's reaction to the larger endeavor in the engineering community to reduce development time and cost by using digital data management technologies across development and manufacturing enterprises. In the DoD's "Digital Engineering Strategy", the DoD states that "Current acquisition processes and engineering methods hinder meeting the demands of exponential technology growth, complexity, and access to information [2]. DoD leadership believes that DE will enable the DoD to meet the current and upcoming challenges to delivering new capabilities to the warfighters in support of the DoD's numerous complex missions. To accomplish this, it is crucial to have a realistic DE strategy in place that can be implemented with new DE technologies while maintaining compliance with current acquisition processes.

When determining how DE will be used by the DoD and the larger defense industry, it is important to remember that DE consists of technology-enabled processes that are intended to improve the execution of defense acquisition process but not to replace the DoD's existing process. The defense acquisition system is defined and constrained by both federal law and DoD regulations. The majority of these rules and processes are contained in the Defense Federal Acquisition Regulations (FAR), DoD Instruction 5000.02, and the Defense Acquisition Guidebook (DAG). The methods used across the DoD to develop requirements, perform systems engineering, select vendors, and manage contracts are embedded in these regulations. As such, it is important to understand the impacts that transition to DE has on these current standards, regulations, and processes.

Upon executing the digital transition, the DoD is discovering a number of issues and constraints that can limit the benefits of DE gained on any given program. Some of these constraints may include program cost and schedule, contract type, Information Technology (IT) infrastructure, workforce culture, staff resourcing and training, and the need for major (document-based) acquisition artifacts (RFP's, contracts, DIDs, etc.).

In balancing these constraints against the opportunities of DE, the key question becomes "What is the realistic digital engineering scope that should be implemented based on program constraints and desired benefits?". This paper will focus on the approach used by OMFV to answer this question with a focus on three common DE areas of interest:

1. To improve USG capability description via the capability development document (CDD) and requirements development via the performance specification (PSPEC)
2. To enhance data packages and deliverables received from vendors
3. To reduce physical test scope and test risk

The process for identifying and rectifying these use cases via a DE approach will be explored in the following sections. These examples provide a small sample set of the DE initiatives the OMFV program focused on while defining the DE strategy for the program and represent a sample "problem set" intended to portray the vision of what DE can deliver to the program. Identifying the vision for DE may – incorrectly - be considered the easy part of the process. This paper will present the challenging aspects of this process including definitions of potential solutions to satisfy the desired use cases; in other words, what DE capabilities and benefits can and should be deployed to meet different aspects of the problem set and to what extent these capabilities must be specified by the USG to the vendors. We will also discuss how these use cases were articulated into the RFP to clearly convey the work requirements to the vendors without constraining innovative solutions. Finding this balance is a crucial part of the process of scoping a DE effort.

2. Background

In many cases, programs are directed to "implement digital engineering" at some point in the program lifecycle. While this may initially come across as a simple directive, dissecting what this means for any specific program is complex, with the degree of complexity varying greatly based on the program scale and current lifecycle phase. This section contains a summary on the emergence of DE in the DoD, some of the top-level regulatory and statutory requirements driving the initiative, and examples of additional guidance and direction given to the Product Management (PdM) teams responsible for leading the digital transition. Additional background information is included on the concept of DE as a sliding scale – a key consideration for DE scoping. This section will also include background on the state of the OMFV program upon entering the digital transition along with key OMFV program characteristics and constraints.

2.1. DoD DE Initiatives

This section contains a summary of DoD and Army Component DE directives and guidance. The purpose of this section is to provide the initial baseline for Army programs for adopting digital methodologies. Note that this is not a complete list for every program but contains some of the key DE references used by the OMFV program.

Formal DoD DE Initiatives and Directives.

- DoDI 5000.88
- DoDI 5000.02
- DoD Digital Engineering strategy
- DoD Digital Modernization Strategy
- DoD Digital Engineering Fundamentals
- Defense Acquisition Guidebook (DAG)
- System Engineering Plan (SEP) template, version 4

DoD Component DE Guidance.

- Assistant Secretary of the Army (Acquisition, Logistics and Technology (ASA(ALT)) Digital Engineering Policy
- Army Digital Engineering Vision
- Army Digital Engineering Strategy
- Army Regulation 70-1 (Army Acquisition Policy)
- Army Pamphlet 70-3 (Army Acquisition Procedures)

DoD Visions and Expectations. A common challenge that programs experience upon implementing DE is figuring out how to bridge the gap from the high-level DoD and DoD Component guidance to a DE implementation. While DE can provide incredible value and benefits to acquisition programs, it is important to understand the return on investment (ROI) that certain aspects of DE can provide for a specific program. Often times, the ideal vision in mind for applying DE to a program might not have a positive ROI (due to program constraints or otherwise). Therefore, understanding the impacts that applying certain aspects of DE has on your program is a crucial step in defining a realistic DE approach.

2.2. Sliding Scale of DE

The adoption of additional technologies or methodologies is often accompanied by a myriad of questions regarding the scope of adoption or degree of utilization of the introduced concept. Digital engineering is no different. The authors contend that – due to the quantity of variables involved in a digital engineering endeavor – there is no universal optimal across all enterprises nor is there a single optimum when only considering the DoD's spectrum of programs. Every enterprise adopting digital engineering is best suited to assess their organization's strategy, project timeline, workforce culture, and available resources – including human resources – and identify their desired benefits from adoption of digital engineering. This supports identification of their unique optimum along the sliding scale of digital engineering.

The adoption of techniques, methods, and practices collectively termed DE is often presented as an all-or-nothing proposition. That is to say, an organization must inject 'digital' into their business, technical, and technical management processes to the maximum degree that is technically feasible in order to claim a digital engineering victory. This proposition ignores two critical elements: adoption of digital engineering is subject to the law of diminishing returns with regards to cost, schedule, and performance and that every organization obtains benefit from said adoption differently. This section will provide a discussion on the various axes involved in adoption of digital engineering and their perceived benefits.

Any conversation of digital engineering adoption should begin with ground zero. That is to say, the “non-digital” engineering method that has been utilized since the formalization of engineering as a discipline. Throughout this paper, this method will be termed document-intensive engineering (DIE). It is beneficial to understand that progress towards the adoption of DE has been on-going since the transition from the drafting table to Computer-Aided Design (CAD). An environment that utilizes Model-Based Engineering (MBE) methods for domain engineering activities without any purposeful effort to integrate the resulting data artifacts with other processes outside of that domain is still considered DIE due to a lack of data availability outside of the native tools used to develop the artifact. This discussion is often framed as data digitization versus digitalization – the formalization of which is outside the scope of this paper. Typically, enterprises that operate in this regime have limited or no adoption of the use of models or digital artifacts to accomplish the systems engineering effort as well. This mode of performing systems engineering activities is termed Document-Intensive Systems Engineering (DISE) [3]. This may be considered a traditional approach and is the baseline for this discussion as very few – if any – substantive efforts still eschew the use of any computer-generated models.

The degree to which models are leveraged across an enterprise’s processes is a key parameter of their overall level of digital engineering adoption. This metric does not consider whether the resulting models are federated, networked, or interfaced in any way and purely judges the degree to which non-specific textual information has been replaced with semantically rigorous definitions through the use of Domain Specific Languages (DSLs). Most enterprises heavily leverage the use of MBE for mechanical, electronic, and other domain specific design activities while the adoption of model-based representations are lagging in business processes and systems engineering, although systems engineering is seeing the adoption of the Systems Modeling Language (SysML) as a foundational language for this purpose. This step reduces the time required to develop designs due to the use of partially automated tooling, efficient computer-aided authoring, and automated checks on the design.

The next representative metric that defines the level of digital engineering adoption is the magnitude of data availability and configuration management (CM) within a particular set of roles, a particular process, or a particular domain. This intra-domain data governance and access has also been readily adopted by most organizations with databases and file sharing services such as SharePoint, Box, or GIT. A layer on top of simple data access is the ability to implement CM processes on documents and design artifacts via tools such as Integrity. It is important to understand that the availability and robustness of sharing data within a particular domain or workflow is not inherently correlated with the data being model-based. This axis indicates the degree that individual artifacts are able to be configuration controlled sufficiently while remaining available to those individuals who require that artifact to perform their job function.

Providing access to required data in a CM environment reduces the risk of defects introduced to the use of old or corrected data and accelerates many processes that require data sharing. The advantages to improving along this dimension are universal across the lifecycle of the effort; however, they do increase as the number and scope of data products increases.

The final lens to view degree of digital engineering adoption on the sliding scale is degree of data connectivity. In other words, to what degree is one element of data – independent of its accessibility, configuration control, or representation – able to interface with additional data elements. Often, this is termed the creation of ‘digital threads’ that reach from earlier conceptualization through architecting, to ultimate design [4]. This is the aspect to digital engineering that enables improved impact analysis across multiple aspects of the system. Integration, federation, and networking of models and simulation occurs to assess the impact of design changes on multiple different attributes of the system and the process of developing said system. Examples include assessing how a design change impacts cost, risk, schedule or specific aspects of performance. These benefits include a greater holistic understanding of the system and adds additional early opportunities for verification and validation of operational capability and that pro-grammatic metrics are within acceptable ranges.

To obtain the best benefit of DE, an organization should consider their use cases for the adoption and map those use cases to the metrics listed above. In other words, one enterprise might require a small set of tightly integrated analysis models to accomplish their business objective while an-other might require a portfolio of independent, unconnected models. Assessing the individual need and relating that need to various elements of digital engineering optimizes ROI. Adoption of DE requires a multi-variate decision making process just as any other analysis of alternatives does.

2.3. DE Use Case: The OMFV Program

OMFV is the Army's program designed to be the next Infantry Fighting Vehicle (IFV). The cur-rent IFV, the Bradley Fighting Vehicle (BFV), first debuted in 1981 [5]. The Army has continually upgraded the BFV since its inception, but significant advancements in technology and capability have proven that the BFV lacks the ability to meet the Army's requirements. With this gap in capability, the Army has sought the development of the Optionally Manned Fighting Vehicle (OMFV) to be incorporated into the Armored Brigade Combat Team (ABCT) structure as the future IFV. As a new capability acquisition, OMFV is applying DE to the acquisition process per the earlier referenced DoD standards and guidelines. The OMFV pro-gram strategy has taken an approach that incorporates the DoD's DE Strategy of 2018, leverages the basic business concept of competition to drive innovation, and utilizes an open architecture which maximizes the platform's ability to maintain capability at the speed of relevance.

3. Program Agnostic Approach to Defining a DE Scope based on OMFV

There is no simple or common solution to implementing DE on any given DoD program, regard-less of scale, budget, or schedule. Every program has unique needs and constraints. As described above, DE is a sliding scale made up of numerous attributes, the combinations of which result in infinite options for implementing DE. While lessons learned can be leveraged from other pro-grams undergoing similar transformations, no two programs will ever share identical DE strategies or implementations; therefore, re-use from prior efforts is inherently limited. This makes de-fining a DE approach for future programs challenging.

Knowing that the options for implementing DE are essentially limitless can be intimidating and figuring out a place to start is also overwhelming. While the unique DE strategies and solutions employed by other programs cannot be directly leveraged, the analysis and decision processes used to select the solution can be. This section will go through the approach taken by the OMFV program team to understand available resources, assess program needs, and select the DE capabilities to focus on. By following this process, the OMFV team was able to reduce what we've coined as the "infinite DE problem" into a tractable design space for strategy selection. More importantly, this process helped guide the team in translating the chosen DE strategy pieces into coherent requirements and guidance in the RFP - a crucial aspect of the acquisition process.

Figure 1 lays out the full process the OMFV team followed to understand, scope, and bound a realistic and feasible DE strategy for the program going into

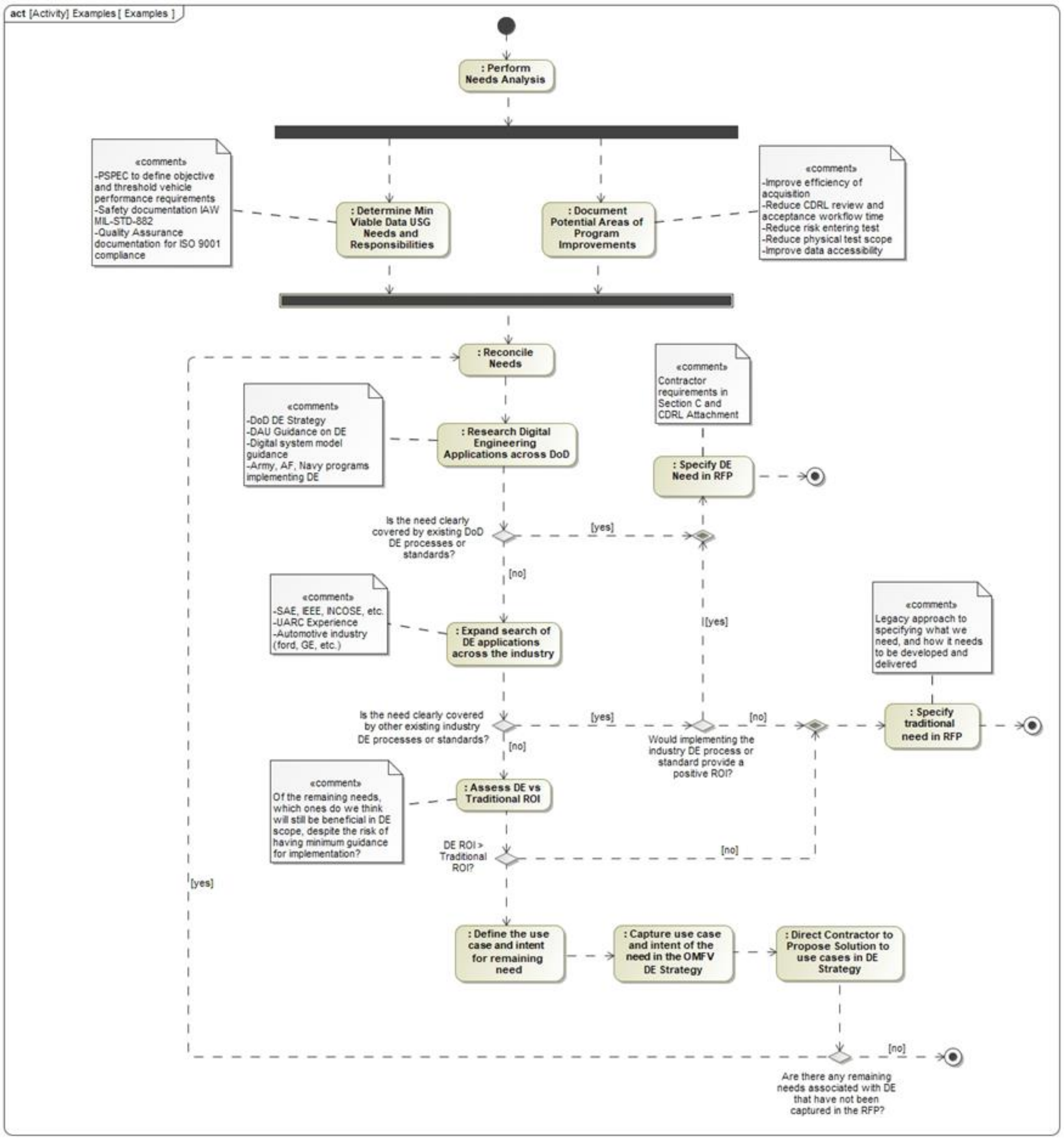

Figure 1: OMFV DE Scope Definition Process

the prototype design and development phase. The next sections delve into more details for each activity within this process. The three aforementioned DE focus areas will continue to be re-visited as we step through the activities to provide examples of the outcomes at different phases of this process.

3.1. DE Scope Definition Process Steps and Results

Step 1. Perform Needs Analysis. The first step in developing a proper DE strategy is formalizing the drivers of the capability need. This step includes “data gathering” and stakeholder inter-views to compile information on the need but also on DE acquisition constraints. Examples may include, but are not limited to:

• Why is this new capability being acquired? What are the associated use cases and operational scenarios for this capability?
• Who are all of the internal and external stakeholders, and what are their roles throughout the program lifecycle?
• What are the stakeholders' responsibilities in these roles? What data do the stakeholders need to perform their roles, in which format, and when?

DoD references can be used as a starting point, but conversations with stakeholders is crucial in understanding the program-specific needs and constraints. Dissecting this input from the stakeholders will inform the decomposition of the top-level initiatives (often driven directly by the DoD DE guidance) into approachable problem statements.

Steps 2 and 3. Determine Min Viable Needs & Reconcile Stakeholder Feedback. This step includes compiling and organizing the information received during the needs analysis. From here, the DE Subject Matter Experts (SMEs) should start to look for patterns in stakeholder input, and identify common themes and high-risk areas to start prioritizing efforts.

Three examples of the output of this step from OMFV are provided in Figure 2. These examples were chosen based on their importance to the program office and relevance to most programs.

The use case diagram in Figure 2 includes three aforementioned use cases that will be re-visited at each step of the process as applicable:

- *DE Use Case #1: The PEO intends to use Digital Engineering to improve capability description and requirements development.*
- *DE Use Case #2: The PEO intends to use Digital Engineering to enhance data packages and deliverables from the contractors.*
- *DE Use Case #3: The PEO intends to use Digital Engineering to reduce physical test scope and test risk.*

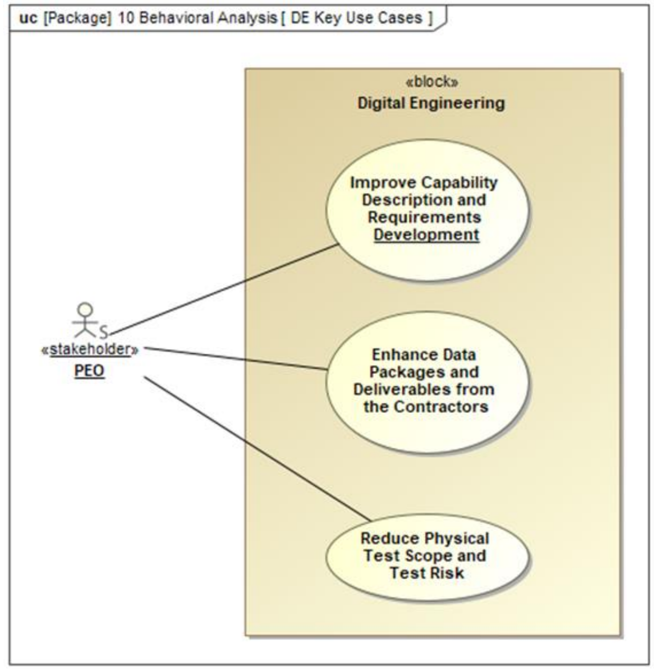

Figure 2: DE Use Cases for the Army Program Executive Office (PEO)

Step 4. Research Potential Solutions to Satisfy Needs. Once the program and stakeholders' needs and concerns regarding DE have been distilled, the DE SMEs can begin mapping the information to extended DE use cases and to potential DE solutions. This requires extensive research into the technology and resources available to understand the available trade space. Additional questions to help determine feasibility of a given solution include:

- Where has this solution been implemented, for which purpose, and on what scale? What were the successes and lessons learned based on other organizations' experiences (if available)?
- Can the solution be implemented within program constraints (within cost/schedule)?
- How mature is the proposed capability? What are the associated risks based on maturity of the capability and any other program concerns (cost/schedule)?

As solutions to the program needs and concerns are being explored, they can be captured in a SysML model with as much supporting information as available. An example of such is shown in Figure 3.

This example shows how the three use cases discussed above were extended to additional use cases. The blocks in the use case diagram depict a potential technology solution for each use case. For Use Case #1: Capability Description and Requirements Development, the program desires to improve the capability description (CDD) and requirements development (PSPEC) processes using DE. One way that DE can improve requirements development is developing and managing requirements in a model-based, configuration-controlled environment (such as Cameo). The program chose this solution with the understanding that articulating requirements in a model-based environment would provide traceability to supplemental source information. This reduces ambiguity by providing rationale and context for the requirements, ultimately improving the dialogue between the USG and Industry.

Another aspect to keep in mind while researching DE solutions is whether the capability should be implemented on the USG side, required of the vendors via the contract, or both. In this case, it makes sense to have the USG perform requirements management of its requirements in a model-based environment and to specify that the vendors execute requirements management in a similar manner.

Another goal of the program was to increase the fidelity of technical data and deliverables coming in from the vendors, formalized as Use Case #2: Enhance Data Packages and Deliverables from the Contractors. One way to enable this is to improve data transparency and impact assessments via collaborative Digital Engineering Environments (DEE). In this example, it is assumed that frequent access to more data would drive increased collaboration in the hopes that problems can be resolved before becoming major issues. The other way this potentially enhances the technical data and deliverables is the ability to perform impact assessments more efficiently thanks to the digital thread(s) across the data. From here, there are countless tool implementations and solutions that can comprise a DEE but this section focuses on use case development.

Use Case #3: Reduce Physical Test Scope and Test Risk explores the use of DE to reduce physical test risk (reduce test failures and re-test), and to influence the Army's obligatory test and evaluation process. While there are several DE attributes that can contribute to test planning, we will focus on one potential solution: additional MS&A to support test.

Similar to the previous use cases, it is vital that the contract language is written such that the appropriate models are being requested, at the right time, and with the right connections within the DEE. The question then becomes, what *are* the right models to ask for in the contract, and exactly how do we ask for it? How do we ask for this information such that the requirement is clear enough for the vendors to bound their proposals to but not constrain innovation? The implications to this question will be discussed in the last step of the process (capture use cases for vendor proposed solutions).

Step 5. Assess Challenges and ROI of Implementing Potential Solutions. DE is comprised of countless digital data types (models, simulations, and analyses), interconnected in different ways across different tools. In addition to the complex metamodel of DE, the technology available to support the interconnected data within the DE – referred to here as the digital thread - is rapidly enhancing and constantly changing. There is a myriad of software and tools that can be used to execute different DE capabilities. Once the DE capabilities and benefits are well defined in the scope, and there is a good understanding of solutions available to execute the scope, it is important to perform trades to gain an understanding of what the ROI would be for the program for each option.

It is important at this point to revisit the concept of DE as a sliding scale. The section on this above

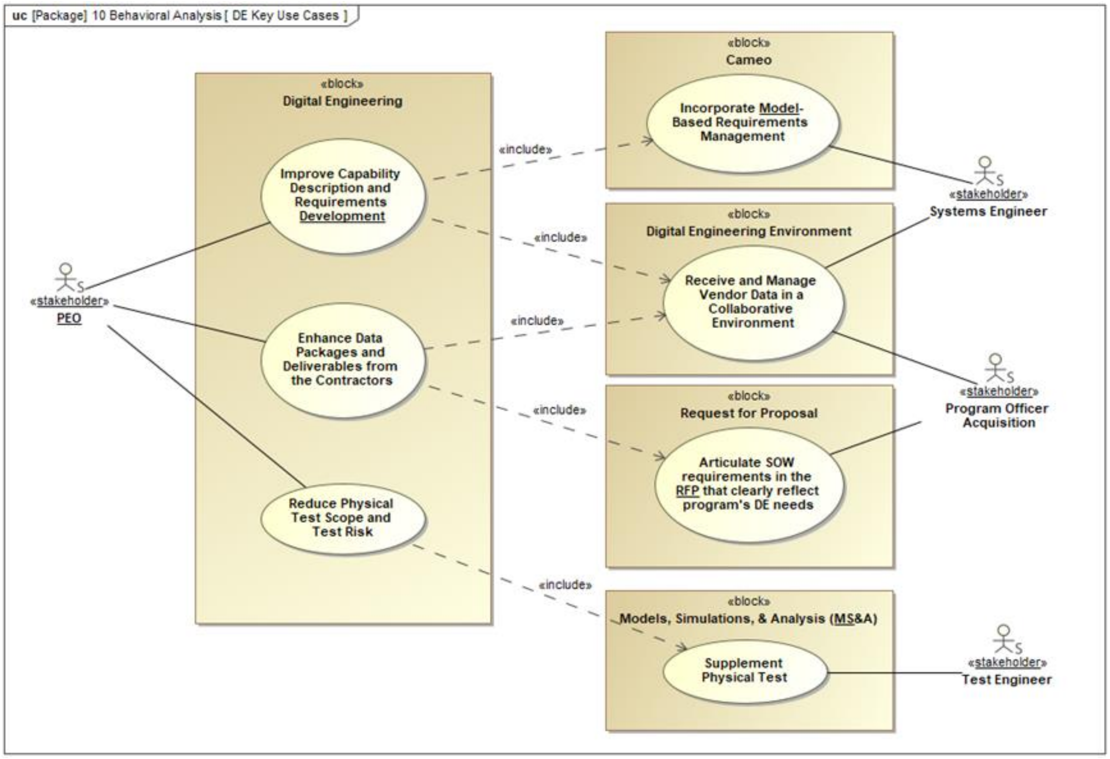

Figure 3: Decomposed DE Use Cases with Potential Solutions

includes examples of metrics that can be used in consideration of ROI assessments. There are numerous decision frameworks that can be put into place to support trade studies and decision making, but for the purposes of this paper, we will not go into the details on this part of the process. The key takeaway at this point; however, is to start documenting the “knowns” and “unknowns” and documenting program risks based on the “unknowns”. These key takeaways are highlighted for each use case below.

Speaking directly to Use Case #1: Capability Description and Requirements Development, model-based requirements management is not a new concept, and is already in practice on most DoD acquisition programs. In this case, the tools and processes associated with model-based requirements management were well understood and decidedly mature enough to be put into place right away; therefore, there were not any major concerns on ROI with regards to tooling. However, adopting new approaches and methodologies – such as utilizing Cameo to perform requirements development – requires cultural change in the workforce. As documented in the DoD’s DE strategy, transforming the culture and workplace to adopt new DE tools and techniques continues to be a challenge and should be taken into consideration throughout the process (US Department of Defense 2018). For OMFV, the transition from document-based to model-based requirements development and requirements management was ultimately deemed a min viable DE capability, with minimal concerns or risks from an ROI perspective. The implementation of model-based requirements management provides an example of one of the more straightforward decisions the program made with regards to the DE strategy.

Deploying a DEE as required by Use Case #2: Enhance Data Packages and Deliverables is a major effort in and of itself, the details of which is outside of the scope of this paper; however, the decision to deploy a DEE to support the DE strategy was clear. A DEE would be required to receive, manage, store, and share data to some extent; therefore, the ROI assessment on this capability was rather straightforward as it was deemed a minimum viable capability necessary to execute the DE strategy at all. However, the question remained at this point – how much of the DEE needs to be defined in order to clearly articulate the USG versus vendor responsibilities in the RFP? The next steps will focus on how to capture the contractual language to support the concept of a DEE, even if the implementation details of the DEE are not fully formed

The DoD currently lacks policy that directly guides the USG program offices in decision making when it comes to USG responsibility for requirement verification activities; meaning, there is no prescribed solution to the MS&A and test scope required to verify the operation and performance of the integrated end product as required by Use Case #3: Reduce Physical Test Scope and Test Risk. There are several valid reasons for this. The level of verification the USG is responsible for varies based on the complexity of the capability being acquired and program factors such as cost and schedule. Also, there simply cannot be a static, standard solution reference given that MS&A capabilities are continuously improving and changing.

The DEE can address some of these technical hurdles by hosting the ASoT in one location accessible by all Army stakeholders, allowing for more informed test planning. This eventually transitions into the Army properly establishing Digital Threads which will enable the Army to use more modeling and simulation capabilities to reduce physical test verification and venture into true Digital Twins. But again, there is a decision to be made based on ROI of what types of MS&A can and should be asked for. Looking into MS&A options at this point, and their potential ROIs helped bound the “knowns” and “unknowns”, which is the important takeaway from this step.

Step 6. Capture Requirements / Deliverables Associated with DE Strategy in the RFP. At this point in pursuing Use Case #1: Capability Description and Requirements Development, the program should have *some* DE requirements that are well understood and can be clearly articulated in the RFP. One example of this is the decision to move forward with model-based requirements management. This capability uses tools already in place, and has proven success across the DoD, allowing this capability to be articulated in the RFP in such a way that clearly communicates to the vendors what the model-based requirements and associated deliverables are. In this case, the model-based work requirements for the vendors can be directly captured in the RFP Statement of Work (SoW) just as traditional work requirements and deliverables would be.

Specifying clear requirements for the DEE in the RFP in support of Use Case #2: Enhance Data Packages and Deliverables was not as straightforward given the number of “unknowns” discovered during the ROI assessment. However, the PdM was able to methodically make decisions on RFP scope based on the “knowns” and the understanding that data needs across multiple disciplines are likely to be shared just based on the DEE concept alone. Ultimately, the DEE’s opportunity to share data more easily reduced the USG’s contract data requirements list (CDRL) by roughly 40%. Additionally, the systematic approach to the RFP inspired logistics, test, quality assurance, and program management to exploit opportunities in the management of the program that previously didn’t exist.

While the ROI assessment for Use Case #3: Reduce Physical Test Scope and Test risk also raised several “unknowns” when it comes to specifying exactly what the PdM should ask of the vendors and how, it also unveiled the minimum viable set of MS&A required to execute the program. In these cases, the “known” MS&A required for the program was stated in the RFP scope, with MS&A types and formats specified as applicable. The "unknowns" that resulted from this ROI exercise is covered in the next section.

Step 7. Capture Use Cases in the RFP For Vendors to Propose to the "unknowns". In many cases, the program may not have all of the information and resources available to have a well-defined approach for a particular use case. Even if there are well-understood solutions, several of the solutions may have a similar ROI. In this case it may be beneficial to solicit solution proposals from the vendor(s). For the sake of OMFV, these were coined as the "unknown" DE solutions. OMFV had a clearly defined use case and data need, but the exact format and types of MS&A to ask of the vendors to satisfy the use case was either unknown or undecided. In these cases, the use cases were included in the OMFV program's DE strategy, and the vendors were asked to propose solutions that would satisfy the use cases. To communicate this to the vendors for OMFV, the USG developed attachments to the RFP containing the DEE and MS&A use cases, providing an opportunity for the

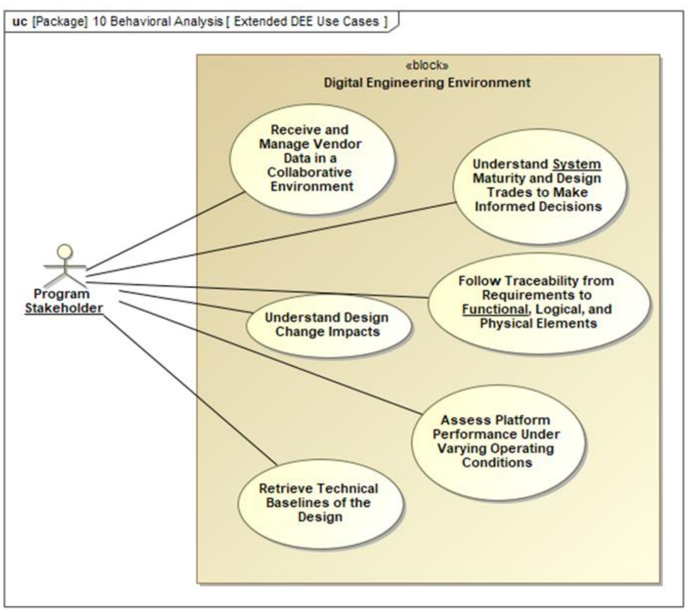

Figure 4: Extended DEE Use Cases for RFP

vendors to propose solutions, which the USG could then in turn perform ROI assessments on. An examples of use cases communicated in the RFP are included as Figure 4, which has been generalized for sharing purposes.

4. CONCLUSION

This paper explored the approach used by the OMFV program to refine a realistic and feasible DE strategy. This process requires an up-front investment in program planning to ensure that program needs are identified, researched, and understood. It also covers the critical steps to ensure that the RFP conveys the contractual language required to satisfy program needs, and provides a solution for articulating guidance in the RFP even if a specific deliverable or solution cannot be articulated. In this ever-evolving world of DE, it is vital provide the vendors flexibility and incentive to provide innovative solutions, while bounding the problem space enough such that the intent is clearly communicated. Throughout the process, it is also important to understand program constraints such that your DE strategy can be realistically implemented based on available program resources (people, tools, training, cost, etc.).

This process concludes with capturing the DE scope and translating the scope into vendor requirements and guidance in the RFP; however, this process only kicks off the beginning of implementing a successful DE program. Upon RFP release, there is additional program planning required to ensure that the IT infrastructure is being put into place to execute the DE strategy, and the correct personnel and training is in place to ensure that all stakeholders can execute their contracted roles within the digital engineering environment. Additional program planning includes ensuring that the processes, plans, and procedures are aligned with the DE strategy. This may include transitioning program plans and processes (i.e. SEP, TEMP) to the model-based environment. Test planning is another major area of program planning that is impacted by the digital transition, and is an essential next step to explore once the DE scope is defined.

5. References

[1] History.com Editors 2009, "President Eisenhower warns of Military-Industrial Complex," *history.com*. [Online]. Available: https://www.history.com/this-day-in-history/eisenhower-warns-of-military-industrial-complex. [Accessed: 21-Mar-2023].

[2] Office of the Deputy Assistant Secretary of Defense for Systems Engineering, "Department of Defense Digital Engineering Strategy," *Digital Engineering Resources*, Jun-2018. [Online]. Available: https://ac.cto.mil/wp-content/uploads/2019/06/DE-Fundamentals.pdf. [Accessed: 21-Mar-2023].

[3] M. Vinarcik, "Popular Digital Engineering Validation Tool Now Supports Failure Analysis," *SAIC Digital Engineering Blogs*, 13-Jan-2021. [Online]. Available: https://www.saic.com/blogs/digital-engineering/system-model-validation-tool-saic-releases-new-version-1-7. [Accessed: 20-Mar-2023].

[4] "DAU Glossary," *DAU Glossary of Defense Acquisition Acronyms and Terms*. [Online]. Available: https://www.dau.edu/glossary/Pages/GlossaryContent.aspx?itemid=27348. [Accessed: 21-Mar-2023].

[5] "Bradley M2/M3 - tracked Armoured Fighting Vehicle," *Army Technology*, 24-Aug-2020. [Online]. Available: https://www.army-technology.com/projects/bradley-m2-m3. [Accessed: 20-Mar-2023].