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Digital Mission Command in the Joint Force Operations

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NPS NRP Executive Summary
Digital Mission Command in the Joint Force Operations
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Naval Postgraduate School, Graduate School of Operational and Information Sciences (GSOIS)

DIGITAL MISSION COMMAND IN THE JOINT FORCE OPERATIONS

EXECUTIVE SUMMARY

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Student Participation: No students participated in this research project.

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Project Summary

The current geo-political situation requires Special Operations Forces to act at the speed of light. This requires all data to be digitized. NAVSPECWARCOM (Naval Special Warfare Command) puts a special emphasis on digitizing mission command to gain advantage over adversarial forces in speed and quality of planning and execution. NAVSPECWAR, due to its nature, conducts digital mission command tasks at the spear of the tactical edge.

Our primary research question is to apply understanding of the data maturation process to the innovation of the digital mission command. Our method is to identify where a significant return on a data value is hidden by using transformation from spatial-temporal representation to a temporal representation organized into temporal snapshots pointing to the spatial objects. This lets warfighters to gain a speed advantage in a battlespace during the execution of the Orient phase in Observe-Orient-Decide-Act loop. Understanding of a data value through the transformations provides our sponsors with informed appreciation on why operating with knowledge is a winning multiplier.

The result of the research proved that for contextually adaptive battlespace, it is paramount to have situational awareness. Analysis of data maturation informed that "projected" situational awareness is the most pertinent. It is obtainable only by accounting for continuing threats at the battlespace. This means that obtaining superior situational awareness is a continuous endeavor.

Our research concluded that it is imperative to integrate data with the meaning of the data as a first step in data enrichment to transform it to knowledge and beyond. We also concluded that adaptive situational awareness requires representing situations in event-driven graph data models. Finally, it is apparent that decision making requires aggregation over layers of summarized graph data models. We recommend using a multi-dimensional multi-hierarchical summarization engine which can imbed graph data models, non-graph data and models.

Keywords: *OODA, Observe-Orient-Decide-Act, projected situational awareness, context, data maturation, Special Operations Forces, transformation, contextually adaptive battlespace, representing situations, event-driven graph data model, aggregation over layers of summarized graph data models, multi-dimensional multi-hierarchical summarization engine*

Background

The focus of our study is to advance the topic sponsor's command and operational requirements and capabilities requested by such requirements. The functional areas we have been asked to study support a modern definition of command and control named "digital mission control." Our research study is synergistic with the sponsor's requirements for innovation by pushing down the military logic from the application layer to the platform layer. This results in all shared reusable functions to be organized in a platform layer. Our research team has concluded that modern operational requirements cannot be

fulfilled without reliance on a foundational data strategy acting as guidance for the system engineering platform and, on a software side, as a guidance to the reference architecture implementation. The results of our team's research will aid "digital mission command" accomplishment because visionary data strategy will make it possible to have operational requirements which are not even imaginable with "as is" legacy data architecture.

Current knowledge of innovating "digital mission command" is highly dependent on the presence or lack of the foundation of a data strategy. If, in our case, "digital mission command" is driven by reference architecture implementation, which is supported by prototyping efforts, such investments are risky due to a likely lack of possible understanding of the future platform's goal and the essential methodology that needs to be put in place to support current and future operational needs.

This topic is a continuation of a past Naval Research Program study. It was conducted by our research team in FY20 for Initial Research Estimate Form NPS-20-N313-A under "Data Strategies in Support of the Naval Operational Architecture." Our present study applied a data strategy designed in the previous FY20 study to a "digital mission command" application suite. "Digital mission command" requires speed in Special Operations Forces' (SOF) acquisition of situational awareness. SOF architecture must support requirements in the highly dynamic battlespace. It is not possible to accomplish such a goal unless a developed platform is highly adaptive due to superior understanding of the meaning of the surrounding mission and environmental events.

The methodology of our research study was designed to be capable to change the behavior of the platforms to modernize "as is" command and control legacy approach based on past operational requirements. Our methodology follows best practices following the evolution of data which follows the Data → Information → Knowledge → Understanding pipeline. Our research methodology provided analysis of all four phases and what is required to support maturing data in each of them.

The platform's behavior must be advanced for two reasons: (1) A need to support the new concept behind "Command & Control" tokened as "digital mission command," and (2) To be cognizant of a decade-long revolution in information technologies which touches such critical technology areas such as cloud technologies, universal storage platforms, and a number of open-source computing frameworks with high levels of adoption.

Findings and Conclusions

Our findings from a "data" step are evolving since FY21 from the earlier study of a data strategy for Naval Operational Architecture. The idea of a universal storage layer as a pillar for a variety of highly adopted computational frameworks is proven via ongoing investments which now include Lockheed Martin Ventures. Our research team believes a realization from technology-savvy innovators is a great benefit to the unification of the "structured" in the over-the-cloud storage layer. A concept of structured multi-

modal data integrated in a universal storage with clouds via containerization and virtualization technologies is a testament to the quality of our research. It proves that our finding regarding investment into the Data Lakes or Data Warehouses in the clouds is viewed by some experts as highly risky due to a steep "pay-as-you-go" pricing structure. A primary need for enabling infrastructure to be cost-affordable is the pivot behind DoD-focused ventures supporting higher-level constructed layers, attempting to escape escalating prices of cloud vendors.

Our research team concluded it is unfeasible to avoid ontologies and their integration with the data to leap to the "information" step in the data enrichment paradigm. Our conclusion is that the process of interpretation of ontologies into the ontological types with an idea of coupling ontological types with data is a streamlined paradigm with a better return on investment. We also concluded that there will be no single "upper ontology." The world requires both a "realistic", the way things are, approach, and a descriptive approach with the presence of conflicting hypotheses. Our ontology should support a reconciliation capability as opposed to taking sides with what, at the moment, is empirical truth. The world is more complex than a simplistic snapshot supported by the "realists."

Our short-term implications convinced us of a high-payoff value by focusing on situational awareness with the goal to provide "contextual adaptation" capability. We feel combining the power of dynamic events of the world states with static objects, which describe the world, will let us discover the dynamics of world concepts. Our long-term implications are focused on defining a method of connecting graph data models' events and objects in time and space to ensure they are concurrently summarized. This requires acquisition of building an aggregation engine which embeds data graph models and other modalities into a multi-dimensional multi-hierarchical cube.

Our findings and conclusions will improve the operational situation, including decision-making. The Naval Postgraduate School research team, per direction from the topic sponsor, LCDR Christian Brown, had a discussion with the Chief Technology Officer at NAVSPECWARCOM in regard to our recommendations on which technologies need to get adopted and which technologies need to be implemented. We were told such development only takes place in the Joint Artificial Intelligence Center (JAIC). We were promised to be introduced to the person in charge of AI stack to present our recommendations on the research, development, and acquisition of AI technologies. We will be reporting to the Naval Research Program on future developments after introduction to JAIC occurs.

Recommendations for Further Research

Additional research study should be guided by the task list presented below:

1. Develop a Graph Basic Linear Algebra Subprograms Application Programming Interface layer over multi-dimensional array storage.
2. Develop a Dynamic View Management layer that persists in a multi-dimensional array storage.

3. Integrate Natural Language Processing parsing/interpretation with a graph data model that persists in a multi-dimensional storage.
4. Develop a rule-based "semantic matching" approach between events and objects/entities for the purpose of "aggregation/summarization of graphs and non-graphs" using a generic function.
5. Implement an aggregation/summarization multi-dimensional multi-hierarchical engine capable of imbedding event graph data models and any non-graph data (including Point Cloud and multi-media) integrated with multi-dimensional array storage.

Acronyms

JAIC	Joint AI Center
NAVSPECWARCOM	Naval Special Warfare Command