12$^{\text{TH}}$ ICCRTS
"Adapting C2 to the 21$^{\text{st}}$ Century"
"Knowledge Sharing Mechanism: Enabling C2 to Adapt to Changing Environments"
Track 1: C2 Concepts, Theory, and Policy
Track 4: Cognitive and Social Issues
Track 5: Organizational Issues

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ABSTRACT

The environments of software engineering and command and control (C2) are very similar because they are both instances of complex problem solving. The common nemesis to successfully developing solutions in these environments is change. The challenge of any complex problem solving process is the balance of adapting to multiple changes while keeping focused on the overall desired solution. The Knowledge Sharing Mechanism (KMS) is proposed as framework to achieve this balance. The KSM is an iterative method for understanding a complex problem, developing a framework for solving that problem, developing partial solutions for the problem, and then reassessing those partial solutions and overall framework until the complete solution has been fully developed. The KSM is based on the integration of Christopher Alexander's unfolding and differentiation processes with the image theory of C2. In image theory, there are two perspectives in developing a solution: topsight and insight. These two perspectives must be balanced in order to achieve success. Alexander's unfolding process is the basis for understanding, as an observer, the complex interactions in both software engineering and C2. The KSM uses Alexander's differentiation process, as an actor, achieving the correct balance of topsight and insight.

OUTLINE

1. Introduction/Research Motivation
   a. Similar histories and lesson learned between C2 and software engineering. Both can be viewed as abstractions of complex problem solving.
   b. The common problem for both C2 and software engineering is how to handle change.

2. Understanding design through Christopher Alexander's "Unfolding Process"
   a. In order to deal with the growing complexity of software, software engineer looked outside their discipline for inspiration. One such inspiration was the architect Christopher Alexander who is known for his works: *The Timeless Way of Building*, *A Pattern Language*, and *The Nature of Order* series.
   b. Alexander recognized that good design in nature exhibited a high degree of "wholeness." This wholeness is create through the use of entities called "centers." Through his twenty plus years of research of design, Alexander documented 15 properties of these centers that are present in good design and help to give the overall design "wholeness" and "life."

3. Image Theory
   a. The value of images in software engineering and C2 in regards to situational awareness and achieving a common operational picture.
   b. The importance of balancing topsight and insight in order to achieve a solution to the problem as outlined in *Field Manual 6-0, Mission Command: Command and Control of Army Forces* and *Marine Corps Doctrinal Publication 6, Command and Control*.
   c. Using Christopher Alexander's differentiation process, which seeks to development good design, to achieve this balance.

4. The Knowledge Sharing Mechanism (KSM)
   a. Knowledge management, like software engineering and C2, is another abstraction of complex problem solving. Knowledge management is concerned with effectively managing large volumes or explicit knowledge as well as attempting to capture and share tacit knowledge within an organization.
   b. The Knowledge Insight Model (KIM) developed by Dr. Thomas L. Honeycutt, North Carolina State University, provided a method for creating, sharing, and managing knowledge. Through the develop of the KIM, four roles in knowledge management emerged: the Framer (who is responsible for understanding the problem and designing an overall framework to solve the problem), the Maker (who is responsible for creating an innovative solution to the problem outlined by the Framer), the Finder (who is responsible for finding resources to supplement the Maker's efforts), and the Sharer (who is responsible for ensuring that the Framer, Maker, and Finders roles work together by sharing information). Of the four roles, the Sharer role is the most critical to the success or failure of the organization.
   c. The Knowledge Sharing Mechanism (KSM) is a framework developed to facilitate the role of the Sharer in sharing knowledge. The KSM attempts to balance topsight and insight perspectives using Alexander's differentiation process. The KSM is an iterative

method for understanding a complex problem, developing a framework for solving that problem, creating, developing, and refining parts of the solution for the problem, and then reassessing those partial solutions and overall framework until the complete solution has been fully developed.

5. Incorporation of the KSM in C2
   a. What would the Military Decision Making Process (MDMP) look like with KSM incorporated into it.
   b. How does the KSM measure against the six attributes of an agile command and control system as outlined in *Power to the Edge, Command and Control in the Information Age*.

6. Conclusion