OR 683 / SYS 680 / ECE 670
Principles of C4I

Instructor: Daniel T. Maxwell, Ph.D.
Location: West 1001
Time: Tuesday 7:20-10:00

I.   Objective

The course seeks to provide students with a balanced overview of the basic principles of C4I (Command, Control, Communications, Computers, & Intelligence). The successful student will understand the complex relationship that exists among the engineering, psychological, and social issues that must be addressed in the design, development, deployment, and application of C4I systems.

II.   Course Theme

Command and Control (C2) has been studied for centuries in the context of military operations. Over the past twenty-five years C2 studies and thinking has been extended to include the contributions and role of communication, computer, and intelligence, (C4I) technologies. Additionally, C4I studies are now an integral part of disaster and emergency response management, as well as other complex operations. This course will provide engineering students with an appreciation of the complexities involved in the design, development of a "System of Systems". The scope will include military command and control, as well as the theory, application and practice including C2 technologies and the design of C2 applications."

The course will consist of a mixture of lectures, guest speakers, and practical exercises intended to provide students with an appreciation of the multi-disciplinary nature of the C4I challenge and some strategies for meeting the challenges presented when providing engineering support for complex systems of systems.

III.   Readings

   a. Sweeney, M. (2002) *An Introduction to Command and Control,* Naval Post Graduate School, Monterey. (Available on Kindle)
   b. Alberts, D. & Hayes R. (2006) *Understanding Command & Control* Command and Control Research Program, Washington D.C.
   c. Maxwell, D. & Tucker, C. (2014) *"Refining The Intelligence Cycle: Adapting to an Era of Population-Centric Security Challenges",* in Human Geography: Socio-Cultural Dynamics and Challenges to Global Security, USGIF Monograph Series Volume 1, 2014.
   d. Alberts and Hayes (2006) *Power to the Edge,* DoD CCRP, Washington D.C.

e. Maxwell & Davis (2013) *"Value Focused Metrics for Emergency Management Planning",* with David F. Davis, Defence Research and Development Canada Centre for Security Science, Reports DRDC CSS 2013 – 021,022,023.

IV. Grading Policy

a. Homework 30%
b. Class Participation 10%
c. Case Study / Project Presentation & Report – 30%
d. Final exam – Take Home 30%

V. Course Outline (By Week)

	Principles of C4I	Reading Assignment
Date	**Topic**	
Sep 1	Class Intro and Overview of C4I Systems Engineering & Command Intent (Dr. Hieb)	Alberts & Hayes – C-2 Chapters 1-4
Sep 8	C2 Fundamentals, Enduring Principles, and Conceptual Models (1 of 2)	Alberts & Hayes Chapters 5-8
Sep 15	C2 Fundamentals, Enduring Principles, and Conceptual Models (2 of 2)	Alberts & Hayes Chapters 9-10
Sep 22	Intelligence Processes	Maxwell & Tucker (2014)
Sep 29	Situational Awareness / Information Fusion / Computational Models of Uncertainty	Sweeney Chapters I-IV
Oct 6	Decision Making and Decision Support Modeling for C2	Sweeney Chapters V-VIII
Oct 13	No Class – (Columbus Day)	Alberts and Hayes PTTE
Oct 20	Operational Planning Processes and Frameworks	Alberts and Hayes PTTE
Oct 27	Introducing Network Centric Concepts -- "Power to the Edge"	Alberts and Hayes PTTE
Nov 3	Measuring C4I Effectiveness	Maxwell & Davis (2013)
Nov 10	Issues in Data and Information Management	Project Work
Nov 17	Planning and Course of Action Development	Project Work
Nov 24	C2 Concept Development and Experimentation (Group Presentations)	Project Work
Dec 1	Emphasize Experimentation (Group Presentations)	Review
Dec 8	Review / Hand out Final Exams (Group Presentations)	Review
Dec 15	Final Exams Due	Exam

Instructor Availability

The instructor will be available for assistance before and after class, or by appointment. Call (703) 409-7828 to arrange a time.

VI.   Supplemental Readings:

    a. Command and Control – Agility

      i. Alberts (2011) *The Agility Advantage* DoD CCRP, Washington D.C.
      ii. Brehmer, B. (2005) *The Dynamic OODA Loop: A New Basis for Development of C2 Systems,* Swedish National Defence College.
      iii. Brehmer, B. (2014) "Command Without Commanders" *Proceedings of the 14th ICCRTS,* Washington D.C.

    b. Risk and Uncertainty

      i. Savage, Sam. *The flaw of averages: why we underestimate risk in the face of uncertainty.* Hoboken, New Jersey: John Wiley & Sons Inc, 2009. Print ISBN: 978-0-471-38197-6

      ii. Anything by Paul Slovic

    c. Planning and Decision Making

      i. Klein, G. (1998) *Sources of Power: How People Make Decisions,* MIT Press, Cambridge
      ii. Kahneman, D. *Thinking Fast and Slow,* Farrar, Strauss & Giroux, 2011 Print ISBN978-0-374-27563
      iii. Keeney, R. (1992) *Value Focused Thinking,* Harvard Press, Cambridge.

    d. Complexity

      i. Dörner, Dietrich. *The logic of failure: recognizing and avoiding error in complex situations.* Basic Books, 1996. Print. ISBN: 978-0-201-47948-5

    e. Architectures

    i. Spewak, S. (1992) *Enterprise Architecture Planning,* Wiley Press, New York

    ii. Anything that explores the Zachman Framework

    iii. Wisnosky, D. (2006) *DoDAF Wizdom,* Wizdom Systems, USA.

f. Intelligence

    i. Charters, David, Stuart Farson, and Glenn Hastedt. *Intelligence analysis and assessment.* Great Britain: Frank Cass & Co. Ltd, 1996. Print. ISBN: 0-7146-4249-5

    ii. Clark, Robert. *Intelligence analysis: a target-centric approach.* 2nd. Washington, DC: CQ Press, 2006. Print. ISBN: 978-1-933116-93-8

    iii. Lowenthal, Mark. *Intelligence: from secrets to policy.* 3rd. Wasington, DC: CQ Press, 2006. Print. ISBN: 1-933116-02-1

g. **Disaster Planning and Assessment**