

22ND INTERNATIONAL
COMMAND AND CONTROL
RESEARCH & TECHNOLOGY SYMPOSIUM
6-8 NOVEMBER – LOS ANGELES, USA

2017

KSCO

9th Knowledge Systems
for Coalition Operations 2017

Symposium Program

Theme: Frontiers of C2

Hosted by

Army Research Laboratory West
USC Institute for Creative Technologies

Symposium Chairs

David Alberts
Jitu Patel

Program Chairs

Micheline Bélanger, ICCRTS
Austin Tate, KSCO

Supporting Organizations

US DOD Command and Control Research Program
UK Defence Science and Technology Laboratory
Defence Research and Development Canada



Day 1

8:00-9:00	Check-in and on-site registration
9:00-9:10	Symposium Welcome
9:10-9:30	ARL-West Welcome and Overview Dr. Cynthia Bedell, Regional Lead, ARL
9:30-9:45	Welcome to USC Institute of Creative Technologies, Clarke Lethin, Managing Director
9:45-10:30	Track Sessions Overview
10:30-10:45	Coffee Break
10:45-12:00	Concepts and Doctrine Panel <ul style="list-style-type: none">• Jes Oedra - UK MoD Development Concepts and Doctrine Center (DCDC)• Lt Col Jim Hill - UK MoD Development Concepts and Doctrine Center (DCDC)• Christopher Moore - US Air Force AF-A9• LTCOL Leon Young, Deputy Director Joint Concepts, ADF HQ - Force Analysis Branch, Department of Defence- Australia
12:00-1:00	Lunch Break
1:00-5:30	Track Sessions
5:30-7:00	Reception

Day 2

8:00-9:00	Check-in and On-site Registration
9:00-9:30	Reflections
9:30-10:30	“C2 and Cyber: Initiatives and Challenge” John J. Garstka, Dep Dir Cyber / DASD C3CB
10:30-11:00	Coffee Break
11:00-12:00	“AI, Robotics and Cyber: How Much Will They Change C2?” Dr. Alexander Kott, Chief Scientist, Army Research Laboratory
12:00-1:00	Lunch Break
1:00-5:00	Track Sessions

Day 3

8:00-9:00	Check-in and On-site Registration
9:00-9:45	“Organized Complexity in Networks: Insights and Opportunities” Dr. David Alderson, Associate Professor, Operations Research Director, Center for Infrastructure Defense, Naval Postgraduate School
9:45-10:30	NATO Research Panel Moderator: Micheline Bélanger, DRDC <ul style="list-style-type: none">• SAS-143 –David S. Alberts, Institute for Defense Analyses• IST-144 - Elizabeth Bowman, Army Research Laboratory• SAS-ET-DS - Elizabeth Bowman, Army Research Laboratory• MSG-136 - Frank T. Johnsen• IST-090/118/050 - Frank T. Johnsen, Peter-Paul Meiler, Marco Manso• IST-147 - Niranjan Suri
10:30-11:00	Coffee Break
10:30-12:00	Demonstration Session
10:30-12:00	Poster Session
12:00-1:00	Lunch Break
1:00-3:30	Track Sessions
3:30	End of Symposium

Tracks and Track Chairs

Track 1: Operational Issues: Coalition Command and Control (Ken Teske)

Track 2: C2 Concepts, Theory, Policy, and Approaches
(Rick Metzger, Aletta Eikelboom, Ingrid van Bommel)

Track 3: Implications of the Internet of Intelligent Things (Niranjan Suri)

Track 4: Cognitive and Socio-technical Challenges (Elizabeth Bowman)

Track 5: Highly Connected, Automated, and Autonomous Forces
(Marco Manso, Frank Johnsen)

Track 6: Interoperability, Integration and Security (Mark Pullen)

Track 7: Human Information Interaction (Adrienne Ragin)

Track 8: Methodology, Experimentation, Analysis, Assessment and Metrics
(Alexander Kalloniatis)

Track 9: Battlefields of the Future (Bryant Russell)

Track 10: KSCO (Austin Tate)

Room

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Day 1, 1:00pm - 3:00pm

Track 2a

C2 Concepts, Theory, Policy, and Approaches

- | | | |
|-----------|-----|--|
| 1:00-1:30 | 70 | Mason Bruza and Mark Reith. Multi-Domain Command and Control: The Need for Capability Transparency |
| 1:30-2:00 | 28 | Mark Hazen, Anthony Isenor, Francine Desharnais, Tania Randall and James Karle. Characteristics of Information Warfare: The Battle for the Narrative |
| 2:00-2:30 | 109 | Peter Houghton, Jes Odedra. Future Joint C2 Concepts |
| 2:30-3:00 | 113 | Dean Lee, Glenn Tolentino, Charles Yetman, Rick Cruz and Stan Volchenok. Big Data Decision Support in Command and Control Systems |

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Day 1, 1:00pm - 3:00pm

Track 9

Battlefields of the Future

- | | | |
|-----------|----|---|
| 1:00-1:30 | 9 | Juha Kukkola, Juha-Pekka Nikkarila and Mari Ristolainen. Asymmetric frontlines of cyber battlefields |
| 1:30-2:00 | 59 | Linda Malinga. Experimenting with 4G LTE for Area Coverage and the Envisioned C2 Deployments over 5G |
| 2:00-2:30 | 5 | Michael Tisdell, Kenneth Teske, Mark Miller and Pat Guerin. Improving Cyber Security Alignment and Integration |
| 2:30-3:00 | 58 | Jayson Durham, Joan Kaina, Jason Landsborough, Minh Vuong, Zeeshan Barkatullah and Ryan Gabrys. Link-Autonomy and Autonomics for Developing Resilient Cross-Layer Communications Services |

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Day 1, 1:00pm - 3:00pm

Track 6a

Interoperability, Integration and Security

- 1:00-1:30 106 Bharatkumar Patel and Brian Wardman. Joint Mission Planning and Decision Support Through C2-Simulation Interoperability
- 1:30-2:00 37 James Ruth and Kevin Galvin. Architecture Driven Scenarios in Support of C2-Simulation (C2SIM)
- 2:00-2:30 97 Fabio Corona, Marco Biagini, Magdalena Wolski and Ulrich Schade. Conceptual Scenario Supporting Extension of C2SIM to Autonomous Systems
- 2:30-3:00 23 Kevin Foltz and William Simpson. Escalation with Accountability for Enterprise Level Security

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Day 1, 1:00pm - 3:00pm

Track KSCO

**Coalition Information Handling,
Situational Analysis & Decision Support**

- 1:00-1:30 118 Karen Myers, Tim Ellis, Tancrede Lepoint, Ronald Moore, David Archer, Grit Denker, Steve Lu, Stephen Magill and Rafail Ostrovsky. Privacy Technologies for Controlled Information Sharing in Coalition Operations
- 1:30-2:00 121 Erica P. Viklund, Heather M. Oonk and Manuela Jaramillo. The Role of Transactive Memory (TM) in Proactive Decision Support (PDS)
- 2:00-2:30 72 Wen Zhou, Weidong Bao, Xiaomin Zhu, Chao Chen, Zhu Wu and Changfei Wu. A Semantic-Based Information Integration Framework of Agile Command and Control
- 2:30-3:00 122 Adrienne Raglin and Christian Schlesiger. Data Analyzer Software: a Knowledge System Supporting Coalition and Team Information Sharing
- 3:00-3:30** *Coffee Break*

Room

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Day 1, 3:30pm - 5:00pm

Track 4a

Cognitive and Socio-technical Challenges

- 3:30-4:00 12 John Hawley, Michael Swehla, Mark Huron and Troy Smith. The New Equipment is Here, Now Comes the Hard Part: Cognitive and Sociotechnical Challenges in Network-Enabled Mission Command
- 4:00-4:30 83 Jose Carreno, Paul Shigley and Shirley Pacheco. Building International Cooperation in the Research and Development Community
- 4:30-5:00 63 Ulrik Spak. The common operational picture – a powerful enabler or a cause of severe misunderstanding?

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Day 1, 3:30pm - 5:00pm

Track 5a

Highly Connected, Automated, and Autonomous Forces

- 3:30-4:00 30 George Galdorisi. Designing UxS for Military Use: Harnessing AI to Provide Augmented Intelligence
- 4:00-4:30 143 Mark Allison. Towards UAV Collaborative Search Utilizing Adaptable Probabilistic State Machines
- 4:30-5:00 31 George Galdorisi and Vladimir Djapic. Command and Control (C2) of Cross-Domain Unmanned Vehicles (UxVs)

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Day 1, 3:30pm - 5:00pm

Track 7a

Human Information Interaction

- 3:30-4:00 103 Andre Harrison, Adrienne Raglin and Mark Livingston. Predicting where people look in information graphics
- 4:00-4:30 15 Mark Mittrick, John Richardson, Derrik Asher, Alex James and Timothy Hanratty. Using the Value of Information (VoI) Metric to Improve Sensemaking
- 4:30-5:00 41 James Michaelis. Techniques for Representation and Usage of Mission-centric Value of Information

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Day 1, 3:30pm - 5:00pm

Track KSCO

Coalition C2 and Collaboration

- 3:30-4:00 111 David Mott, Yunfeng Zhang, Soheil Eshghi, Cheryl Giammanco and Troy Kelley. A Framework for Modelling the Effect of Emotion on Uncritical Reasoning
- 4:00-4:30 3 Austin Tate and Jeffrey Hansberger. Virtual Operations Centres for Coalition Operations and Distributed Team Collaboration
- 4:30-5:00 76 Jitu Patel and Peter Houghton. Where are the Knowledge Systems? - Understanding obstacles to technology adoption
- 5:30 – 7:00** *Reception*

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Day 2, 1:00pm - 3:00pm

Track 2b

C2 Concepts, Theory, Policy, and Approaches

- | | | |
|-----------|----|---|
| 1:00-1:30 | 95 | Jitu Patel and Gordon Pattison. Headquarters Maturity Model: An Approach to Optimising a HQ for Operational Advantage |
| 1:30-2:00 | 49 | Ingrid van Bommel, Aletta Eikelboom, Marcel van Hekken, Roy Benda, Maaike Roelofs, Reinout Pieneman and Judith van de Kuijt. NetForce Command, the next step?! |
| 2:00-2:30 | 62 | Per Wikberg, Josephine Sassen-Van Meer, Jessica Ward-King, Björn Johansson, Martin Yelle and Jennifer Peach. Human and organizational adaptability and agility in the military organizations: Perspectives from Sweden, The Netherlands and Canada. |
| 2:30-3:00 | 78 | Siddharth Pal, Scott Rager, Will Dron, Ertugrul Ciftcioglu, Kevin Chan and Prithwish Basu. Topology control of Command and Control networks |

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Day 2, 1:00pm - 3:00pm

Track 1a

**Operational Issues: Coalition
Command and Control**

- | | | |
|-----------|----|--|
| 1:00-1:30 | 71 | George Galdorisi, Stephanie Hsieh and John Morrison. Command and Control for the Global Network of Navies |
| 1:30-2:00 | 57 | Tim Grant. Simulating Multi-Cultural Coalitions: Why doesn't Benny die? |
| 2:00-2:30 | 34 | Gregory Judd and Kevin Chan. Enhancement of Battlespace Information Management Systems for Coalition Networks using C2 Agility Design Concepts |
| 2:30-3:00 | 60 | Jonas Alastair Juhlin. The Agile Approach |

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Day 2, 1:00pm - 3:00pm

Track 6b

Interoperability, Integration and Security

- | | | |
|-----------|-----|--|
| 1:00-1:30 | 105 | Rachid El Abdouni Khayari. C2SIM Challenges for a Comprehensive Command Post Training with InfoOps |
| 1:30-2:00 | 86 | J. Mark Pullen and Nicholas Clark. A Distributed Development Environment for a C2SIM System of Systems |
| 2:00-2:30 | 54 | Adam Brook and Kevin Galvin. The Use of C2-Simulation Interoperability Standards to Support a Decentralised Command System |

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Day 2, 1:00pm - 3:00pm

Track 8a

**Methodology, Experimentation, Analysis,
Assessment and Metrics**

- | | | |
|-----------|----|---|
| 1:00-1:30 | 24 | Roy Benda, Ingrid Van Bommel, Nathalie Vink, Marcel Van Hekken, Rosie Paulissen, Judith Van de Kuijt and Jan-Willem Streefkerk. Towards the analysis, development and evaluation of NetForce Concepts, A framework to realise NetForce concepts in tomorrow's battlespace |
| 1:30-2:00 | 47 | Alexander Kalloniatis. Integrating Analysis and Analysing Integration of Planning and Execution in headquarters models |
| 2:00-2:30 | 73 | Scott Rager, Lisa Scott, Kevin Chan, Ram Ramanathan, William Dron and Thomas La Porta. Analyzing the Impact of Network Topology on Efficiency of Command and Control through Agent-based Simulation |
| 2:30-3:00 | 80 | Andre Costa, Roberto Follador and Paulo Costa. Enhanced Petri-net model for command and control evaluation of an air defense system |
| 3:00-3:30 | | <i>Coffee Break</i> |

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Day 2, 3:30pm - 5:00pm

Track 2c

C2 Concepts, Theory, Policy, and Approaches

- | | | |
|-----------|----|---|
| 3:30-4:00 | 35 | Jacobus Venter and Minrie van Ellewee. Capability Management Rethink |
| 4:00-4:30 | 55 | Maaïke Roelofs, José Kerstholt and Ingrid van Bommel. Networked collaboration: lessons learned from the civilian domain |
| 4:30-5:00 | 67 | Rodrigo Mendonça Lagares, Ricardo Fernandes, Arthur Fernandes Araujo and Paulo Nunes. How to transform Information Superiority into Decision Superiority? |

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Day 2, 3:30pm - 5:00pm

Track 4b

Cognitive and Socio-technical Challenges

- | | | |
|-----------|----|--|
| 3:30-4:00 | 11 | Russell Bryant. Does Group Conflict Improve Performance of Personnel and Organizations? Or Does It Really Matter in the Battlespace? |
| 4:00-4:30 | 42 | Elizabeth K. Bowman, Marie-Eve Jobidon and Alexandre Bergeron Guyard. Human Interpretation of Text and Video Analytics |

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Day 2, 3:30pm - 5:00pm

Track 7b

Human Information Interaction

- 3:30-4:00 116 John McDonnell and Luke Marsh. Recommender Systems for Maritime C2
- 4:00-4:30 27 Derrik Asher, Justine Caylor, Mark Mittrick, John Richardson, Eric Heilman, Elizabeth Bowman, Boleslaw Szymanski and Gyorgy Korniss. The Investigation of Social Media Data Thresholds for Opinion Formation
- 4:30-5:00 104 Sue Kase, Michelle Vanni, Justine Caylor and Jeff Hoye. A crowdsourced investigation of decisional guidance approaches to information processing

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Day 2, 3:30pm - 5:00pm

Track 3

**Implications of the Internet
of Intelligent Things**

- 3:30-4:00 142 Paul Labbé. Could early adoption of internetworking of intelligent things provide significant advantages?
- 4:00-4:30 96 Adrienne Raglin, Brian Jalaian, Michael Lee, Stephen Russell and Andre Harrison. Human Variabilities in C2 Machine Learning
- 4:30-5:00 66 Marco Manso, Frank Johnsen and Marianne Brannsten. A Smart Devices Concept for Future Soldier Systems

Day 3, 10:30am -12:00pm Poster Session

- 85 Amanda George, Samia Ali, Jeff Vu, Viral Bhalodia and Stephanie Hszieh. SPAWAR Unified DevOps Orchestration Engine (SUDOE) – A Tool to Simplify Orchestration of Virtual Machines and Containers
- 40 Marielle Mokhtari and Valerie Lavigne. : Improve the Battlefield Situation Awareness through an Effective IM/IX Framework

10:30-11:00

Coffee Break

Day 3, 10:30am -12:00pm Demonstration Session

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- 147 Timothy Hanratty. Advanced NLP Analytics

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- 145 Siddharth Pal, Scott Rager, William Dron, Ertugrul Ciftcioglu, Kevin Chan and Prithwish Basu. Toplogy Control of Command and Control Networks

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- 144 Lisa Scott, Kelvin Marcus, Will Dron and Kevin Chan. Multigenre Experimentation within the Network Science Research Laboratory

12:00-1:00

Lunch Break



Day 3, 1:00pm - 3:00pm
Track 2d
C2 Concepts, Theory, Policy,
and Approaches

1:00-1:30	1	David Alberts. Agility, Automation, and Autonomy
1:30-2:00	17	Marius Vassiliou and David Alberts. Mission Command and Agile C2
2:00-2:30	20	Xin Jin. Research on C2 AI Problem Decomposition
2:30-3:00	38	Mats Persson and Björn Johansson. The lack of convergence between C2 theory and practice



Day 3, 1:00pm - 3:00pm
Track 1b
Operational Issues: Coalition
Command and Control

1:00-1:30	18	Jonathan Agre, Karen Gordon and Marius Vassiliou. Spectrum Sharing Initiatives: Federal Response to Escalating Military and Commercial Demands
1:30-2:00	26	Patrick Guerin, Mark Miller, Mike Tisdell and Ken Teske. Pre-Shared Key-Enabled CSfC: A Positively Disruptive Technology and Enabler for Next Generation MPE Secure Communications
2:00-2:30	25	Mark Miller, Ken Teske, Mike Tisdell and Patrick Guerin. Protecting Information Sharing Systems with Commercial Solutions for Classified Encryption
2:30-3:00	4	Ken Teske, Michael Tisdell, Mark Miller, Patrick Guerin and William Fleiser. Improving C2 Alignment and Integration

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Day 3, 1:00pm - 3:00pm

Track 5b

Highly Connected, Automated, and Autonomous Forces

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|-----------|----|---|
| 1:00-1:30 | 32 | Michael Hieb, Matthew Peterson, Shane Kelly, Mark Riecken and Marius Vassiliou. Exploring Trust and Autonomy in a Hybrid Human/Robotic Force |
| 1:30-2:00 | 10 | Carlos Eduardo Pinheiro Rocha, Ricardo Fernandes and Leonardo Moreira. Leveraging Command and Control with Automated Planning |
| 2:00-2:30 | 53 | Meiler Peter P, Johnsen Frank T, Trude Bloebaum, Marco Manso, Jose-Maria Alcaraz Calero, Qi Wang, Ian Owens, Norman Jansen, Christoph Barz, Joanna Sliwa and Kevin Chan. Improving Integration between Tactical and HQ Levels by making SOA applicable on the Battlefield |
| 2:30-3:00 | 22 | Oliver Meyer, Hans-Christian Schmitz, Nico Bau, Christopher Bulach, Frédéric Gallezio and Michael Gerz. MIP-Solutions for Civil-Military Cooperation |

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Day 3, 1:00pm - 3:30pm

Track 8b

Methodology, Experimentation, Analysis, Assessment and Metrics

- | | | |
|-----------|-----|--|
| 1:00-1:30 | 44 | James Karle, Tania Randall, Don Coady and Glenn Franck. Emergent Display Technologies: Developing Use-Case Prototypes for Military Command Teams in Virtual Environments |
| 1:30-2:00 | 46 | Alexander Kalloniatis, Cayt Rowe, Phuong La, Mathew Zuparic and Peter Hoek. OODAWN in the MER: from distributed Situation Awareness to Decisions and Actions in operational C2 using weighted network theory |
| 2:00-2:30 | 112 | Rick McCourt, Ahmed Ghanmi and Irene Collin. Human Information Interaction in a Joint Electro-Magnetic Spectrum Coordination Cell |
| 2:30-3:00 | 74 | Tania Randall, Aren Hunter, Mark Hazen and James Karle. Mission-Relevant Criteria for Naval Task Group (NTG) Course of Action (COA) Analysis |
| 3:00-3:30 | 19 | Sarah Markham. Knowledge Representation to Capture & Retrieve Experiential Learning in Military Settings |

End of Symposium

Notes



International C2 Institute

www.internationalc2institute.org

What is IC2I?

The International Command and Control Institute (IC2I) is a nonprofit corporation under the US Internal Revenue Code Section 501 (c) (3) created exclusively for scientific and educational purposes. The focus of the Institute is on enhancing our understanding of emerging technologies, and their implications for command and control of complex enterprises and endeavors operating in highly dynamic and contested environments. These technologies are enabling the creation of socio-technical organizations that are learning to leverage networked human-machine collaborations that employ autonomous systems, real and virtual.

Why was IC2I created?

The Command and Control Research Community, composed of an international community of researchers (from industry, academia and government) and practitioners (e.g., military, emergency services), has, over the past 20 years, created an invaluable body of literature that was about to become inaccessible to researchers and practitioners due to uncertain Government funding. The annual gathering of this community, the International C2 Research and Technology Symposium (ICCRTS), was also in danger of being disrupted or discontinued. IC2I was created, in part, to ensure both the continued access to this important body of literature and the continuation of ICCRTS meetings so that researchers could continue to build upon previous work by interacting and collaborating with one another.

How is IC2I funded?

The Institute currently receives no direct Government support. Its creation was funded by private donations. The initial donors established a goal for IC2I to become funded by memberships and proceeds from events and publications. A portion of this year's ICCRTS registration fee will be used to cover the costs of maintaining on-line access to the body of literature and planning for future events. Participants in ICCRTS will receive a one-year membership in the Institute that will enable them to access the symposium proceedings and archives. They will also receive a membership discount to future events.