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16th International Command and Control Research
Technology Symposium (ICCRTS)
June 2011 Overseas Visit Report

Cherylne Fleming

Joint Operations Division
Defence Science and Technology Organisation

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ABSTRACT

The 16th International Command and Control Research Technology Symposium (ICCRTS) conference was held on the 21- 23 June 2011 in Canada. The theme was "Collective C2 in Multinational Civil-Military Operations." This year's symposium explored the C2-related responses to these changes and challenges. Five Joint Operations Division papers were accepted for presentation. This general document outlines this conference, the JOD presentations and provides feedback from the ICCRTS conference Chair.

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*Joint Operations Division
DSTO Defence Science and Technology Organisation
Fairbairn Business Park Department of Defence
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16th International Command and Control Research Technology Symposium (ICCRTS) June 2011 Overseas Visit Report

Executive Summary

The 16th International Command and Control Research Technology Symposium (ICCRTS) conference was held on the 21- 23 June 2011. The theme was “Collective C2 in Multinational Civil-Military Operations.” This overseas visit report provides an overview of ICCRTS 2011. Including the three primary research areas that emerged from the conference of:

- agility and what that means for organisational structures;
- the concept of “Harmony of Purpose”¹; and
- the need to develop better approaches to discovery of second and tertiary effects to decision making, operational analysis and nation building.

This is followed by an overview of the plenary sessions, and the topics of the parallel track presentations. Additionally the abstract and associated audience questions from the Joint Operational Division (JOD) of Defence Science and Technology Organisation (DSTO) presentations delivered is included.

ICCRTS Chair, Dr Alberts praised the consistently high standard of presentation and papers of JOD DSTO. He noted the challenges in presenting effectively across such a diverse range of topics. Another point Dr Alberts noted was the value he saw in the different types of presentations which JOD offer each year. These aligned with his view of the purpose of the conference.

Finally the report makes some recommendations for future ICCRTS considerations for JOD DSTO.

¹ This is not a new concept – but it appears to be gaining traction within the ICCRTS community.

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1. Background

The 16th International Command and Control Research Technology Symposium (ICCRTS) conference was held on the 21- 23 June 2011. The theme was “Collective C2 in Multinational Civil-Military Operations.”

Since the first ICCRTS in 1995, extensive changes have occurred in the international environment, in the nature of threats to national security, in the missions undertaken to protect our security, in the technologies available to support our endeavours, and in the ways the functions associated with command and control are carried out. This year’s symposium explored the C2-related responses to these changes and challenges.

2. Overseas Visit Report

This overseas visit report provides an overview of ICCRTS 2011. This includes the three primary research areas that emerged from the conference from my perspective. This is followed by an overview of the plenary sessions, and the topics of the parallel track presentations. Also included are the abstract and associated audience questions from presentations given by the Joint Operations Division (JOD) of Defence Science and Technology Organisation (DSTO). Finally the additional aspects of the trip are summarised under other business and include some information on trip preparation, feedback from ICCRTS Chair and recommendations for future ICCRTS attendance.

From my perspective, based on the sessions I was able to attend, the three primary research areas that emerged across the conference were:

- The idea of agility and what that means for organisational structures featured in many presentations. This remains an ongoing area of research for this community.
 - Plenary Dr Alberts
 - Papers 068, 072, 146, 052, 106, 064
- The concept of “Harmony of Purpose”¹ (rather than unity of command) as applied to complex endeavours. In particular, a Swedish presentation (092) had many links across the civil – military community (disaster relief) as well as those interested in coalition operations.
 - Primarily paper 092
 - Track 10 and part of track 8
 - Plenary Mr Roy Johnson (briefly)
- The need to develop better approaches to discovery of second and tertiary effects to decision making, operational analysis and nation building. Many authors identified that this remains an area of research for their nations. This included issue such as how

¹ This is not a new concept – but it appears to be gaining traction within the ICCRTS community.

to undertake and develop analysis, models and visualisation, and so make informed predictions.

- Plenary Mr Pontius
- Plenary Dr Alberts

The absence of papers examining Socio-technological approaches is noteworthy. There were several that explored the technical aspects but most identified the “socio” aspects as remaining an area of “work in progress”. This issue was commented on during the “wrap up” plenary.

3. Plenary Presentations

Day 1 Tuesday 21 June opened proceedings with Welcoming addresses from Dr Guy Vezina (Canada) and Dr David Alberts (US) Conference Chair. These were followed by three plenary presentations.

3.1 C2 Challenges and a Way Ahead: Mr Ronald Pontius Director C2 Programs and Policy OASD (NII)

The primary thrust of this paper was the DoD Netcentric Data strategy based on visible, assessable, understandable and trustable data. The speaker expanded on the historical aspects of “data hugging” where the need to know construct had limited data exploitation. However he did not offer any suggestions for moving from the “data hugging” to the “open sharing” primary perspectives. The presenter identified three tiers of joint mission threads – tier 1 capability gaps, tier 2 exercises and tier 3 mission rehearsal and how this aligns with thinking about the 4W’s (who / what / when / where) elements of data / information / knowledge and its accessibility were also expanded on at length.

3.2 Measuring Agility: Dr David Alberts Director Research OASD (NII)-DoD CIO

The primary theme for this plenary paper was how perspective shapes the way that agility is understood and measured. With examples from systems thinking, entity, activity and organisational perspectives were used to illustrate his views of the many valid perspectives of measuring and visualising agility. Dr Alberts identified that different approaches are required for different situations to be seen as “successful” and that this success was different in effect, scope and exploits for these different contexts. Different C2 structures (from hierarchal / edge / coordinated / collaborative) were shown to work in different contexts. Examples included the allocation of discussion / decision space, evaluating interaction patterns and dissemination of information.

3.3 Information Sharing in Complex Endeavours: Mr Roy Johnson Director Integrated ICT support OASD (NII)-DoD CIO & Mr Garard Christman Program Manager and Senior Systems Engineer Femme Comp Inc (FCI)

This presentation focused on situational awareness for decision support, specifically in the unclassified information sharing (UIS) context. Disaster relief examples were provided where there are many organisations to coordinate, a diverse set of actors, several types of C2 structures and the need to facilitate bi-directional information sharing. There were also comparisons made with commercial information intelligence systems used by companies like AMAZON (originally an online book seller's business model) and how that data collection can be utilised for other purposes. Collecting information about transactions/ actions to improve the corporate agility, co-ordination etc are the aim of FIST (smart phone application) which is to be uploaded for situational context utilising the power of the crowd concept with an example of Haiti and SMS TXT. This FIST application is interesting as it is an application which was described as easy to share, easy to use and provides linkages into extant US military systems. For DSTO this has implications for our disaster relief, CIMIC and FJOC activities.

4. Topics of the Parallel Track Presentations

The 16th ICCRTS was comprised of tracks on various topics:

1. concepts, theory and policy
2. approaches and organisations
3. information and knowledge exploitation (detection / collection/ instrumentation)
4. information and knowledge exploitation (discovery / access / sharing / processing of existing)
5. collaboration, shared awareness and decision making
6. experimentation metrics and analysis
7. modelling and simulation
8. architectures, technologies and tools
9. networks and networking
10. C2 management and governance in Civil-Military Operations
11. cyberspace management

Each presentation was allocated 30 minutes: 20 minutes to present, 5 minutes for questions and discussion, and 5 minutes to allow individuals to move to the next presentation of their choice.

JOD provided five papers within three of topic areas:

- **Topic 2: Approaches and Organizations:** This examined designing, analysing, and implementing various approaches to focus and convergence (e.g., C2, management, governance). This topic area contained a wide spectrum of papers from "initial thoughts" through to detailed results and implications for Defence.

- **Topic 7: Modelling and Simulation:** which encompassed models and simulations that represent emergent behaviours in C2. Most of the papers in this topic area were theoretical, exploring initial ideas and hypothetical situations in the unclassified domain.
- **Topic 9: Networks and Networking:** this topic area addressed social or socio-technical as well as communications and information networks and networking behaviours. Of interest is interoperability in the context of complex endeavours which require new (inter)organizational and process models that reflect the complexity of collective operations and behaviours, and the development and application of appropriate standards.

5. JOD DSTO Presentations

In preparation for ICCRTS, DSTO Canberra held a “mini ICCRTS” day which allowed each author to present their paper to the JOD audience. This approach was commended by Dr Alberts and some of the Topic Chairs. They queried whether this might provide opportunity to contact the wider community of researchers in future years.

I gave each of the five JOD presentations based on material developed by the paper authors. While I had developed a working knowledge of topic covered in those papers for which I was not an author, I recommended that the audience engage the authors directly if they had detailed questions.

Dr Alberts and the Topic Chairs commented that the JOD DSTO papers demonstrated a good balance across the spectrum of “student / new starter” to “work in progress” and “conceptual” with the depth and rigour commented. The abstracts from the five papers are provided below. A point of contact was provided for further information.

5.1 Paper 174 (POC: Irena Ali) “Coexistence or operational necessity: the role of formally structured organisation and informal networks during deployments. Track 2

The military faces an increasingly turbulent environment requiring flexibility and agility of organisational processes and structures. This is particularly prevalent for military forces interfacing with civilian organisations. Furthermore, the current military paradigm of network centric operations (NCO) is reliant on timely information flows, flexible command structures and adaptability to achieve mission outcomes. This paper reports on the findings and implications for organisational architectures and command and control of a study into the role of informal networks within a formally structured organisation in complex operational environments. Based on the analysis of two combat and one humanitarian deployments, this research examines whether informal networks contribute to military mission outcomes and what factors facilitate the co-existence of formal

organisational structures and informal networks during operational deployments. This analysis provides understanding of the prevalence and efficacy of informal networks during deployments, and their interaction with formal C2. The interrelationship between three emergent factors - accountability, autonomy and appropriateness of C2 arrangements - is necessary to harness the agility inherent in informal networks and the stability offered by formal structures. Doctrinal, command, and training implications of these findings are also discussed in this paper.

This paper was introduced by the chair (Dr Philip Farrell) as "one of my favourites of this track... it was beautiful to read". Participants were impressed with the quality and depth of data / robustness of the scientific research / rigour applied to the development of the analysis. Many had not seen this level of detail prior (they noted that interviewing 12 participants was considered robust in Dstl).

Questions from the audience included:

- When do formal C2 structures become informal and vice versa?
- Is there strategic C2 informal relationships and how were these presented / included?
- How to improve training to take advantage of the phenomena?

5.2 Paper 010 Anthony Dekker "Analyzing C2 structures and self-synchronization with simply computational models" Track 9

Although command and control is a complex activity, useful lessons about C2 can be learnt from simple computational models. In this paper, we describe experiments with two such models. The Kuramoto model, though with some serious limitations, provides a representation of information flow and self synchronisation in an organisation. A second (agent based) model, based on factorisation, provides a representation of planning that is slightly more realistic. These models suggest that the time for an organisation to reach a decision is related to the average distance in the organisational network, although our two experiments disagree on the nature of this relationship. Comparing the simulation results to empirical real-world studies confirms the relationship between time and the average network distance. Although the empirical studies suggest that this relationship is linear, the Kuramoto model might be more realistic in its suggestion of a non-linear relationship, since it captures the idea of information being attenuated during transmission by misunderstandings. The Kuramoto model therefore reveals a need for further empirical studies in this area.

Questions from the audience included:

- Can you describe the Kuramoto Model and underlying model assumptions?
- What are those limitations identified in the abstract?
- What is "to information being attenuated by Chinese Whispers as it spreads across the network"? the Q was really what are "Chinese whispers"
- Discussion between participants expanding into the relationship between the entities in the Kuramoto model

- What if the matrix is only partially disconnected? This built into a discussion on other related network information flows.

5.3 Paper 079 Sasa Baskarada “Towards a Semiotic Information Position Framework for Network Centric Warfare” Track 3

Semiotics is a field of study that deals with the relationships between representations, intended meanings, and interpretations of signs and symbols. As such, it is of particular relevance to a range of network centric warfare primitives, including data, information, knowledge, awareness, and understanding. In this paper, we apply semiotics to such primitives in the physical, information, cognitive and social network centric warfare domains from the syntactic, semantic, and pragmatic perspectives. As a result, we present the Semiotic Information Position (SIP) framework and evaluate it through a thought experiment involving a simple command and control scenario.

The chair noted this paper was considered for Best paper and spoke of the need to identify these new-starter / student papers, which bring alternative ideas into ICCRTS.

Questions from the audience included:

- Can you describe the difference between the Semiotic and semiology?

5.4 Paper 023 John O’Neill, Lydia Byrne, Cherylne Fleming, Duncan Byrne and Bede Galvin “Modelling and Assessing Air-Surface Integration” Track 2

Air-Surface Integration (ASI) is an important theme in the Australian Defence Force (ADF). This paper describes a systems analysis approach to ASI in an Australian context presenting ASI models that describe the structure, function, and behaviour of the ASI system. ASI is an inherently cross-boundary capability that emerges at the macro-system level integrating the components into a coherent system for coordinating, controlling and deconflicting operations in the air and on the surface. The boundaries that are crossed include airspace control measures, roles managing each airspace control measure, roles across services, roles across nations, and information flows across components. The paper describes how the ASI baseline model has been used to evaluate the current ADF ASI force structure capability and identifies socio-technical issues in the ASI system for capability designers.

Participants were again impressed with the quality of the scientific research applied to the development of the visualisations. These participants made the connection between the work by Irena and the work of the ASI team and commented on the short term nature of their tasking limited their research achieving such depth.

Questions from the audience included:

- Regarding formal and informal networks and Liaison officers
- Synchronisation of distributed C2 (battle rhythm)
- There were further discussions associated with visualisation representations; of particular interest was our use of different representations for alternative aspects of the problem (and how these can change as the researcher identifies more information about the topic). This aspect of representations is of interest to many in the international community.

5.5 Paper 055 Anthony Dekker “Game theory, adaptation and genetic programming: some perspectives on Operations Research for Counter IED” Track 7

This paper explores operations research issue is in the response to improvised explosive devices using the concept of a fitness landscape. In particular, we examine optimisation approaches that the share on a fixed fitness landscape for blue actions; game theoretic approaches where fitness is dissociated with the combination of red and blue actions; and approaches that are shared fitness landscapes are constantly changing as a result of red and blue activity. In particular, we examine the use of genetic programming. We discuss the strengths and weaknesses of these approaches with respect to an illustrative simulation model, and present experiments suggesting that genetic programming is a promising mechanism for exploring adaptivity in such simulation models.

Questions from the audience included:

- Have other fitness landscapes been explored?
- Is ~60% desirable? Even in hypothetical explorations?

5.6 Other presentations

Given six streams ran in parallel, I chose those presentations that appeared most relevant to the research interests of JOD. In cases where such papers clashed, I coordinated with Dr Fred Bowden (LOD) to ensure that we had better coverage of relevant material. The list of papers I attended are included in Table 1.

Table 1: List of papers attended during ICCRTS 2011.

<i>Paper Number</i>	<i>Title of Paper</i>
006	On optimising command and control structures
018	Multilingual context extraction extended with background knowledge for military intelligence
029	Web shared confrontation and collaboration analysis for civil military operations
037	A smarter common operational picture: the application of abstraction hierarchies to Naval command and control
042	Applicability of visual analysis to defence and security operations
045	Managing complex interoperability solutions using model driven architecture
056	Operational planning with uncertain and ambiguous information: command and control and the natural environment
063	Applying influence diagrams to support collective command and control in multinational civil military operations
064	Civil military incident command: integrating incident command systems and command and control to meet current emergency response demands
068	Innovating command and control training using visualisation technologies
085	Information design for synchronisation and coordination of modern complex multinational operations
089	Information fusion for collaborating commanders at different levels
092	Harmony rather than unity: a command concept for complex endeavours
106	Organisational agility model and simulation
117	Information sharing in emergency response
125	Optimisation based multilevel asset allocation model for collaborative planning
134	Towards a command and control poly-visualisation tool: leveraging the power of social network analysis and geographic information systems.
146	Plan failure analysis and plan adaptation the multilevel campaign planning
178	AEGIS International and ballistic missile defence: a new interoperability network

6. Other Business

6.1 Trip Preparation

The formal notification from JOD executive of my attendance was a unexpected (as I was not a lead author). In future years it would be helpful if when the papers are seeking approval, authors are asked to identify if they wish to be considered as the JOD presenter. This would allow supervisor(s) and the staff member involved to determine the impact on the work program and develop strategies to overcome problems that might arise.

Preparation for presenting the five papers required significant time to gain a sufficient working knowledge of the subject and ensure the key messages were able to be delivered in the allotted time. This included:

- Reading through the related conference papers;
- Engaging with the presenters on content (both quality and quantity), messages and key points, along with any questions I had; and
- Reading through some of the core background papers.

As such this preparation time was considerable. As such, time was not available during the normal work hours, so I undertook these activities out of hours. In future, I suggest that more time is made available to the JOD presenter to prepare for ICCRTS.

6.2 Feedback from the ICCRTS Chair

Dr Alberts praised the consistently high standard of presentation and papers of JOD DSTO. He noted the challenges in presenting effectively across such a diverse range of topics. I noted the use of an internal "mini ICCRTS" prior the conference, which allowed authors to present their paper(s), providing me with a good basis to effectively present their work. He supported this concept and expressed a desire to observe this in future, if at all possible. He suggested that next year we might look into making the JOD "mini ICCRTS" a VTC which would allow the presenters to engage with their fellows internationally more readily.

Another point Dr Alberts noted was the value he saw in the different types of presentations which JOD offer each year. These aligned with his view of the purpose of the conference. His groupings were "student papers / new starters" like that from Sasa Baskarada, "exploratory papers" based on new data or work in progress and "conceptual directional papers". This point tied into several of the conversations which the various chairs of the topics areas and I had had about the mixed sets of different papers with a spectrum of "readiness" for publication / peer review seen as perfect for this conference.

6.2.1 Other Information

It was announced during the conference that:

- Dr Albert's appointment ended in the fall (US autumn), future appointments were still in negotiations.
- Next 17th ICCRTS would be held in Washington next June (19-20-21 or 26-27-28 June 2012).

7. Recommendations

It is recommended that:

- JOD continue to use a “mini ICCRTS” prior to ICCRTS 2012 and consider inviting some of our primary allies to hear from the authors and ask the authors questions directly.
- ICCRTS presentation be scheduled as phoenix seminars to allow JOD peers to question the authors prior to “mini ICCRTS”. These phoenix seminars could form part of the approval process for JOD major conferences.
- Authors should identify if they wish to be considered to attend ICCRTS upon submission of their abstract for approval.
- JOD DSTO appoints who is going to attend ICCRTS by Feb 2012 to allow plenty of time for OVA and other paperwork to be submitted.
- Each author provides an information pack for the JOD presenter including presentation (with detailed speaking notes) paper and core papers referenced by the author.
- JOD DSTO encourages papers from “students / recent starters” in addition to “work in progress” and “conceptual or directional” papers.
- JOD consider sending more than one presenter given the importance of this conference to JOD core business, the breadth of material covered, and the quantum of JOD presentation.

Appendix A: Participant List

Table 2: List of Participants from ICCRTS 2011

	Last Name	First Name	Organisation	Email
1	Agre	Jonathan	Institute for Defense Analyses	jagre@ida.org
2	Aguiar	Steven	Naval Undersea Warfare Center	Steven.Aguiar@navy.mil
3	Ahn	Byungoh	KIDA	boahn@kida.re.kr
4	Alberts	David	DoD CIO	david.alberts@osd.mil
5	Allen	Dave	DRDC	Dave.Allen@drdc-rddc.gc.ca
6	Allouche	Mohamad	DRDC	Mohamad.Allouche@drdc-rddc.gc.ca
7	Andersson	Dennis	Swedish Defense Research Agency	denand@foi.se
8	Arciszewski	Henryk	TNO	henryk.arciszewski@tno.nl
9	Ball	Doug	UNC Chapel Hill	djball@email.unc.edu
10	Bandstein	Sara	Swedish Defence Research Agency	sara.bandstein@foi.se
11	Barak	Itai	MOD Israel	grd-att4@israelemb.org
12	Barry	John M.	Boeing	john.m.barry2@boeing.com
13	Barton	Robert	Niteworks	bob.j.barton@niteworks.net
14	Bau	Nico	Fraunhofer FKIE	nico.bau@fkie.fraunhofer.de
15	Beer	Monica	Personnel Recovery Education and Training Center	monica.beer@jppra.jfcom.mil
16	Bélanger	Micheline	DRDC	Micheline.Belanger@drdc-rddc.gc.ca
17	Bélanger	David	Thales	david.belanger@ca.thalesgroup.com
18	Bell	Robert	New Jersey Institute of Technology	rbell1209@comcast.net
19	Benaskeur	Abder	DRDC	Abderrezak.Benaskeur@drdc-rddc.gc.ca
20	Bergeron-Guyard	Alexandre	DRDC	Alexandre.Bergeron-Guyard@drdc-rddc.gc.ca
21	Bonaceto	Craig	MITRE	cbonaceto@mitre.org
22	Bordetsky	Alex	Naval Postgraduate School	abordets@nps.edu
23	Boukhtouta	Abdeslem	DRDC	abdeslem.boukhtouta@drdc-rddc.gc.ca
24	Boury-Brisset	Anne-Claire	DRDC	Anne-Claire.Boury-Brisset@drdc-rddc.gc.ca
25	Bowden	Fred	DSTO	fred.bowden@defence.gov.au
26	Bowman	Elizabeth	Army Research Laboratory	ebowman@arl.army.mil
27	Brehmer	Berndt	Swedish National Defence College	berndt.brehmer@fhs.se
28	Broos	Elly	NLDA	E.Broos@nlda.nl
29	Brundick	Frederick	Army Research Laboratory	frederick.s.brundick.civ@mail.mil
30	Bryant	Russell	Program Executive Office (Integrated Warfare Systems)	Russell.Bryant@navy.mil
31	Bryant	James	Sheffield Hallam University	J.W.Bryant@shu.ac.uk
32	Carter	Miles	Evidence Based Research	carter@ebrinc.com

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	<i>Last Name</i>	<i>First Name</i>	<i>Organisation</i>	<i>Email</i>
33	Champoux	Pierrette	Champoux Williams Consultants	pierrette.cwc@gmail.com
34	Chan	Kevin	Army Research Laboratory	kevin.s.chan@arl.army.mil
35	Cheah	Mervyn	Singapore Technologies Electronics	mervyncheah@stee.stengg.com
36	Christman	Gerard	Femme Comp	gerard.christman.ctr@osd.mil
38	Clemente	Mark	Boeing	mark.n.clemente@boeing.com
39	Cohen	Mika	Swedish Defence Research Agency	mika.cohen@foi.se
40	Collazo	Rodrigo	Brazilian Navy	rodrigocollazo@uol.com.br
41	Costa	Paulo	George Mason University	pcosta@gmu.edu
42	Czarnecki	Jonathan	Naval War College Monterey	jczarne@nps.edu
43	de Castro	Nelson Osório	Masada Consultoria e Serviços	nocastro@boxfile.com.br
44	de Greef	Tjerk	Delft University of Technology	t.e.degreef@tudelft.nl
45	DeFrancesco	Anton	Securboratorion	adefrancesco@securboratorion.com
46	DePass	Beth	BBN Technologies	bdepass@bbn.com
47	Diptee	Darryl	Naval Postgraduate School	ddiptee@gmail.com
48	Doshi	Bharat	Johns Hopkins University Applied Physics Laboratory	Bharat.Doshi@jhuapl.edu
50	Egan	Richard	New Jersey Institute of Technology	egan@njit.edu
51	Farrell	Philip	DRDC	philip.farrell@drdc-rddc.gc.ca
52	Ferreira	Marcelo Corsino	Brazilian Navy	corsino@casnav.mar.mil.br
53	Finch	David	Department of National Defence	David.Finch@forces.gc.ca
54	Fleming	Cherylne	DSTO	Cherylne.Fleming@dsto.defence.gov.au
55	Fletcher	Andrew	Cap CCII NCA	capcciiinca-cbmar@mod.uk
56	Forrester	Bruce	DRDC	Bruce.Forrester@drdc-rddc.gc.ca
57	Franklin	Jude	Raytheon	Jude_E_Franklin@raytheon.com
58	Freedman	Daniel	Cornell University	dfreedman@cs.cornell.edu
59	Frini	Anissa	DRDC	Anissa.Frini@drdc-rddc.gc.ca
60	Gagnon	Michel	DRDC	Michel.Gagnon@drdc-rddc.gc.ca
61	Gendron	Gerald	SOCJFCOM/J9	gerald.gendron@jfc.com.mil
62	Genik	Lynne	DRDC	lynne.genik@drdc-rddc.gc.ca
63	George	Amanda	SPAWAR	amanda.george@navy.mil
64	Gizzi	Nicholas	SPAWAR	nicholas.gizzi@navy.mil
65	Gomez	Elizabeth	New Jersey Institute of Technology	elizabeth.avery@njit.edu
66	Gotaishi	Masahito	Chuo University	gotaishi@tamacc.chuo-u.ac.jp
67	Gouin	Denis	DRDC	Denis.Gouin@drdc-rddc.gc.ca
68	Granåsen	Magdalena	Swedish Defence Research Agency	magdalena.granasen@foi.se
69	Granlund	Rego	Santa Anna IT Research Institute	rego.granlund@santaanna.se

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	<i>Last Name</i>	<i>First Name</i>	<i>Organisation</i>	<i>Email</i>
70	Granlund	Helena	Swedish Defence Research Agency	helena.granlund@foi.se
71	Grant	Timothy	Netherlands Defence Academy	tj.grant@nl-da.nl
72	Grenier	Pierre	Québec International	pgrenier@quebecinternational.ca
73	Haas	Niina	Caracal	niina.haas@brightoutcome.com
74	Hafsøe	Trude	Norwegian Defence Research Establishment	trude.hafsoe@ffi.no
75	Hansen	Bjørn Jervell	Norwegian Defence Research Establishment	Bjorn-Jervell.Hansen@ffi.no
76	Happe	Jens	MDA	jhappe@mdacorporation.com
77	Hayes	Richard E.	Evidence Based Research	rehayes@ebrinc.com
78	Hazen	Mark	DRDC	mark.hazen@drdc-rddc.gc.ca
79	Hecking	Matthias	Fraunhofer FKIE	matthias.hecking@fkie.fraunhofer.de
80	Heffner	Kevin	Pegasus Simulation Systems	k.heffner@pegasim.com
81	Hieb	Michael	George Mason University	mhieb@c4i.gmu.edu
82	Holmberg	Martin	Swedish National Defence College	martin.holmberg@fhs.se
83	Hruza	Petr	University of Defence Czech Republic	petr.hruza@unob.cz
84	Hudson	Ken	Loyalist College	khudson@loyalistic.on.ca
85	Hull	Cecilia	Swedish Defence Research Agency	cecilia.hull@foi.se
86	Hunter	Aren	DRDC	aren.hunter@drdc-rddc.gc.ca
87	Hutchins	Susan	Naval Postgraduate School	shutchins@nps.edu
88	Irاندoust	Hengameh	DRDC	hengameh.irاندoust@drdc-rddc.gc.ca
89	Jacobs	Jim	Raytheon	Jim_Jacobs@Raytheon.com
90	Jaros	Vítezslav	University of Defence Czech Republic	Vitezslav.Jaros@unob.cz
91	Jobidon	Marie-Eve	DRDC	marie-eve.jobidon@drdc-rddc.gc.ca
92	Joglar	Hernán	Army of Chile	hernanjoglar@yahoo.es
93	Johnsen	Frank	Norwegian Defence Research Establishment	frank-trethan.johnsen@ffi.no
94	Johnson	Travis	Air Force Institute of Technology	trj1370@gmail.com
95	Kabanza	Froduald	Universite de Sherbrooke	kabanza@usherbrooke.ca
96	Kamneth	Narong	Royal Thai Air Force	narong_kamneth@rtaf.mi.th
97	Kara	Musa	Turkish Naval Forces	musa.kara@yahoo.com
98	Kleinman	David	Naval Postgraduate School	kleinman@nps.edu
99	Krakowski	Ofir	MOD Israel	ofirkr@gmail.com
100	Kuylensstierna	Jan	Swedish National Defence College	jan.kuylensstierna@fhs.se
101	Landsman	Seth	MITRE	landsman@mitre.org
102	Larsson	Sven-Ake	Swedish Defence Forces	sven-ake.larsson@mil.se
103	Lavigne	Valerie	DRDC	valerie.lavigne@drdc-rddc.gc.ca
104	Law	James	SPAWAR	jim.law@navy.mil
105	Lecocq	Regine	DRDC	regine.lecocq@drdc-rddc.gc.ca
106	Lefrancois	Marcel	DRDC	marcel.lefrancois@drdc-rddc.gc.ca

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	<i>Last Name</i>	<i>First Name</i>	<i>Organisation</i>	<i>Email</i>
107	Leggatt	Andrew	BAE Systems	andrew.leggatt@baesystems.com
108	Lemche	Viggo	DALO	viggo.lemche@mil.dk
109	Lemyre	Louise	University of Ottawa	louise.lemyre@uottawa.ca
110	Letowski	Szymon	Evidence Based Research	letowski@ebrinc.com
111	Lif	Patrik	Swedish Defence Research Agency	patrik.lif@foi.se
112	Liu	Jason	General Network Service	gnsi1984@aol.com
113	Loaiza	Francisco	Institute for Defense Analyses	floaiza@ida.org
114	Madeo	Francesca	Simulationteam	francesca.madeo@simulationteam.com
115	Maes	Herman	MOD Belgium	herman.maes@mil.be
116	Manso	Marco	TEKEVER	marco.manso@gmail.com
117	McHale	Robert	Air Force Research Laboratory	robert.mchale@rl.af.mil
118	Melling	Alec	Sheffield Business School	a.melling@shu.ac.uk
119	Michaud	Guy	Fujitsu Consulting	guy.michaud@ca.fujitsu.com
120	Miller	Scot	Naval Postgraduate School	samille1@nps.edu
121	Miller	Paul	Personnel Recovery Education and Training Center	Paul.Miller@jpra.jfcom.mil
122	Ming Yi Ong	Ming Yi Ong	Singapore Ministry of Defence	Ong_Ming_Yi@starnet.gov.sg
123	Mitchell	William	Royal Danish Defence College	IMO-11@fak.dk
124	Morales-Perea	Ernesto	Boeing	ernesto.e.morales-perea@boeing.com
125	Mutambaie	Alain	NATO	amutambaie@nacma.nato.int
126	Nissen	Mark	Naval Postgraduate School	MNissen@nps.edu
127	Ntuen	Celestine	North Carolina A&T State University	ntuen@ncat.edu
128	Ockerman	Jennifer	Johns Hopkins University Applied Physics Laboratory	jennifer.ockerman@jhuapl.edu
129	Ooms	Dick	Netherlands Defence Academy	dm.ooms.02@nllda.nl
130	Osatuyi	Babajide	New Jersey Institute of Technology	osatuyi@njit.edu
131	Osorno	Marcos	Johns Hopkins University Applied Physics Laboratory	Marcos.Osorno@jhuapl.edu
132	Ota	Daniel	Fraunhofer FKIE	daniel.ota@fkie.fraunhofer.de
134	Paytan	Ronnen	Philosophical Instruments	ronnen@philosophical-instruments.com
135	Pedersen	Richard	US Army Mission Command Center of Excellence	richard.pedersen@us.army.mil
137	Phister	Paul	Air Force Research Laboratory	paul.phister@rl.af.mil
138	Pigeon	Luc	DRDC	luc.pigeon@drdc-rddc.gc.ca
139	Pinsent	Celine	University of Ottawa	celine.pinsent@uottawa.ca
140	Pontius	Ronald	DoD CIO	ronald.pontius@osd.mil
141	Proulx	René	Thales	Rene.Proulx@ca.thalesgroup.com
142	Pullen	J. Mark	George Mason University	mpullen@c4i.gmu.edu

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	<i>Last Name</i>	<i>First Name</i>	<i>Organisation</i>	<i>Email</i>
143	Randall	Tania	DRDC	tania.randall@drdc-rddc.gc.ca
144	Reed	Sabrina	Evidence Based Research	reed@ebrinc.com
145	Rodas	Olinda	SPAWAR	maria.rodas@navy.mil
146	Roy	Claude	DRDC	Claude.Roy@drdc-rddc.gc.ca
147	Roy	Jean	DRDC	jean.roy@drdc-rddc.gc.ca
148	Ruddy	Mary	Azigo	mary@meristic.com
149	Rushing	Margita	Evidence Based Research	rushing@ebrinc.com
150	Sarakki	Venu	Sarakki Associates	vsarakki@sarakki.com
152	Schultz	Kevin	Johns Hopkins University Applied Physics Laboratory	kevin.schultz@jhupl.edu
153	Sedlmeyer	Bob	Indiana University Purdue University Fort Wayne	sedlmeye@ipfw.edu
154	Simpson	Christopher	SOLUTE Consulting	csimpson4@mac.com
155	Simpson	Lenard	AFC2IC/C2DT	Marvin.simpson.ctr@langley.af.mil
156	Srivanich	Surapong	Royal Thai Air Force	surapong_sri@rtaf.mi.th
157	Steinmetz	Philipp	Fraunhofer FKIE	philipp.steinmetz@fkie.fraunhofer.de
158	Stewart	Keith	DRDC	Keith.Stewart@drdc-rddc.gc.ca
159	Stoddard	Mark A.	DRDC	Mark.Stoddard@drdc-rddc.gc.ca
160	Stuart	Laura	USG	laura_stuart4@yahoo.com
161	Teppan	Erich	Universität Klagenfurt	erich.teppan@aau.at
162	Teske	Ken	C2OTM FIT	ken.teske@jcom.mil
163	Tey	Frederick	DSO National Laboratories	tliankhe@dso.org.sg
164	Thunholm	Peter	Swedish National Defence College	peter.thunholm@fhs.se
165	Tin Hua Lee	Tin Hua Lee	Singapore Ministry of Defence	LEE_Tin_Hua@starnet.gov.sg
166	Tisdell	Michael	FGM	michael.tisdell.ctr@jcom.mil
167	Toque	Pascal	Boxfile Importação e Exportação	ptoque@boxfile.com.br
168	Unal	Murat	Turkish Naval Forces	murat8unal@yahoo.com
169	Uruguay	André Luiz	Instituto de Estudos Avançados	auruguay@gmail.com
170	Valin	Pierre	DRDC	Pierre.Valin@drdc-rddc.gc.ca
171	van Burken	Christine	TNO	c.g.v.burken@tue.nl
172	Vassiliou	Marius	Institute for Defense Analyses	mvassili@ida.org
173	Wagner	Richard	DRDC	richard.wagner@drdc-rddc.gc.ca
174	Wang Heng	Wang Heng	Science and Technology on Information Systems Engineering Laboratory	puchengew@yahoo.com.cn
175	Wartik	Steven	Institute for Defense Analyses	swartik@ida.org
176	Wassell	Alexander	SPAWAR	Alexander.Wassell@navy.mil
177	Wheaton	Kendall	DRDC	kendall.wheaton@drdc-rddc.gc.ca
178	Whittington	Richard	Salamander	dick.whittington@tsorg.com
179	Wood	Donna	DRDC	donna.wood@drdc-rddc.gc.ca
180	Wrick	Varley	MITRE	vwrick@mitre.org
181	Wuthikarn	Chakrit	Royal Thai Air Force	chakrit_wut@yahoo.com

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	<i>Last Name</i>	<i>First Name</i>	<i>Organisation</i>	<i>Email</i>
182	Xin Jin	Xin Jin	Science and Technology on Information Systems Engineering Laboratory	jinxin28work@163.com
183	Zhao	Ying	Naval Postgraduate School	yzhao@nps.edu

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19. ABSTRACT The 16 th International Command and Control Research Technology Symposium (ICCRTS) conference was held on the 21- 23 June 2011 in Canada. The theme was "Collective C2 in Multinational Civil-Military Operations." This year's symposium explored the C2-related responses to these changes and challenges. Five Joint Operations Division papers were accepted for presentation. This general document outlines this conference, the JOD presentations and provides feedback from the ICCRTS conference Chair.					