



Defence Research and  
Development Canada

Recherche et développement  
pour la défense Canada



## Colloque S&T Symposium 2009

*Understanding the Human Dimension in 21st Century Conflict/Warfare:  
Taking Care of the Front Line / Comprendre la dimension humaine dans  
les conflits/la conduite de la guerre au XXIe siècle: Veiller à la ligne de  
front*

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DEFENCE R&D CANADA - Corporate

Technical Report  
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## **Defence R&D Canada – Corporate**

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# Abstract

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Defence S&T Symposium 2009, which focused on “Taking Care of the Front Line,” was the third of a three part series exploring the human-centric dimensions of conflict in the future security environment. When deployed, Canadian Forces are increasingly expected to navigate the tides of complex situations and environments that require strategies that are not purely military in nature. To successfully support such endeavours, a whole-of-government approach is necessary. Such an approach cannot work unless the best direction of policy and action is clearly established, but the complexities involved may create confounding issues for decision makers. To this end, human-centric S&T research is clearly needed. Four themes were used to illustrate the role best played by the S&T community to support those who are on the “pointy-end” (i.e. the front lines).

## Theme 1: Preparing for Irregular Warfare

Knowledge and information are key ingredients to any strategy that can hope to deal with irregular warfare. “Knowledge” in this sense may be an understanding of the opposing force, historical knowledge relating to lessons learned from similar conflicts that occurred in the past, the information gained from intelligence gathering, or research findings from the S&T community regarding how to deal with tactics such as improvised explosive devices (IEDs).

## Theme 2: Complexity and Conflict

In order to adequately care for the front line, it is necessary to understand the complex environments in which the modern military operates. Although Canada has engaged in peacekeeping missions since the 1950s, there have been significant changes within the mission space related to the proliferation of information technologies, a shift away from being secure within our own national borders, a trend toward global linkages, and a massive expanse of partnerships in which modern militaries engage. While military operations have always been complicated, the modern military takes part in “complex endeavours” that present challenges to traditional organizational structures, models of leadership, and even definitions of success.

## Theme 3: Duty of (to) Care

The shift from “Duty of Care” to “Duty to Care” reflects an imperative: in the reciprocal set of obligations at the heart of the social contract between Canadian Forces personnel and civilians, there is a duty and obligation to care for individuals in uniform who make extraordinary sacrifices to serve their country. Taking care of the front line is a multi-faceted process that includes providing the best possible care for individuals injured in the line of duty, a health care system that treats all sick and injured personnel, care for the spiritual well-being of members of the Canadian Forces, and the re-establishment of veterans into society after they leave the military.

#### Theme 4: Super-Empowered Individuals

Scientific and technological innovations make it possible for small numbers of individuals to have a disproportionate level of impact upon a given situation. “Super-empowered” individuals, and organizations, have the capacity to single-handedly bring about high degree of change. Care for the front line, in this context, can be divided along three dimensions: the role of S&T in developing more effective training techniques, providing support for the modernization of Canadian soldiers through S&T programs such as the Integrated Soldier System Project (ISSP), and providing information regarding performance enhancing technologies and chemicals that are being used, or may be used, by opposing forces.

As these themes illustrate, the enormous challenges involved in taking care of the front line defy simplistic solutions. Original research presented by representatives from the defence community, academia, and industry illustrate the complexity of the issues involved, and point to a need for inclusive approaches to taking care of the front lines that break down existing barriers between departments within government, military and civilians, the front lines and the home front, and even leaders and their subordinates. What it means to take care of the front line within the future battlespace can only be understood using models that can account for high levels of complexity. To this end, the role of human research within the S&T community is becoming an increasingly important factor that enables the agility and adaptability of the Canadian Forces.

## **Résumé**

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Le Colloque S et T pour la défense 2009, qui était axé sur la question de fond « Veiller à la ligne de front », était le troisième d’une série en trois volets qui se penche sur les questions conflictuelles centrées sur l’humain dans l’environnement de sécurité de l’avenir. Lorsqu’elles sont déployées, les Forces canadiennes doivent de plus en plus composer avec les méandres de situations et d’environnements fort complexes qui exigent des stratégies qui ne sont pas de type exclusivement militaire. Pour appuyer ces efforts, on doit faire appel à une approche pangouvernementale. Cette approche est vouée à l’échec si une orientation optimale en matière de politique et d’action n’est pas établie, mais les complexités en cause risquent de provoquer des problèmes déroutants pour les décideurs. Ainsi, on a de toute évidence besoin d’une recherche en S et T axée sur le facteur humain. On s’est servi de quatre thèmes pour illustrer le rôle joué par le milieu de S et T pour appuyer ceux et celles qui se retrouvent aux secteurs « pointus » (autrement dit à la ligne de front).

### Thème 1 : Se préparer à des conflits non conventionnels

La connaissance et l'information sont des aspects cruciaux d'une stratégie qui vise à composer avec des conflits non conventionnels. À cet égard, la « connaissance » peut consister en la compréhension de la force d'opposition, la connaissance historique en rapport avec les leçons retenues de conflits analogues qui ont eu lieu auparavant, l'information obtenue suite à la collecte de renseignements ou les résultats de recherches réalisées par le milieu de S et T sur la façon de faire face à des tactiques comme celles qui font appel à des dispositifs explosifs de circonstance (IED).

### Thème 2 : Complexité et conflits

Afin de s'occuper adéquatement de la ligne de front, on doit comprendre les environnements complexes dans lesquels les forces militaires modernes mènent leurs activités. Bien que le Canada participe à des missions de maintien de la paix depuis les années 1950, des changements importants sont survenus quant à l'espace de mission en raison de la prolifération des technologies de l'information, de la diminution de la sécurité à l'intérieur de nos propres frontières, de la tendance à favoriser les liens mondiaux et du large éventail de partenariats auxquels les forces militaires modernes prennent part. Certes, les opérations militaires ont toujours été complexes, mais les forces militaires modernes participent à des « entreprises complexes » qui posent des problèmes en ce qui concerne les structures organisationnelles traditionnelles, les modèles de leadership et les définitions mêmes de la réussite.

### Thème 3 : Devoir de diligence et devoir de soigner

Le passage du « devoir de diligence » au « devoir de soigner » découle d'un impératif : en raison de l'ensemble des obligations réciproques autour desquelles s'articule le contrat social qui prévaut entre le personnel des Forces canadiennes et les civils, on doit prendre soin des militaires qui font des sacrifices incroyables pour servir leur pays. Les efforts visant à prendre soin de la ligne de front consistent en un processus polyvalent qui porte notamment sur l'offre des meilleurs soins possibles aux personnes blessées dans le cadre du service, qui comprend un système de soins de santé qui traite toutes les personnes malades et blessées, qui s'occupe du bien-être spirituel des membres des Forces canadiennes et qui réintègre les anciens combattants à la société après leur départ des forces militaires.

### Thème 4 : Individus superpuissants

Grâce aux innovations scientifiques et technologiques, de petits groupes de personnes peuvent avoir une incidence disproportionnée sur une situation quelconque. Les individus « superpuissants », et les organisations, sont en mesure de provoquer à eux seuls un degré élevé de changement. Dans ce contexte, le soin de la ligne de front peut être subdivisé en trois aspects : le rôle de la S et T en vue du développement de techniques d'entraînement plus efficaces, l'offre d'un soutien visant la modernisation des soldats canadiens par le biais de programmes de S et T,

par exemple, le Projet d'équipement intégré du soldat (PEIS), et l'offre d'informations sur les technologies qui améliorent le rendement et les produits chimiques dont les forces d'opposition se servent ou peuvent se servir.

Ces thèmes soulignent les énormes défis à relever en rapport avec les efforts visant à s'occuper de la ligne de front, pour lesquels on ne peut pas faire appel à des solutions simples. Les recherches initiales présentées par des représentants du milieu de la défense, des universités et de l'industrie décrivent la complexité des questions en cause et soulignent la nécessité d'approches globales pour les soins de la ligne de front qui aplanissent les obstacles actuels entre les ministères du gouvernement, entre les forces militaires et les civils, entre les lignes de front et le front intérieur et même entre les chefs et leurs subalternes. Afin de cerner la nature des efforts nécessaires pour prendre soin de la ligne de front dans l'espace de combat de l'avenir, on doit se servir de modèles qui peuvent prendre en compte des degrés élevés de complexité. À cette fin, le rôle de l'étude sur les humains réalisée par le milieu de S et T est un facteur de plus en plus important qui assure l'agilité et la capacité d'adaptation des Forces canadiennes.

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## Executive summary

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### **Colloque S&T Symposium 2009: Understanding the Human Dimension in 21st Century Conflict/Warfare: Taking Care of the Front Line / Comprendre la dimension humaine dans les conflits/la conduite de la guerre au XXI<sup>e</sup> siècle : Veiller à la ligne de front**

**Stefan Wolejszo; Kyle Fraser; Orrick White (Ed); DRDC Corporate TR 2009-010; Defence R&D Canada – Corporate; June 2009.**

Defence S&T Symposium 2009, which was held in Ottawa on April 21-23, was attended by approximately 200 participants from across the military, academic and civilian spectrum. The event was co-sponsored by the Assistant Deputy Minister (S&T), the Chief of Force Development and the Chief of Military Personnel. The purpose of Defence S&T Symposium 2009, which was the third of a three year series, was to explore the human-centric issues in 21<sup>st</sup> century conflict. More specifically, the main theme of the conference was “Taking Care of the Front Line”. This theme was addressed in panel discussions within the sub-themes of Knowledge, Complexity, Duty of (to) Care, and the Super-Empowered Individual.

In the opening presentation of Defence S&T 2009, the Chief of Force Development outlined key security trends that impact upon the Future Security Environment (FSE), including the spread of disease and pandemics, an aging population in the West coupled with a young population in developing nations, climate change leading to an increased demand for humanitarian aid, widespread poverty, and the growth of extremism. He argued that the conceptual component of future security analysis is vital, and that there is a need for better definitions for all of the factors listed above. In the following presentation, the Assistant Chief of Military Personnel agreed that these trends in the future security environment will lead to a significant shift away from the relatively clear cut military tasks of the past and toward increasingly complex operations to engage a different kind of adversary. He added that the personnel management model also has to adapt to significant changes in the increasingly diverse recruitable population. Training models also need to be adapted to focus upon cultural intelligence, defined as the ability to recognize and understand the shared beliefs, attitudes, values and behaviours of a group of people and apply that knowledge to influence outcomes under complex and changing circumstances.

In keeping with the issues outlined by the Chief of Force Development and the Assistant Chief of Military Personnel, the ADM (S&T) argued that the wicked problems<sup>1</sup> which exist in the current,

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<sup>1</sup> "Wicked problem" is a phrase used in social planning to describe a problem that is difficult or impossible to solve because of incomplete, contradictory, and changing requirements that are often difficult to

and future, security environment(s) require an analysis of complex systems that is grounded in human oriented science and technological research.<sup>2</sup> An essential interface exists between the scientific and political communities, and science plays an essential role by assisting decision-makers through the provision of necessary tools needed to unravel the complexities inherent in the FSE. To achieve this end, science must be adaptive and resilient. He noted that the traditional view that the world evolves in a somewhat linear manner is no longer defensible; instead, shocks have become the “new normal” within the existing complex global system. It is also important to acknowledge that what one does, and what happens after a shock, is often as important as the shock itself.

The Preparing for Irregular Warfare panel agreed that knowledge and information are key ingredients to any strategy that can hope to deal with irregular warfare. “Knowledge” in this sense may be an understanding of the opposing force, historical knowledge relating to lessons learned from similar conflicts that occurred in the past, the information gained from intelligence gathering, or research findings from the S&T community regarding how to deal with tactics such as improvised explosive devices (IEDs). However, it is equally important to understand the limitations of our knowledge. For example, while IEDs have been used in conflict for decades, research relating to how to train the front line personnel to successfully counter such devices is still necessary. Fundamental changes in the process of intelligence gathering have occurred since the end of the Cold War, and it is important to understand what intelligence gathering can, and can not, do in the FSE.

The session on Complexity and Conflict built on the argument that the knowledge and information are essential components of successfully navigating the FSE, and emphasized that in order to adequately care for the front line, it is necessary to understand the complex environments in which the modern military operates. While Canada has engaged in peacekeeping missions since the 1950s, there have been significant changes within the mission space related to the proliferation of information technologies, a shift away from being secure within our own national borders, a trend toward global linkages, and a massive expanse of partnerships in which modern militaries engage. It is possible to glean information from past experience, but the application of this experience is always tempered by unique combinations of factors that form the modern mission space. Although military operations have always been complicated, the modern military takes part in “complex endeavours” that present challenges to traditional organizational structures, models of leadership, and even definitions of success.

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recognize. Moreover, because of complex interdependencies, the effort to solve one aspect of a wicked problem may reveal or create other problems.

<sup>2</sup> Human science is a term applied to the investigation of human life and human activities via a rational, systematic, and verifiable methodology. It includes but is not necessarily limited to fields of study commonly included within the social sciences and humanities, including history, sociology, anthropology, and economics.

Members of the Duty of Care panel agreed to change the name of the session to Duty to Care. The shift reflects an imperative: in the reciprocal set of obligations at the heart of the social contract between Canadian Forces personnel and civilians, there is a duty and obligation to care for individuals in uniform who make extraordinary sacrifices to serve their country. Taking care of the front line is a multi-faceted process that includes providing the best possible physical, emotional, and spiritual support for CF personnel. This care includes medical coverage for individuals injured in the line of duty, a health care system that treats all sick and injured personnel, care for the spiritual well-being of members of the Canadian Forces, and the re-establishment of veterans into society after they leave the military. At the heart of the imperative to provide care for the front line is human S&T research that provides invaluable information regarding treatment for battlefield injuries, medical care, post-retirement programs providing support during transition periods for personnel and their families, and spiritual services.

The final panel addressed the theme of Super-Empowered Individuals. Scientific and technological innovations in training, equipment, and even performance enhancing pharmaceutical substances make it possible for small numbers of individuals to have a disproportionate level of impact upon a given situation. Care for the front line, in this context, can be divided along three dimensions: the role of S&T in developing more effective training techniques, providing support for the modernization of Canadian soldiers through S&T programs such as the Integrated Soldier System Project (ISSP), and providing information regarding performance enhancing technologies and chemicals that are being used, or may be used, by opposing forces. The technological facets surrounding Super-Empowered individuals are accompanied by significant human dimensions: “high tech” equipment that is cumbersome or difficult to use will hamper, rather than help, the performance of front line personnel; ethical questions arise when substances are used to enhance, rather than restore, human performance levels; and failures of imagination and nerve may occur when we resist exploring what is technologically possible, or do not adequately extrapolate current trends and developments.

Defence S&T Symposium 2009 was concluded with words of both encouragement and caution from the ADM (S&T) and the Director General of DRDC Toronto. The future of human science and technology is bright, due to the fact that human S&T research clearly plays an integral role in the FSE, but profound challenges loom on the horizon. A changing global environment, coupled with a shift in the nature of conflict and warfare, has demonstrated that human S&T has much to offer in the future of defining solutions to existing and emerging problems. Simultaneously, these opportunities are met with great challenges reflected in the complexity and diverse spectrum of human conflict in the 21<sup>st</sup> century, and the obligation to manage expectations in the search for solutions.

## Sommaire

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### **Colloque S&T Symposium 2009: Understanding the Human Dimension in 21st Century Conflict/Warfare: Taking Care of the Front Line / Comprendre la dimension humaine dans les conflits/la conduite de la guerre au XXI<sup>e</sup> siècle : Veiller à la ligne de front**

**Stefan Wolejszo; Kyle Fraser; Orrick White (Ed); DRDC Corporate TR 2009-010; R & D pour la défense Canada – Corporate; Juin 2009.**

Le Colloque S & T pour la défense 2009, qui a eu lieu à Ottawa du 21 au 23 avril, a attiré environ 200 participants provenant des forces militaires, des universités et du milieu civil. L'événement a été coparrainé par le Sous-ministre adjoint (Science et technologie), le Chef – Développement des Forces et le Chef du personnel militaire. Le Colloque S & T pour la défense 2009, qui était le troisième d'une série en trois volets, avait pour but de se pencher sur les questions axées sur le facteur humain en rapport avec les conflits du 21<sup>e</sup> siècle. Plus particulièrement, le thème principal du colloque était le suivant : « Veiller à la ligne de front ». On a discuté de ce thème en petits groupes en abordant les sous-thèmes suivants : connaissance, complexité, devoir de diligence et devoir de soigner et individus superpuissants.

Dans la présentation initiale du Colloque S & T pour la défense 2009, le Chef – Développement des Forces a souligné les principales tendances en matière de sécurité qui ont une incidence sur l'environnement de sécurité de l'avenir (ESA), notamment la propagation de maladies et les pandémies, le vieillissement de la population dans les pays de l'Ouest, de pair avec la jeune population des pays en développement, le changement climatique qui entraîne une demande accrue d'aide humanitaire, la pauvreté généralisée et la hausse de l'extrémisme. Il a avancé que le volet conceptuel de l'analyse de la sécurité de l'avenir est vital et qu'on a besoin d'une meilleure définition de tous les facteurs indiqués ci-dessus. Dans la présentation qui a suivi, le Chef adjoint du personnel militaire a soutenu que ces tendances quant à l'environnement de sécurité de l'avenir vont entraîner un changement considérable : on n'exécutera ainsi plus des tâches militaires bien définies, comme par le passé, mais plutôt des opérations de plus en plus complexes face à un adversaire d'un type différent. Il a ajouté que le modèle de gestion du personnel doit également s'adapter aux changements importants que subit la population visée par le recrutement, qui est de plus en plus diversifiée. On doit en outre adapter les modèles d'entraînement afin de mettre l'accent sur le renseignement culturel, qui consiste en la capacité de reconnaître et de comprendre les croyances, les attitudes, les valeurs et les comportements communs à un groupe de gens, puis utiliser ces connaissances afin d'exercer une influence et ainsi obtenir les résultats souhaités dans des circonstances complexes et changeantes.

Conformément aux questions mentionnées par le Chef – Développement des Forces et le Chef adjoint du personnel militaire, le SMA(S & T) a avancé que les problèmes pernicious qui prévalent dans les environnements de sécurité actuel et de l'avenir exigent une analyse de systèmes complexes qui se fonde sur une recherche scientifique et technologique axée sur l'humain. Des liens essentiels ont été établis entre les milieux scientifique et politique, et la science joue un rôle crucial, car elle aide les décideurs en leur offrant les outils dont ils ont besoin pour éclaircir les complexités dont fait preuve l'ESA. Ainsi, la science doit pouvoir s'adapter et être robuste. Il fait remarquer que le point de vue traditionnel voulant que le monde évolue selon une perspective somme toute linéaire n'est plus valable. En effet, les « surprises » sont désormais chose courante dans le système mondial complexe d'aujourd'hui. Il importe de plus de reconnaître que ce qu'on fait, et ce qui se produit après une « secousse », sont dans bien des cas des aspects tout aussi importants que l'événement lui-même qui a provoqué une surprise.

Le groupe qui a abordé le thème « Se préparer à des conflits non conventionnels » a convenu que la connaissance et l'information sont des aspects cruciaux d'une stratégie qui vise à composer avec des conflits non conventionnels. À cet égard, la « connaissance » peut consister en la compréhension de la force d'opposition, la connaissance du passé en rapport avec les leçons retenues de conflits analogues qui ont eu lieu auparavant, l'information obtenue suite à la collecte de renseignements ou les résultats de recherches réalisées par le milieu de S et T sur la façon de faire face à des tactiques comme celles qui font appel à des dispositifs explosifs de circonstance (IED). Toutefois, il est tout aussi important de cerner les limites de nos connaissances. Par exemple, même si on se sert d'IED dans le cadre des conflits depuis de nombreuses années, on doit toujours effectuer des recherches afin de déterminer la façon d'entraîner le personnel de la ligne de front afin qu'il puisse neutraliser efficacement ces dispositifs. Le processus de collecte de renseignements a subi des changements de fond depuis la fin de la guerre froide et il importe de déterminer ce que la collecte de renseignements pourra, et ne pourra pas, accomplir dans l'environnement de sécurité de l'avenir.

La séance sur la complexité et le conflit s'appuyait sur l'argument voulant que la connaissance et l'information soient des aspects essentiels qui permettent d'œuvrer efficacement dans l'ESA, et on a ainsi souligné le fait que pour s'occuper adéquatement de la ligne de front, on doit comprendre les environnements complexes dans lesquels les forces militaires modernes œuvrent. Bien que le Canada participe à des missions de maintien de la paix depuis les années 1950, des changements importants sont survenus quant à l'espace de mission en raison de la prolifération des technologies de l'information, de la diminution de la sécurité à l'intérieur de nos propres frontières, de la tendance à favoriser les liens mondiaux et du large éventail de partenariats auxquels les forces militaires modernes prennent part. On peut tirer des renseignements utiles des expériences du passé, mais l'application de cette expérience est toujours tempérée par un ensemble unique de facteurs qui compose l'espace de mission moderne. Certes, les opérations militaires ont toujours été complexes, mais les forces militaires modernes participent à des « entreprises complexes » qui posent des problèmes en ce qui concerne les structures organisationnelles traditionnelles, les modèles de leadership et les définitions mêmes de la réussite.

Les membres du groupe sur le devoir de diligence ont accepté de changer le nom de la séance, qui s'appelle désormais « devoir de soigner ». Ce changement découle d'un impératif : en raison de l'ensemble des obligations réciproques autour desquelles s'articule le contrat social qui prévaut entre le personnel des Forces canadiennes et les civils, on doit prendre soin des militaires qui font des sacrifices incroyables pour servir leur pays. Les efforts visant à prendre soin de la ligne de front consistent en un processus polyvalent qui porte notamment sur l'offre du meilleur soutien physique, psychologique et spirituel possible au personnel des FC. Il s'agit notamment des soins médicaux destinés aux personnes blessées dans le cadre du service, d'un système de soins de santé qui traite toutes les personnes malades et blessées, d'un soutien en vue du bien-être spirituel des membres des Forces canadiennes et de la réintégration des anciens combattants à la société après leur départ des forces militaires. Au cœur de l'impératif quant à l'offre de soins à la ligne de front figure la recherche en S et T qui fournit des renseignements fort utiles au sujet du traitement des blessures subies sur le champ de bataille, des soins médicaux, des programmes après-retraite proposant un soutien pendant la période de transition aux membres du personnel et à leurs familles et des services spirituels.

Le dernier groupe s'est penché sur le thème des individus superpuissants. En raison des innovations scientifiques et technologiques en matière d'entraînement et d'équipement, et même des substances pharmaceutiques visant à augmenter la performance, de petits groupes de personnes peuvent avoir une incidence disproportionnée sur une situation quelconque. Dans ce contexte, le soin de la ligne de front peut être subdivisé en trois aspects : le rôle de la S et T en vue du développement de techniques d'entraînement plus efficaces, l'offre d'un soutien visant la modernisation des soldats canadiens par le biais de programmes de S et T, par exemple, le Projet d'équipement intégré du soldat (PEIS), et l'offre d'informations sur les technologies qui améliorent le rendement et les produits chimiques dont les forces d'opposition se servent ou peuvent se servir. Les facteurs technologiques propres aux individus superpuissants vont de pair avec des aspects humains importants : l'équipement de haute technologie qui est encombrant ou difficile à utiliser diminue, plutôt que d'améliorer, le rendement du personnel du front; des questions d'éthique se présentent lorsqu'on se sert de substances qui améliorent, plutôt que de rétablir, les performances humaines; on risque d'assister à un manque d'imagination et de sang-froid si nous ne nous penchons pas sur les possibilités sur le plan technologique ou si nous n'extrapolons pas adéquatement les tendances et les développements actuels.

Le Colloque S et T pour la défense 2009 s'est conclu par des mots d'encouragement et de mise en garde prononcés par le SMA(S & T) et le directeur général de RDDC Toronto. L'avenir de la science et la technologie humaines est prometteur, car la recherche de S et T sur les humains joue de toute évidence un rôle prépondérant dans l'ESA, mais des défis fondamentaux se pointent à l'horizon. La modification de l'environnement mondial, de pair avec le changement de la nature des conflits et de la guerre, ont démontré que la S et T portant sur les humains aura beaucoup à offrir dans la mise au point de solutions aux problèmes existants et nouveaux. Parallèlement, ces possibilités se butent à des problèmes de taille qui découlent de la complexité et du spectre

diversifié des conflits humains du 21<sup>e</sup> siècle, de même que de la nécessité de composer avec les attentes quant à l'élaboration de solutions.

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# 1 Introduction

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Defence S&T Symposium 2009 was the culmination of an interrelated series of symposia focused upon the human-centric dimensions of conflict. In the new and future security environment and three challenges were identified to be at the core. These challenges were: 1) an unfamiliar adversary in a battlespace largely governed by ideology, 2) an urgent requirement to improve the preparedness and protection of our frontline personnel, and 3) the need for actionable understanding of the multi-organizational response to conflict. The first symposium in this series, held in 2007, examined changes in battlespace and the three dimensions of human conflict: person-versus-person, person-versus-nature, and person-versus-self. The second symposium, held in 2008, centered upon three key themes related to human complexity in the 21<sup>st</sup> century: 1) adversarial intent, 2) understanding the “influence” battlespace; and, 3) human complexity. At the end of the second symposium, it was noted that in order to make a difference for the Canadian Forces (CF) in the future, the many ideas and concepts that emerged during these symposia to must be implemented and operationalized. How to achieve this objective was the focus of Defence S&T Symposium 2009.

Building on the knowledge gained from the past two symposia, the core theme of Defence S&T Symposium 2009 was “Taking Care of the Front Line.” This Symposium examined the issue of establishing a comprehensive approach to providing care of the front line across the entire operational spectrum, while at the same time recognizing that the players involved in taking care of the front line are diverse and their roles complex. The sub-themes of this symposium were: Preparation for Irregular Warfare; Complexity and Conflict; Duty to Care; and, the Super-

Empowered Individual. The objective of this Synopsis is to capture the overall themes that emerged during the three day symposium.

## 2 The Future Security Environment in the 21<sup>st</sup> Century

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The importance of “Taking Care of the Front Line” is paramount. But what does taking care of the front line mean? <sup>3</sup> To answer this question, MGen S.A Beare (Chief of Force Development) and Cmdre A. Smith (Chief of Military Personnel) focused upon key trends and the futures across various time horizons. They identified what these trends may mean for those on the front lines as well as those at the “back end” (referring to the home front), and they asked where Science and Technology (S&T), particularly human oriented research, fits into this equation.

Futures research is centered upon identifying key trends with the goal of anticipating shocks that may occur in the future. Key future security trends, which are viewed in a global context, include the spread of disease and pandemics, an aging population in the West coupled with a young population in developing nations, climate change leading to an increased demand for humanitarian aid, widespread poverty, and the growth of extremism. While each of these trends would individually pose significant challenges to the security environment of the future, it is important to note that they will be exacerbated by other developments, including the increased influence and importance of non-state actors, the rise of asymmetric warfare and terrorism, and the proliferation of weapons. MGen Beare argued that the conceptual component of future security analysis is vital, and that there is a need for better definitions for all of the factors listed above.

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<sup>3</sup> Traditionally, the term ‘Frontline’ (the region where a battle is being, or has been, fought) has conjured up the image of direct military operations against the enemy; frequently, referred to as the pointy-end of the spear. However, given the nature of the battlespace in the 21<sup>st</sup> century this understanding of the frontline is insufficient. Instead, in the 21<sup>st</sup> century, the battlespace require a multidimensional, comprehensive approach to operations.

Soldiers today are already expected to accomplish tasks that were in the domain of the Special Forces only 20-30 years ago, and future security trends provide convincing evidence that the military will continue to be asked to deal with situations and operational environments that are increasingly complex. In such complex environments we cannot operate as stove pipes, and in order to meet upcoming challenges we need to develop complex adaptive systems focused upon unity, agility, adaptability, innovation and trust. The development of such complex adaptive systems begins at the home front, where instability modeling and integrated planning are developed, and resilience and Inter- and Intra- agency trust within institutions is established. Taking care of the front line starts at home, and involves coordinated approaches from a wide range of agencies and actors. An important challenge is removing existing barriers that inhibit comprehensive and “whole of government” approaches from being realized.

Cmdre Smith also acknowledged that trends in the future security environment will lead to a significant shift away from the relatively clear cut military tasks of the past, toward increasingly complex operations to engage a different kind of enemy. From this point of view, one of the major contributions made by the Chief of Military Personnel (CMP) to support the front-line is to provide the Canadian Forces (CF) with all means possible to keep personnel safe and reduce the need to put them in harm’s way. The CF military personnel management model aims to achieve the strategic effect of having the right person with the right qualifications at the right place and time. This process is guided by the following five pillars: 1) recruit; 2) train and educate; 3) prepare; 4) support; and, 5) honour and recognize. Further to this aim, CMP’s goals include

preparing the CF and its personnel to influence the battlespace and intervene before “the fight hits the ground” in complex endeavours.<sup>4</sup>

‘Taking Care of the Front-Line’ within the context of the pillars that underpin the personnel management model will continue to present challenges for the CF. Canada’s recruitable population is becoming increasingly diverse, and recruits are older and more mature than has been the case in the past. In order to fully engage these populations and benefit from their added skills and knowledge, the CF needs to be more attuned to the impact made by their level of diversity and life experience.

Unfortunately, despite an acknowledgement that older recruits, and those raised in the digital age, need to be “trained differently” (e.g. more use of virtual environments and simulations), to date the implementation of such approaches has proven to be a challenge. Training models need to be adapted to focus on cultural intelligence; whereby, cultural intelligence is defined as the ability to recognize and understand the shared beliefs, attitudes, values and behaviours of a group of people. This knowledge can then be applied to influence outcomes under complex and changing circumstances.

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<sup>4</sup> Complex endeavours are formed when a large number of disparate entities share a purpose or related purposes. Complex endeavours may include, for example, joint military organizations, inter-agency partners, public-private partnerships, etc.

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### 3 Ingar Moen Memorial Lecture <sup>5</sup>

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**Distinguished Recipient:** Professor Janice Stein,  
Director, Munk Centre for International Studies, University of Toronto

In her lecture “Strategic Leadership in a Complex World,” Professor Janice Stein focused upon the issue of complexity and how existing leadership models must adapt within complex systems. She reinforced the notion that while it is possible to understand complicated systems through an analysis of constituent parts, complex systems present more difficult challenges. To illustrate this difference, she used the automobile and Afghanistan as disparate examples. An automobile is a complicated system that may be understood through the isolation and analysis of individual pieces of the system, which work together in a relatively consistent, linear and predictable manner. However, complex systems have many interwoven components that impact upon one another in ways that are often unpredictable. Afghanistan has elaborate leadership networks and systems of governance that cannot be understood in isolation from other factors. Such complex systems often defy linear logic, rendering it difficult to identify clear patterns and to formulate accurate predictions. The key challenge that she identified was: How can we formulate integrated solutions to complex problems?

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<sup>5</sup> Ingar Moen was among DRDC’s most influential scientists prior to his passing in June of 2006. Dr. Moen chaired the Disruptive Technology Working Group, and was a driving force of the S&T policy directorate and the S&T symposia. He played an instrumental role in the development of many strategic documents and activities, including the Technology Investment Strategy (TIS) and “*Looking Forward, Staying Ahead*.” The first annual Ingar Moen Memorial Lecture in memory of Dr. Moen and his legacy was presented at the Defence S&T Symposium 2007.

She noted that strategic leadership, which is a form of values-based leadership, plays a critical role within complex environments. This form of leadership is predicated by a tacit understanding that tough decisions and tradeoffs will sometimes be made in order to reach an achievable goal. However, the attributes of strategic leadership are often diametrically opposed to those typically found in command and control environments. The central premise of strategic leadership is that the role of the leader is to find the best people (who are often known as the “mavericks” or “mad scientists”) and to “get out of their way,” which typically means the leader coordinates, rather than controls, the activities of these people. Within the strategic leadership model, leaders take on the role of being a resource for individuals, ensuring that those under his or her command have everything that is needed at their disposal. In order for such a model to be successful, tolerance for ambiguity must prevail over strict bureaucratic principles such as “order” and “predictability”, and existing barriers that foster silos and secrecy must be removed. Such barriers may be an artefact of a particular institution, or they may be traditional disciplinary divisions.

According to Professor Stein, strategic leadership in a complex world is delineated by the following characteristics:

1. Enable rather than direct
2. Coordinate rather than control
3. Tolerance for openness rather than secrecy
4. Capacity to work outside of silos and across boundaries
5. Promote ambiguity rather than order
6. Values-based leadership

Professor Stein noted that strategic leaders must abandon traditional organizational patterns, and “revel in the chaos.” She argued that if an individual or organization adopts these principles, and takes the notion of strategic leadership seriously, the end result will be a more robust organization. However, when strategic leadership is applied, key decisions are pushed down the chain of command, the risk profile of the organization rises. Therefore, in order for strategic leadership to be successful, there must be a high level of trust that the right people, who are capable of using sound judgment, are in the right positions.

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## 4 Session: Preparing for Irregular Warfare

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**Session Chair:** Dr. Joe Baranski, Chief Scientist, DRDC Toronto

**Keynote Speaker:** Dr. Martin Rudner, Professor Emeritus, Carleton University

**Panellists:**

Dr. Angela Gendron, Professor, Carleton University  
Dr. Jerzy Jarmasz, Defence Scientist, DRDC Toronto  
Dr. Jez Littlewood, Director, CCISS, Carleton University  
Mr. George Kolisnek, Senior Fellow, CCISS, Carleton University

This session focused upon the ways in which knowledge can be used to prepare for irregular warfare. “Knowledge” in this case includes, for example: 1) an understanding of the opposing force (s); 2) an understanding of the context relating to lessons learned from similar conflicts that occurred in the past; 3) information gained from the process of intelligence gathering; and, 4) research findings from the S&T community about to how to deal with tactics such as improvised explosive devices (IEDs).

The keynote speaker for this session was Dr. Martin Rudner who not only presented an overview of the evolution of Al-Qaeda and Jihadist terrorism, but also how they are operationalizing intelligence. He suggested that Al-Qaeda is not a localized phenomenon; rather, they are operating on a global level roughly overlapping the boundaries of the old British Empire. This organization has established a plan of action with distinct phases of activity, beginning with an attack on 9/11 that was designed to force a reaction from the West which would, in turn, compel the Islamic community to pick sides in the upcoming conflict. Global communication and

information networks, such as the Internet, are utilized by such terrorist organizations to coordinate future activities and present warnings that attacks are coming (this warning is a component of the Islamic laws of war). Effectively dealing with the threats presented by a decentralized, yet highly organized, terrorist organization that operates on a global level is a “wicked problem” with no easy solution.

Collectively, the panel agreed that Canada’s risk profile is changing, and we are now considered a target rather than a ground for staging, training and fund raising for terrorist organizations. As one presenter pointed out, “the conflict has now come to us, and we no longer have a choice.” Another panellist noted that history may provide useful clues about how to deal effectively with terrorist organizations engaged in irregular warfare. While extinguishing terrorism may not be likely, it is possible to contain it by establishing a clear set of obtainable objectives and by effectively utilizing both *reactive* and *proactive* strategies. Reactive strategies include using the police and the judicial system to hold those responsible accountable for their actions. While the most important of the proactive strategies is intelligence, which provides vital information about upcoming threats.

That said, panel members acknowledged that the intelligence cycle has been in flux, and there is a need to have an understanding of what intelligence can and cannot do in the current environment. Since the end of the Cold War, significant changes in the intelligence gathering and usage processes have occurred along the axes of direction, collection, analysis and dissemination of information:

1. *Direction:* In the Cold War era, the collection of intelligence was primarily utilized for establishing doctrine. In the present context intelligence is collected with the goal of enhancing the effectiveness of a particular doctrine or operation.
2. *Collection:* Intelligence gathering in the Cold War era was marked by massive amounts of information collected on a vast array of topics. The present era is characterized by a narrow use of resources, and a narrow and very specific range of targets who are often individuals. An increase in the legal issues surrounding data collection has also occurred, which has increased the level of complexity and difficulty in the intelligence gathering process.
3. *Analysis:* During the Cold War the analysis was primarily strategic in nature, and focused upon the future capabilities of the opposition. We presently we do not have same degree of analysis, and the central focus is upon immediate concerns such as the location, future positioning, present and future actions, and capability and threats of the opposition.
4. *Dissemination:* In the Cold War era, intelligence was coordinated and coded, timely and accurate. In the contemporary era, intelligence is narrow and directed, time sensitive and perishable, and the process of record keeping is strongly emphasized.

A major issue that was raised was that we are accumulating increasingly specific information and raw data, but there is less emphasis upon “knowledge”. In other words, there is a deficiency in our interpretation of what collected data and information actually means.

The question of how to deal with improvised explosive devices (IEDs) was provided as an illustration of the distinction between information and knowledge in terms of identification and interpreting their threat. IEDs (once referred to as ‘booby traps’) have been used in many conflicts over a long period of time and it is exceptionally difficult to develop effective strategies for countering such devices. As one panellist noted, contemporary research shows that the identification of IEDs is not simply a matter of pattern matching; it is also dependent on team dynamics, experience, and intuition. Therefore, in term of teaching soldiers, this leads to the question of how soldiers can be trained to effectively identify these devices. The panellist illustrated how research has provided an understanding about how people learn to identify IEDs, and this knowledge has been utilized to construct training simulations that bridge the gap between the classroom and the field.

## 5 Session: Complexity and Conflict

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**Session Chair:** Dr. Paul Pulsifer, Director S&T Intelligence, DND

**Keynote Speaker:** Dr. Richard Hayes, CEO, Evidence Based Research Inc.

**Panellists:**

Dr. Richard Hayes, CEO, Evidence Based Research, Inc.

Mr. Mike Elliott, Senior Policy Advisor, Afghanistan Task Force, PCO

Dr. Chris Spearin, Associate Professor, CFC, DND

Dr. Greg Smolynec, Team Leader, DRDC CORA, DND

In order to adequately care for the front line, it is necessary to understand the complex environments in which the modern military operates. As many have acknowledged, although Canada has engaged in peacekeeping missions since the 1950s, there have been significant changes within the mission space. These changes relate to: 1) the proliferation of information technologies; 2) the shift away from the belief that we are secure within our own national borders; 3) the recognition of the importance of global linkages; and, 4) the massive variety of partnerships in which modern militaries need to engage. While military operations have always been complicated, the modern military takes part in “complex endeavours” that present challenges to traditional organizational structures, models of leadership, and even definitions of success.

Dr. Richard Hayes, the keynote speaker for this session, argued that the mission space has changed from the use of the traditional military structure to deal with fixed threats towards combating variable threats with an emphasis on national security and complex operations. He

pointed out that information technologies have created global linkages which have eroded the belief that we are secure within our own national boundaries. There has also been an enormous expanse of partnerships critical to the success of given missions; including, those groups or individuals with similar belief systems, those who cooperate with us, friends of convenience, neutral parties, and even adversaries. Such groups and individuals are complex in and of themselves, reflecting a wide array of cultures, values, norms, laws, etc.

He went on to reinforce the reality that missions have become complex endeavours in which a multitude of actors (with goals and definitions of success that need to be compatible) are engaged in a wide variety of activities that require synchronization. The problem that arises however is that while such complex endeavours cannot be commanded by any individual, they must still be led. According to Dr. Hayes, the type of collaboration required to successfully navigate through the complexities of modern missions requires robust networks of information sharing that cut across existing organizational and even national boundaries. This level of information sharing requires a willingness to be interdependent and to trust others, which is difficult to accomplish.

The increasing reliance on private security forces that operate in conflict zones is but one example of the complexity of contemporary conflict; especially when this reliance is due to under-resourced western militaries. According to one panel member, the number of private security personnel rose exponentially in the post-9/11 era. He estimated that there are currently 28,000 private security personnel in Afghanistan and approximately 50,000 in Iraq. It is common practice for private security firms, commonly rooted in North America, to hire and train local

individuals. While such organizations provide much needed training and skill development to members of the indigenous population this may also create a drain upon the number of people who join the local armed forces or police.

One panellist captured the central issue of the problem(s) created by a limited pool of military resources by stating provocatively that “a strategy which is not adequately resourced is not a viable strategy.” Nevertheless, the expansion of the reliance on private security and other non-military personnel is likely to continue. This leads to the challenge of reconciling fundamental differences in military and civilian culture. One panellist suggested that aside from the growth of litigation processes, many of the issues that the Canadian Forces currently deal with may be less new and unfamiliar than we may think. He pointed out that the Canadian Forces have been engaged in highly complex peace operations, backed by sets of complex analyses, since the 1950s. This legacy makes Canada well equipped to deal with contemporary complex environments. The question remains, however, whether 9/11 and the subsequent global shock generated by this attack, has created revolutionary changes that have forever altered the evolutionary progression of CF development. If so, what are the implications?

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## 6 Session: Duty of (to) Care

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**Session Chair:** Dr. Kelly Farley - Chief Scientist, DRDC DGMPRA

**Panellists:**

Mr. Karol Wenek - DGMP, CMP, DND

BGen H.F. Jaeger, M.D. - CF Surgeon-General, DND

Maj. John Organ - Deputy Area Chaplain, DND

Ms. Brenda Mac Cormack - Director, New Veteran's Charter Program, Canada

In his introductory remarks, session Chair Dr. Kelly Farley set the stage by challenging the name of the session's theme. He challenged that rather than "Duty *of* Care" the session should be called "Duty *to* Care." While this may seem to be semantics, this small shift in wording is significant because it reflects an imperative: in the reciprocal set of obligations at the heart of the social contract between Canadian Forces personnel and civilians, there is a *duty and obligation to care* for individuals in uniform who have made significant sacrifices to serve their country. Taking care of the front line is a multi-faceted process that includes providing: 1) the best possible care for individuals who are injured in the line of duty; 2) a health care system that treats all sick and injured personnel; 3) care for the spiritual well-being of members of the Canadian Forces; and, 4) the re-establishment of veterans into society after they leave the military.

Members of the Canadian Forces may become injured in the course of fulfilling their duties. Medical research that focuses upon lessons learned from past cases is a key component of minimizing the impact of injuries, and ultimately saving lives. The high level of success of the

current medical program is best illustrated by the fact that only two of the more than 500 injured individuals taken into medical care in Afghanistan subsequently died of their wounds.

One panellist noted that in terms of providing vital medical care, we have effectively established a baseline of care that is highly successful in terms of saving lives. However, high quality medical care is not solely about dealing with life threatening injuries. For example, Canadian Forces medical professionals have found sports medicine contributes to information regarding effective care for brain trauma and head injuries. It was also noted that the most difficult issue from a medical research standpoint is that of mental health. Although we know that approximately 4% of Canadian Forces personnel return from deployment with Post Traumatic Stress Disorder (PTSD) and 4.2% return with depression, the fact that we do not know how many individuals had these conditions prior to deployment makes it difficult to accurately assess the impact of operations on mental health.

Following the direct medical care that occurs after an injury -- which is the necessary first line of care for the front line -- a process of rehabilitation and reassessment takes place. The three tiers of health care and support that are designed to care for Canadian Forces personnel are the health care system, the administrative support system, and the veteran support system. One panellist noted that from a research evaluation perspective, the key questions that arise are how services can best be provided, and whether the existing system and programs are effective. The fact that we have a small force with a limited amount of resources and positions introduces other difficult questions regarding the limits on employment (i.e. do we retain or release individuals who have

sustained debilitating injuries or illnesses). Policy is located at the nexus of people, society, and the mission, and while a larger force could more easily absorb individuals who have been seriously injured, the relatively limited amount of positions within the Canadian Forces, combined with the need to accomplish difficult missions, leads to a great deal of pressure to medically release such individuals. Although battlefield injuries are (correctly) often the main focus of discussion, other issues need to be discussed as well. One panellist noted that an aging Canadian Forces population is largely responsible for the fact that 1100 people were issued medical releases over the past five years. Factors like these must be recognized in order to develop a more complete understanding of the issues at hand.

Along with support following physical injuries, psychological support is also needed to ensure a high level of quality care for the front line. Personnel are also often concerned about what will happen once they leave the Canadian Forces. The goal of Veteran's Affairs is the reestablishment of people into civilian life after military service, and to maintain contact over time. A central concern is that research has shown that individuals often experience poor outcomes after transition into civilian life. The outdated and fragmented services that survived post-World War II cutbacks, which are available to veterans, have become outdated and largely ineffective. This issue has been addressed by the new Veteran's Charter, which came into effect on April 1, 2006. The current focus of Veteran's programs shifts away from the direct needs of the individual and towards a more holistic wellness-based approach that includes transitioning entire families into post-military life.

The focus on wellness and well-being of personnel is further reflected in the promotion of religion and spirituality within the Canadian Forces. One panellist presented the case that religion and spirituality are human rights that are supported by the Canadian Charter of Rights and Freedoms. Furthermore, such belief systems also have qualities that augment and support the front line. The Canadian Forces Chaplaincy works to ensure that the spiritual needs of individuals are met, both in operations and on the home front. However, it is important to note that more research is needed in order to assess what types of spiritual programs provide the most benefit for CF personnel.

## 7 Session: Super-Empowered Individual(s)

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**Session Chair:** Dr. Andrew Vallerand, Chief Scientist, DRDC CSS

**Panellists:**

Dr. John Frim, Defence Scientist, DRDC Toronto  
Dr. Jay Goodwin, Research Psychologist, U.S. Army Research Institute  
Dr. Adam Russell, Principal Investigator, Scitor Corporation

The Defence S&T Symposium series was created to explore new frontiers in science and technology. The session dedicated to exploring the “super empowered individual” helped to set the scene for 2010 whereby the symposium will return to exploring emerging and potentially disruptive science and technology in the human, information and cognitive domains. In this context, the session focused on the notion that scientific and technological innovations make it possible for small numbers of individuals to have a disproportionate level of impact upon a given situation. Further the session focused upon how technological innovations are being used to aid and empower soldiers in the field.

“Super-empowered” individuals, and organizations, have the capacity to single-handedly bring about high degree of change. Care for the front line, in this context, can be divided along three lines: the role of S&T in developing more effective training techniques; providing support for the modernization of Canadian soldiers through S&T programs such as the Integrated Soldier System Project (ISSP); and, providing information regarding performance enhancing technologies and chemicals that are being used, or may be used, by opposing forces.

Super-empowered individuals, and organizations, have an enhanced capacity to elicit and direct change. One panellist argued that developments in training strategies related to cultural intelligence can provide just such an edge to modern Canadian soldiers. Rather than solely teaching soldiers about specific facts related to a particular deployment (e.g. governance structures in Afghanistan) which may be of limited use in other contexts, training should focus on general themes of culture so that a high level of cross-cultural competence is developed that is transferable into different settings. The capacity that needs to be developed is agility, and the ability to learn about cultures quickly when that necessity arises. Such capacity cannot be achieved through employment of contracted subject matter experts; but instead, can only be achieved through a commitment to long term training programs.

Technological innovations also play a key role in the development of the super-empowered individual within the Canadian Forces. One panel member presented an overview of the Integrated Soldier Systems Project (ISSP) which develops essential tools such as night vision equipment. Such development takes place in cycles and is marked by a large degree of testing and simulations. A key challenge in this body of research is to get the human factor right from the start. In other words, front line personnel will reject equipment that is too cumbersome, unreliable, or complicated to use effectively.

The most controversial aspect of the development of super-empowered individuals occurs when developments in science and technology allow individuals to exceed the normal baseline of

human performance. As one panellist pointed out, we are already using technology to enhance human performance. For example, eye glasses are used to enhance visual perception in some individuals, and many others use coffee as a stimulant to stay awake longer. However, pharmaceutical substances that allow individuals to well exceed standard mental and/or physical levels of human performance are currently being developed. The chilling implication of this development is that rather than supporting the front line by providing information about who the enemy is, and where they are located, a further question of “what drugs are they on?” arises. In light of these changes, the two negative outcomes that must be avoided are a “failure of nerve” and a “failure of imagination.” An unwillingness or inability to extrapolate a trend to its logical consequences is referred to as a failure of nerve, the consequence of which is that problems are not addressed after they have been identified. When a failure of imagination occurs all of the critical pieces of the puzzle are in place except for one: we cannot imagine why anyone would engage in a particular activity. As a result, we do not adequately anticipate the problems that are looming on the horizon. Trend analysis is absolutely vital to counter the potential of each of these failures, and it is important to note that small shifts can lead to large consequences over time.

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## **8 Conclusion: The S&T Challenges of 21<sup>st</sup> Century Conflict**

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The future of human science and technology is bright but profound challenges loom on the horizon. A changing global environment, coupled with a shift in the nature of conflict and warfare, has demonstrated that human S&T has much to offer in the future of defining solutions to existing and emerging problems. Simultaneously, these opportunities are met with great challenges reflected in the complexity and diverse spectrum of human conflict in the 21<sup>st</sup> century, and the obligation to manage expectations in the search for solutions.

The global environment of the 21<sup>st</sup> century is largely characterized by trends toward failed and failing states, mass movement of people and a shift toward urbanization, changing demographics, and an ever-increasing and accessible age of information technologies and media. Within this context, human conflicts exist in person(s)-versus-nature, person(s)-versus-person(s), and person(s)-versus-self manifestations. While S&T has arguably dealt largely within the realm of person(s)-versus-nature conflicts through technological development and environmental manipulation, the person-versus-self dimension of conflict is perhaps the least considered of the three. One challenge for human S&T in addressing these conflicts is the ability to understand, explain, and apply dimensions of complexity in the process of identifying problem and solution spaces in a spectrum of conflict involving both state and non-state actors at various levels.

The fact that the world is simultaneously becoming increasingly interconnected and fractured is not in dispute. The trend toward increasing global interconnectedness and interdependence is exemplified by the globalization of critical infrastructure, such as economics, transportation and communication. There are also signs that the world is becoming increasingly fractured, particularly along lines of ideology, culture, religion. In complex contemporary global systems, such centripetal and centrifugal forces are juxtaposed against, or even caused by, one another. To make matters even more complex, nature, in forms such as climate change and disease propagation, stimulates existing processes of interconnectedness and polarization.

In conclusion, it is cautioned that these comments should be presented as views of the world reality for consideration, vice being expressed as indisputable facts. That being said, the concept that the world evolves in a somewhat linear manner is no longer tenable; shocks have become the “new normal” within the existing complex global system. It is important to acknowledge that what one does, and what happens after a shock, is often as important as the shock itself. An essential interface exists between the scientific and political communities and science plays an essential role by assisting decision-makers by providing the tools necessary to unravel such complexities. To this end, science has to be adaptive and resilient. We can no longer depend on the Newtonian model in which phenomena are broken into constituent parts that may be individually analyzed in order to establish a predictive capability within that system. The key limitation of this model is that it presupposes a series of relatively simple cause and effect relations that do not adequately account for the non-linearity that is the *sine qua non* of complex systems. Instead, the wicked problems that exist in the current, and future, security environment

will require an analysis of complex systems that includes human oriented S&T research at its core.

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## List of symbols/abbreviations/acronyms/initialisms

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ADM	Assistant Deputy Minister
CEO	Chief Executive Officer
CF	Canadian Forces
CFD	Chief of Force Development
Cmdre	Commodore
CMP	Chief Military Personnel
COS	Chief of Staff
DGMPRA	Director General Military Personnel Research and Analysis
DND	Department of National Defence
DRDC	Defence Research & Development Canada
FSE	Future Security Environment
IED	Improvised Explosive Device
ISSP	Integrated Soldier System Project
MD	Medical Doctor
MGen	Major General
NRC	National Research Council
OCS	Office of the Chief Scientist
PTSD	Post Traumatic Stress Disorder
R&D	Research & Development
S&T	Science and Technology

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Defence S&T Symposium 2009, which focused on “taking care of the front line,” was the third of a three part series exploring the human-centric dimensions of conflict in the future security environment. When deployed, Canadian Forces are increasingly expected to navigate the tides of complex situations and environments that require strategies that are not purely military in nature. To successfully support such endeavours, a whole-of-government approach is necessary. Such an approach cannot work unless the best direction of policy and action is clearly established, but the complexities involved may create confounding issues for decision makers. To this end, human-centric S&T research is clearly needed. Four themes were used to illustrate the role best played by the S&T community to support those who are on the “pointy-end” (i.e. the front lines).

#### Theme 1: Preparing for Irregular Warfare

Knowledge and information are key ingredients to any strategy that can hope to deal with irregular warfare. “Knowledge” in this sense may be an understanding of the opposing force, historical knowledge relating to lessons learned from similar conflicts that occurred in the past, the information gained from intelligence gathering, or research findings from the S&T community regarding how to deal with tactics such as improvised explosive devices (IEDs).

#### Theme 2: Complexity and Conflict

In order to adequately care for the front line, it is necessary to understand the complex environments in which the modern military operates. Although Canada has engaged in peacekeeping missions since the 1950s, there have been significant changes within the mission space related to the proliferation of information technologies, a shift away from being secure within our own national borders, a trend toward global linkages, and a massive expanse of partnerships in which modern militaries engage. While military operations have always been complicated, the modern military takes part in “complex endeavours” that present challenges to traditional organizational structures, models of leadership, and even definitions of success.

#### Theme 3: Duty of (to) Care

The shift from “Duty of Care” to “Duty to Care” reflects an imperative: in the reciprocal set of obligations at the heart of the social contract between Canadian Forces personnel and civilians, there is a duty and obligation to care for individuals in uniform who make extraordinary sacrifices to serve their country. Taking care of the front line is a multi-faceted process that includes providing the best possible care for individuals injured in the line of duty, a health care system that treats all sick and injured personnel, care for the spiritual well-being of members of the Canadian Forces, and the re-establishment of veterans into society after they leave the military.

#### Theme 4: Super-Empowered Individuals

Scientific and technological innovations make it possible for small numbers of individuals to have a disproportionate level of impact upon a given situation. “Super-empowered” individuals, and organizations, have the capacity to single-handedly bring about high degree of change. Care for the front line, in this context, can be divided along three dimensions: the role of S&T in developing more effective training techniques, providing support for the modernization of

Canadian soldiers through S&T programs such as the Integrated Soldier System Project (ISSP), and providing information regarding performance enhancing technologies and chemicals that are being used, or may be used, by opposing forces.

As these themes illustrate, the enormous challenges involved in taking care of the front line defy simplistic solutions. Original research presented by representative from the defence community, academia, and industry illustrate the complexity of the issues involved, and point to a need for inclusive approaches to taking care of the front lines that break down existing barriers between departments within government, military and civilians, the front lines and the home front, and even leaders and their subordinates. What it means to take care of the front line within the future battlespace can only be understood using models that can account for high levels of complexity. To this end, the role of human research within the S&T community is becoming an increasingly important factor that enables the agility and adaptability of the Canadian Forces.

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Defence; Symposium; Science; Technology; Human Dimension