



# IRAHSS 08

International Risk Assessment And Horizon Scanning Symposium 2008

REALISING THE VISION: CHALLENGES AND SOLUTIONS

## SYMPOSIUM REPORT

13 – 14 October 2008

Marina Mandarin Hotel, Singapore

NATIONAL SECURITY  
COORDINATION SECRETARIAT



**S. RAJARATNAM SCHOOL  
OF INTERNATIONAL STUDIES**  
A Graduate School of Nanyang Technological University



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SYMPOSIUM  
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## EXECUTIVE SUMMARY

The 2<sup>nd</sup> International Risk Assessment and Horizon Scanning Symposium (IRAHSS) conducted on 12–14 October 2008 in Singapore revealed that the project of Risk Assessment and Horizon Scanning (RAHS) still remains very much a project of experimentation, discovery and evolution. The intellectual and technological landscape of RAHS—similar to its ultimate goal of better sense making within a rapidly altering domestic and international context—remains a terrain that requires continuous, careful and gradual mapping.

From the second IRAHSS, four common issues may be discerned from the various presentations and discussions. They are: (i) the need to understand and acknowledge both the cognitive limitations and possibilities of humans operating in a strategically variegated environment; (ii) the ability of technology to overcome these limitations whilst expanding possibilities; (iii) the potential applicability of such a technology by governments; (iv) and the manner in which such sense-making, data organizing and communication technologies may alter daily life—including the area of government-people interaction.

With regard to the cognitive limitations of the human mind in making sense of a complex adaptive external environment, speakers such as Steven Popper, Irene Sanders, Andrew Parker and Desmond Saunders-Newton laid the groundwork for what all RAHS projects are seeking to overcome—our cognitive limitations in the face of shifting environmental conditions characterized by what Popper memorably described as “deep uncertainty”. Despite coming at the issue from differing perspectives, all the speakers engaged with the nexus between environment, cognition and action and offered a deeper appreciation of the challenge at hand.

These limitations can hopefully be overcome to some extent by a second theme of IRAHSS 08—technology as the tool to expand human cognition and resultant action. Sharing practical examples, speakers such as Adrian Taylor, Didier Sornette, Erik Peterson and René Rohrbeck illustrated how technology can be applied to mitigate surprises such as stock-market crashes, threats to communication systems and the collection of intelligence.

Of clear utility to Singaporean policy elites and for that matter other governments, the third theme that emerged was the potential practical applications of RAHS approaches and technologies to empower policymakers in understanding as well as responding to issues that may affect their societies. For example, Yeong Gah Hou provided an overview of the challenges as well as the lessons learnt from the development of the JCTC’s Strategic Early Warning (SEW) programme, which was developed in order to enhance senior policymakers’ understanding of strategic counter terrorism. Also, Michael Charlton-Weedy (speaking about the experience of the U.K.) and Stephen De Spiegeleire (speaking on the experience of the Dutch) both dealt with the possibilities of systems such as RAHS while warning about their limitations from a policy perspective.

Finally, a fourth key issue raised by the symposium relates to the manner in which sense-making, data organizing and communications technology are altering—and will continue to alter—the relationship between governments and their people. For example, Eric Willis spoke about the potential political uses of mobile-phone technology to mobilize masses while Sirkka Heinonen pointed out how the accelerating advance of information technology would permit governments to more deeply integrate the citizenry into the process of appreciating new risks and challenges—and usher in an era where a “whole-of-society” approach to national security management becomes less of a slogan and more of a functioning reality.

Finally, both the keynotes speakers, Nova Spivack and Dave Sifry, noted how the emergence of the semantic web and the blogosphere have, respectively, transformed the communications landscape. Hence, to an extent unprecedented in human history, ordinary people across the globe are now participating in more everyday conversation and regular online interaction with one other, influencing trends, fashions and opinion and, as such, may well represent an untapped and valuable information resource by governments seeking to make sense of environmental complexity.

In summary, IRAHSS 08 accomplished its mission of conducting, in essence, a survey of the Singapore RAHS project and similar projects from around the world. To be fair, the continuing challenges posed by human cognitive bias, the practical limits to technology as an enabling tool, the personality, educational and professional attributes of the ideal strategic analyst—as well as more basic questions surrounding the future of the discipline of Futures or Foresight Studies—were raised throughout the symposium. Taking all these into account, there may hence be a need to better scope what RAHS’s ultimate goals are in the Singapore context. In this respect, perhaps if RAHS can, in the words of eminent futurist Peter Bishop, enable policy elites to permit themselves to “being surprised in small ways over a long time rather than in a big way all at once”, then maybe that is all that is required. As a final observation, the manner in which the concept of risk is approached may require further re-evaluation. Rather than being viewed by and large as something negative and to be anxious about, a more balanced approach that perceives some types of risk as constituting strategic opportunities is probably needed as well.

For more information on the symposium’s contents other than this report, speakers’ presentations can be accessed at [http://rahs.org.sg/t2\\_iraahss08\\_atc.html](http://rahs.org.sg/t2_iraahss08_atc.html)

## WELCOME ADDRESS BY DEPUTY PRIME MINISTER PROFESSOR S. JAYAKUMAR



**Professor S. Jayakumar**, Deputy Prime Minister and Coordinating Minister for National Security, officially opened the two-day symposium.

Professor Jayakumar noted that in an increasingly complex world, risk assessment and horizon scanning have become a key issue for many governments. The recent sub-prime mortgage crisis, collapse of financial institutions and concerns over global warming all serve as reminders that an inter-connected world is marked by uncertainties. These strategic events also provide a glimpse into possible future complexities and uncertainties. Professor Jayakumar stressed that it was important to have a coherent and systematic framework to anticipate and manage potential change. Therefore, a coordinated analysis of trends and scenarios that might pose a serious and debilitating impact on Singapore is necessary.

Three years after the inception of the RAHS project, in 2005, RAHS has been found to be a natural component of a networked government. RAHS offers a holistic approach to the detection and identification of early threat and indications of opportunities. Hence, the system encourages horizontal collaboration and information sharing between agencies.

Professor Jayakumar highlighted that “diversity” was not just a manifestation of the opportunities and threats we face but also reflects the approach that ought to be taken when dealing with complex issues. In RAHS, different sets of tools are used to address problems of various complexity levels. The RAHS Experimentation Centre, for example, has engaged many local and international agencies in its experiments covering topics such as maritime security and national stability indicators. Moreover, as part of its outreach efforts, the RAHS programme has been introduced to three local universities. Students from the Singapore Management University, National University of Singapore and Nanyang Technological University have the opportunity to use the programme to analyse, for instance, the Asian Financial Crisis and possible futures relating to China, global food and multi-lateral security.

Professor Jayakumar also commented that a healthy diversity could only be assured when horizon scanning agencies from different countries cooperate in their efforts. The RAHS Group has begun discussions on possible projects with a few countries. Pilot projects, exercises and workshops would ensure that the right combination of methods, technologies and approaches to risk assessment and horizon scanning could be discovered.

## WELCOME DINNER SPEECH BY HEAD OF CIVIL SERVICE, MR. PETER HO



**Mr. Peter Ho**, Head of the Singapore Civil Service and Permanent Secretary for National Security and Intelligence Coordination, began his speech by noting the highly unpredictable and complex global climate today. Mr. Ho stressed that the financial crisis was spreading and set to envelop the world, as four of the global engines of economic growth appeared to be heading for trouble at the same time. Concerned that government must be able to manage and emerge triumphant from these uncertainties and

challenges, he believed that RAHS would be an essential toolkit to manage complexity and disruptive change.

To meet these challenges, efforts have been invested in improving RAHS, slowly but surely building a network of international agencies that will continue research and experimentation. RAHS is releasing a tender for "version 2.0" to embrace new capabilities such as deep web-harvesting to track blogs, forums and conduct sentiment analysis. He added that RAHS has also benefitted from having a broad outreach programme, adding a diversity of views and perspectives that are critical in horizon scanning. It is hoped that the combination of these efforts will contribute effectively to strategic anticipation efforts.

Lastly, Mr. Ho provided some insights into the future of RAHS. He noted that RAHS stands at a critical point where it has to be evaluated and improved in order to meet the challenges of horizon scanning. He emphasized that experimentation with new concepts and technologies would have to continue to broaden the boundaries and new frontiers for RAHS in the horizon-scanning field. In conclusion, he encouraged all to continue sharing precious information and lessons learnt in order to contribute to the progress of RAHS.



## COCKTAIL RECEPTION SPEAKER: ERIC WILLIS

### MOBILE NETWORKS AND HORIZON SCANNING



At the evening cocktail reception hosted by PS Peter Ho, **Eric Willis**, CTO, Offbeat Guides and Co-Founder, RareEdge, spoke about the use of mobile-phone technology as a political tool and the implications for regulators and the state, both in terms of dealing sensibly with the issue as well as for possible horizon-scanning utility.

The first such usage Willis discussed was the use of mobile phones to organize “flash mobs”. Using information and communication technologies such as the World Wide Web or, in this case, mobile phones, activists or ordinary peoples can quickly organize and mobilize fairly large groups of people. Mr. Willis noted that usually these flash mobs are for fun, spontaneous and seemingly random activities. In some cases, it is used for political purposes. While there are many examples of the benign uses of flash mobs,

Willis highlighted the Cronulla race riots case in Australia as one example where they could be used for violent ends and highlighted how difficult it was for police and authorities to deal with the volume of text messages being sent at the height of the riots.

While mobile phones and the Internet can be used to organize a large group of people to mass in particular locations—whether for good or bad ends—text-messaging (or SMS) is playing an increasing role in political elections around the world. In Kenya a group called Kenyans for Peace used text messages to get their message to a mass audience while also assembling a list of elected representatives’ mobile phone numbers in an attempt to improve accountability. In South Korea the role of text messaging may have turned the tide of the election in 2002. There, a last-minute campaign sent 800,000 text messages and e-mails to young voters reminding them to vote. The increased voter turnout at the polls helped the “underdog” candidate to win by a two-per-cent margin.

In conclusion, Willis spoke about the difficulties that the increased ubiquity of easy to use mobile phones poses for governments, regulators and mobile-phone companies. Mobile phones allow people to exploit the power of social networks to organize large groups of people to come together (for good or bad purposes) or to broadcast their message to a wider audience more easily. The issue for regulators, Willis posited, is how to put in place policies that allow them to: (i) control the instantaneous flow of information that mobile phones provide; (ii) monitor messaging in order to stave off negative events like those seen in the Cronulla riots before they occur; and (iii) act accordingly with authorities.

## PANEL ONE: HORIZON SCANNING IN GOVERNMENT AND SOCIETY

### COUNTER-TERRORISM STRATEGIC EARLY WARNING: THE JCTC JOURNEY



**Yeong Gah Hou**, Director of the Joint Counter Terrorism Centre (JCTC), Singapore, provided an overview of the challenges as well as the lessons learnt from the development of JCTC's Strategic Early Warning (SEW) programme.

The mandate of JCTC is to enhance senior policymakers' understanding of strategic counter-terrorism issues in Singapore. JCTC is also tasked with two key missions: (i) conducting strategic analysis of terrorism-related issues to support policymaking and the development of counter-terrorism capabilities and (ii) providing strategic early warning of terrorism-related developments through the SEW programme.

The challenges faced during the early development of the SEW programme were similar to the cartographic challenge of identifying and charting unknown territories. Yeong added that several useful lessons could also be drawn from the analogy to mapmaking. For instance, cartographers usually start with the development of reference points and rely on tools such as the telescope and the com-

pass to aid them in translating concepts and understandings of a given terrain into actions. For the SEW programme, this involved developing threat reference points, tools selection and the understanding of issues that form the core of JCTC's work.

"Threat", in JCTC's perspective, can be viewed from three key levels: (i) the clear and immediate; (ii) strategic surprise; and (iii) "sensed" potential threat. Yeong explained that sensed potential threats refer to things or events that are potentially problematic but that the exact danger that they pose is still unknown. Thus, they require close monitoring. JCTC aims to bridge the effort of agencies that are scanning for threats far out in the time horizon and with those dealing with clear-and-present threats.

Yeong explained there are three components of JCTC's understanding of what constitute the "strategic" and the "early" of the SEW programme. The first element relates to the time that decision-makers and operational agencies have to respond to the threat identified. As the threats covered by the SEW programme are usually not imminent security concerns, decisions-makers and operational agencies have some lead-time to respond. For planning purposes, JCTC works on time frames ranging from three to five years. However, the amount of lead-time needed would still depend on how quickly events unfold within the security domain.

Yeong also spoke on JCTC's engagement with the RAHS project and its influence on the SEW programme. The three influences could be categorized broadly in terms of: (i) RAHS concepts and analytical tools; (ii) RAHS data retrieval and info-management tools; and (iii) the spirit of collaboration.

Yeong stressed that it was the spirit of collaboration that has had a lasting impact on the work of JCTC. This is especially so in terms of adopting a holistic approach to the solution of complex problems,

which also happens to be the guiding principle of the RAHS project. The SEW programme has also made similar and deliberate efforts to engage the various stakeholders, partners and agencies from both the public and private sectors to discuss security issues.

In conclusion, Yeong highlighted four lessons learnt from the SEW process: (i) the need to be clear about the issues to study; (ii) the need to understand both the strengths and limitations of conceptual tools; (iii) the importance of human analysis; and (iv) the importance of collaboration.

## THE UNITED KINGDOM'S CONCEPT OF NATIONAL RISK ASSESSMENT



**Michael Charlton-Weedy**, Chief Executive of the United Kingdom's Cabinet Office Emergency Planning College, spoke on the United Kingdom's concept of "National Risk Assessment". The events of 2000 and 2001—floods, strikes and pandemics—were, in contrast to the previous decade, seen as sharp shocks and a wake-up call to the U.K. The realization that the national government's awareness of risks, preparedness processes, structures and speed of response were deficient marked a watershed in the U.K.'s approach to civil protection, risk management and risk assessment.

The first of several National Risk Assessment measures was the replacement of the 1948 Civil Defence Act, which was geared around the Cold War, with the Civil Contingencies Act (CCA) of 2004. Charlton-Weedy noted that 2004 Act was significant in three key ways. Firstly, it mandated multi-agency joint risk assessments at the local level. Secondly, it provided a standardized risk model for universal use. Finally,

it provided the mandate for the annual publication and disclosure of the resultant local risk registers. Charlton-Weedy noted that there is an open accountability for this and that the first edition of the national risk register was published this year, shortly after the release of the national security strategy.

The National Risk Assessment, which in essence takes into account all risk, provides both strategic and coordination direction. That said, however, he also highlighted that processes to ensure balance and restraint in approaches also have to be in place to prevent people from chasing the latest fashionable risks.

There are two broad ways in which hazard impacts can be assessed against "likelihood". Firstly, there are areas that can be easily understood mathematically and chronologically (from historical experiences). This usually involves the relatively objective measures of such primary impacts as fatalities and casualties. The second way involves the subjective measures of secondary impacts like fear (psychological impacts) and outrage against perceived failures of government responsibilities. Charlton-Weedy opined that the entire process is not an exact science. He added that it becomes more inexact once the threat of terrorism is considered and integrated into the national risk assessment.

While there may be different ideas on how to have a framework for assessing risk, Charlton-Weedy stated that the approach or model used must be methodological and thorough. There are certain problems, however, that a deliberate risk assessment brings with it. Sociologically, one engenders a great belief in systems and processes. That itself may create the risk of being surprised.

In conclusion, Charlton-Weedy stated that in the U.K.'s case, the resultant horizon-scanning approach

taken is human-based, multi-disciplinary and multi-dimensional; the role of technology is peripheral. There is a serious risk in the overlaying of more technology on top of the by-products of technology.

Likewise, there is also a problem in having horizon-scanning teams lacking diversity or multi-disciplinarity in their personnel and methods used. Diversity is an asset to the business of risk assessment.

## FINLAND'S WHOLE-OF-SOCIETY APPROACH TO HORIZON SCANNING



**Sirkka Heinonen**, Professor of Futures Research, Finland Futures Research Centre, presented on Finland's whole-of-society approach to horizon scanning. The strong futures emphasis in Finland could be partly explained by its national will to survive and focus on persevering in the face of adversities, also known as "*sisu*" in Finnish. Moreover, it is a natural desire for humans, companies and nations to wish for continuity. Therefore, the will for survival forms the basis for both security thinking and futures thinking in Finland.

The four major emerging types of risk, Heinonen believed, are: (i) systematic financial collapse; (ii) food security; (iii) supply chain security; and (iv) energy security. These risks are global in nature, affecting all countries. However, it is not certain if different cultural approaches can contribute to a better understanding of these risks. As the "risk landscape" is more complex and challenging now, a robust and systematic foresight process must take into account citizens' view of the future. While risk

management has become a key element of strategy in both the private and public sectors, Heinonen stated that the question of risk ownership (e.g. who owns risks, whom perceives and foresees the risks) remain unanswered.

The Finnish government started to produce futures or foresight reports for submission to its parliament in the early 1990s. This is a formal process regulated by its constitution. The government's foresight reports serve two purposes: (i) to use these reports to outline objectives and to provide a framework for subsequent government-level decision-making; and (ii) to create avenues for new out-of-the-box thinking and public debates on long-term future developments.

At the beginning of the twenty-first century, there was a change from mere reporting to the engagement of citizens in dialogues over future concerns and issues. Foresight was also an integral aspect of major strategy and innovation processes. To further advance foresight development and engagement the Finnish Innovation Fund (SITRA), an independent public fund that falls under the supervision of the Finnish parliament, launched a national foresight network in 2006.

In view of the interconnectivity of external and local risks, Heinonen opined that the integration of foresight processes and strategic planning is crucial for countries to gain a competitive edge in the global market. She also added that in a systematic foresight process it is not only important to monitor foresight practitioners' views but also citizens' perspective of the future as well. For Finland, this "whole-of-society" approach serves as the basis for the maintenance of futures-centred dialogues amongst the authorities, academics, business enterprises, civic associations and the citizens. She emphasized that it may never be possible to create risk-free societies but a better understanding and interpretation of risks is key to opening up new opportunities and preparing for the future.

## FORWARD ENGAGEMENT, COMPLEXITY AND PUBLIC POLICY



**Leon Fuerth**, Research Professor of International Affairs, Elliott School of International Affairs, George Washington University, spoke on the need for the U.S. government to identify major and potential developments in the future and to assess policy responses early, what Fuerth has termed the practice of "Forward Engagement". In his opinion, it was more favourable to engage the future sooner rather than later. He opined that excessive focus on short-term development could slow down actions or responses to future events.

During his eight years in the Clinton administration, Fuerth thought the inter-agency system and how it connected to White House policymaking was good with the exception that it lacked the capacity to think in longer terms. Issues that had been perceived to be in the future were already begun to mature rapidly, confronting the administration as full-fledged policy issues.

Fuerth believed there was a need to truly integrate longer-range thinking about what could affect the U.S. national economy as a national security issue. Therefore, based on the Cold War concept of "Forward Deployment", where the military assets are deployed to points closer to a place of attack in advance, Fuerth developed the concept of "Forward Engagement". The concept of "Forward Engagement" aims to identify major potential developments originating further in the future than normally considered, and to assess policy responses early in the belief that it is more effective to engage the future sooner than later.

The configuration of problems that "Forward Engagement" aims to deal with can be best explained using the insights of the complexity theory. This emphasizes that events are discontinuous rather than linear, they take governments by surprise, and they are disproportional in the way that small changes can produce violent alterations of circumstances. Using the complexity theory, one can make a contrast between policies that can best deal with such situations and those that cannot.

Bureaucratic structure is also ill suited to deal with complexity. In the structured world of the government, knowledge leads to "vertical columns of authority" and such columns are reified by laws. The complexity theory teaches us that these columns are arbitrary and provide a barely adequate framework to deal with the complexities of change.

However, a major process is taking place in Washington where an ongoing project funded by Congress on National Security Reform is leading the effort to what may be the most major congressional reform in 25 years. He concluded by saying that in order to truly integrate the concept of "Forward Engagement" into the policy realm requires a re-thinking of the concept of national security within the context of a whole-of-society approach.

## KEYNOTE SPEAKER 1: NOVA SPIVACK

### TWINE.COM—COLLECTIVE INTELLIGENCE FOR HORIZON SCANNING



**Nova Spivack**, CEO & Founder, Radar Networks, explored the coming changes in the way data and social relationships on the web are organized via the semantic web and showed how one application of this—Twine—could be used for horizon-scanning purposes.

Whereas the social graph (or network), popularized in recent years by websites like Myspace or Facebook, connects people, the semantic graph “connects everything”. In a semantic graph, one can connect people to companies, documents to projects, events to places, and so on. Making such relationships explicit, searchable and useable will revolutionize the web, improving search, personalization and collaboration.

Spivack explored how the current make-up of the web is akin to a files server holding disparate documents, new approaches such as the semantic web will organize data on the web like a database, essentially “making the data smarter”, as opposed to making software smarter. In this way, one increases the granularity of information available on the web. Such an approach, Spivack believed, would have a profound effect on knowledge and information management.

Spivack then discussed five approaches to creating semantic networks: (i) tagging; (ii) statistics; (iii) linguistics; (iv) semantic web; and (v) artificial intelligence. Each method has pros and cons to its ease of use and applicability, and Spivack discussed a variety of companies that are using one of these approaches, or a combination therein, to semantic networks.

Concluding his keynote speech, Spivack highlighted the approach his company, Twine, is taking to semantics. Twine applies collective intelligence to help find, organize and distribute interesting content. Twine focuses on “interest networking”, which is a form of horizon scanning where the goal is to discover and track content about key interests in a collaboration. Horizon scanning in Twine is facilitated by the cooperation of artificial intelligence and collective intelligence. The users of Twine collectively scour the web to find the most valuable content about the various interests they have. All the capabilities of Twine are powered by the semantic web. Spivack also discussed how the underlying semantic platform and the semantic graph behind Spivack has only barely been exposed.

## PANEL TWO: HORIZON-SCANNING APPROACHES

### STRATEGY AND PLANNING FOR DEEPLY UNCERTAIN FUTURES: MAKING GOOD DECISIONS WHEN YOU LACK GOOD PREDICTIONS



**Steven Popper**, Senior Economist, RAND, and Co-Founder & COO, Evolving Logic, examined the problem of “deep uncertainty” and how our inability to characterize uncertainty leads to weak, poor or catastrophic decisions. However, by applying robust decision methods to strategy, policy and course-of-action analysis, the mitigation of some of the effects of this deep uncertainty is possible. In closing, Popper used the example of achieving global sustainability over the twenty-first century to highlight how such an approach may be used.

Popper discussed how any effort to apply “foresight” to strategic planning faces a number of challenges. These include our tendency to recapitulate conventional wisdom, the “tyranny of the present” and our illusion of control over the situation, defining the next steps—the “so what”—that comes out of many scenario exercises and, finally, the need for prediction to inform prescription.

Deep uncertainty gives rise to a multiplicity of possible answers to the question of “What lies beyond the horizon” and yet the ultimate question should not be “What will happen?” but “What should we do to best achieve our goals?” These questions of action and decision choices should direct horizon-scanning efforts, Popper believed, as they provide a focus on what we need to learn and provide a context for the assessment of findings.

Traditional analytic methods first characterize uncertainties and then assess alternative decisions, but future challenges confront decision-makers with deep uncertainty where they do not know, or key parties involved in the decision-making process do not agree on the proper probabilities, models and appropriate measures of outcomes. Decisions can go wrong if decision-makers assume that risks are well characterized when they are not, or if uncertainties are underestimated. Another issue that can arise due to deep uncertainty or disagreement amongst decision-makers includes competing analyses that lead to gridlock and brittle strategies. All of this may lead to a misplaced concreteness that can blind decision-makers to surprise and attempts to forecast the unpredictable.

To mitigate such issues, Popper suggested using robustness as a measure to characterize uncertainties based on vulnerabilities of strategies. The key question here is, “What change in assumptions would cause a shift from one strategic course to another?” Instead of a single forecast, one uses many scenarios to imagine the future, seeking robust strategies that do well across many scenarios assessed according to several values instead of trying to seek optimal strategies. Using data mining and computers as “prosthesis for the imagination” one can reduce uncertainties to easy-to-interpret “bad scenarios” where strategy performs poorly.

## STRATEGIC THINKING IN AN UNCERTAIN WORLD



**Irene Sanders**, Founder and Executive Director, Washington Centre for Complexity and Public Policy, discussed the power of visual thinking and how insights from complex adaptive systems (CAS) research may enhance strategic thinking and allow the development of greater insight about the present and foresight about the future. Defining complexity as a state arising “when an increasing number of variables begin interacting in interdependent and unpredictable ways, Sanders stated that, “to be an effective twenty-first-century leader, you must understand and develop the skills of complexity thinking” and surmised that complexity science provides a theory-driven framework for thinking about and responding to the future. Complex adaptive systems concepts lay the foundation for the appropriate selection and usage of tools. Sanders closed by presenting on one set of tools she has developed called FutureScape®.

Sanders defined complexity science as “a growing body of interdisciplinary knowledge and a new vocabulary about the structure, behaviour and dynamics of change in complex adaptive systems”. Complex adaptive systems are “open evolutionary systems ... continuously processing and incorporating new information” that must adapt to change. Sanders believed that complex adaptive systems are everywhere, from self-organizing patterns, shapes and structures to self-organizing beliefs, cultures and societies.

In order to properly deal with complex adaptive systems, Sanders noted that visual thinking is one tool that can help. Quoting an article by Jean-Francois Colonna, Sanders stated that visual thinking has many uses, including the synthesis, comparison and validation of data; detecting changes; comprehending abstract concepts; seeing inaccessible or invisible phenomena and relationships; improving communication; and aiding in the discovery of new insights. Sanders’ FutureScape® method is a visualization tool that aims to tap the collective intelligence of an organization or group, support non-linear thinking and help identify emerging conditions and opportunities.

Sanders closed by looking at seven keys to exploring the strategic landscape: (i) Look at whole systems, not just their parts; (ii) complex adaptive systems are self-organizing and pattern-forming; (iii) small changes can create big results; (iv) maps, models and visual images make it easier to see connections, relationships, patterns of interaction; (v) scanning across disciplines is the key to seeing subtle changes and emerging conditions; (vi) non-linear thinking is critical to recognizing clues about changes in the environment and; (vii) perspective on the issue is important.



## HOW OUR BRAINS USE THE PAST TO PREDICT THE FUTURE



**Andrew Parker**, Professor of Physiology, University of Oxford, shared insights from studies into neuroscience and behavioural analysis to attendees. Parker discussed how our present-day activities must be overlaid on a biological heritage. This heritage forms the basis for human success and endeavour but may also lead people into actions that are sometimes counter-intuitive and apparently

irrational. Brains allow us to avoid repeating past mistakes and plan future actions and store information about rewards and penalties.

The major biological advantage of possessing a large brain is the capacity to free us from the immediacy of the present. Compared with animals, humans can remember a greater number of things in more complex ways. In itself, this is a huge advantage. However, human consciousness also allows us to rehearse future scenarios based on this stored information. With this capacity, we can benefit from the past by exploring possible futures.

Parker explored what strategies we could use to play to the strengths and minimize the weaknesses of the brain. These include making snap decisions, exploiting the "wisdom of the crowds" and training people in cognitive skills. Humans make use of conscious reasoning to evaluate scenarios in many contexts but any particular decision that they take is often influenced by other assumptions and values, which often arise from outside the immediate context. This tendency is, on different occasions, a strength and a weakness. Parker, therefore, suggested that collective decision-making might be most successful if it takes into account this tendency of individual participants.

## CONSEQUENCE APPRECIATIVE CHOICE: A FRAMEWORK FOR ASSESSING THE PROPAGATION OF "EFFECTS" ON HUMAN COMPLEX SYSTEMS



**Desmond Saunders-Newton**, Adjunct Associate Professor, University of Southern California, and Director of Social Computation and Complexity, BAE Systems AIT, posited a framework in his presentation for assessing the consequences that arise from intentional changes within or upon human complex systems in order to better assess, understand and anticipate "effects" as they relate to highly complex systems that explicitly account for the role of humans and their artefacts.

One of the problems, Saunders-Newton discussed, is that our ability to put into action well-crafted policies or strategies is that our understanding of the nature of consequence may be constrained due to the methods used. We often use social science theory to help explore or understand our choices and consequence outcomes, yet even with prolific data they may not be "fully" visible or ably exploited by the strategic analyst. This lack of exploitation is partially driven by analytic training or focus; though tools also are a limiting factor. However, Saunders-Newton argued, computational methods make social science data visible and exploitable. Advanced computational methods allow for: (i) the unravelling of the full complexity of social science data that are inherent in complex societies; (ii) the exploring "plausible-possible" social trajectories leading to future worlds; (iii) the better consideration of the impact of various mitigation strategies on "future" worlds; and (iv) the establishment of a corporate memory and an ability to assess multiple perspectives (theories) of society and culture.

However, Saunders-Newton also stated that "technology is not enough". It is only a small part of the picture. Indeed, it is the expertise and demographics of the "analytic corps" that also matter.

## PANEL THREE: HORIZON SCANNING APPLIED

### GATHERING OPEN-SOURCE INFORMATION AND TURNING IT INTO INTELLIGENCE



**Adrian Taylor**, Director, Policy and Strategy Advice, European School of Governance, discussed in his presentation the practicality of transforming open-source information into intelligence in a contemporary society. He argued that by doing so, the intelligence cycle can be improved.

Taylor began his speech by suggesting the need for a paradigm shift with regards to views on open-source information. In a world that is surrounded by vast amounts of information, the adage of "information is power" no longer holds true. He argued that the ability to handle information and turn it into material for useful decision-making is the key.

Open-source intelligence involves collecting information from open sources and analysing it to produce recommendations for actions. Taylor highlighted that open sources are not only confined to information found on the Internet but also that found in the media, official data, professional and academic papers.

Similarities and differences between classified information and open-source information were then discussed. There is a wide variety of both types of information. For both, their accuracy is not guaranteed as well. However, accuracy is essential for classified information while for the case of open-source information, the impact and speed of obtaining the information is the important factor. Open-source information also has many collectors and viewers while the audience for classified information is limited. Furthermore, classified information is limited in quantity, in contrast to the vast volume of open-source information.

Given the vast nature of open-source information, challenges in the form of complexity of deciphering the information overload must be tackled. Taylor pointed out that most governments concentrate more effort on the collection aspect of the intelligence cycle and neglect the direction, dissemination and analysis of the information obtained. He suggested that more attention is needed in these areas.

The interpretation of information demanded the implementation of scenario-planning exercises. Taylor argued that fluid scenarios were necessary to explore the context. The introduction of non-experts to obtain diversity in views and interpretation will push the limits of the scenarios involved.

Taylor also talked about the importance of performing horizon scanning in order to understand future possibilities so as to make the best decision to anticipate it in the current time. However, for most time, the process is hindered by the presence of politics.

In conclusion, Taylor advocated keeping the process of intelligence gathering public and tapping into the collective unconscious.

## ENDOGENOUS VERSUS EXOGENOUS ORIGINS OF CRISES



**Didier Sornette**, Chair of Entrepreneurial Risks, ETH Zurich, presented a general theory that combines the synthesis of the endogenous and exogenous origins of crises and extreme events. He defined crisis as a dramatic and rapid change in the system. Crises often come about not as surprises, but as culminations of complex, preparatory stages. The endogenous way of looking at crises suggests that they are simply part of the manner in which organizations behave or can be termed "self-organized" criticality. The exogenous view, or catastrophism, sees extreme events as caused by shocks outside of the system.

However, Sornette proposed that there is no meaningful difference between endogeneity and exogeneity and suggested that there is a very deep relationship between the two in explaining catastrophic events. Deriving his views from the principles of physics, Sornette stated that the fluctuation disability theorem links endogenous to exogenous. Sornette also stated that it is possible to derive this conclusion by shocking the system studied and then measuring the response and function, or examining the endogenous fluctuation to shocks and measuring the relationship between the two.

Sornette continued by highlighting case studies from the September 11 attacks and reaction to the destruction of the Ayodhya Mosque in India in 1992. He also applied his theory to instances such as epileptic seizures and the financial crisis. The timing between a particular event and the response time of people reacting to the event is measured over a long period. This is due to the fact that universal time-memory appears to be hard-wired into the minds of people. People do not react to events immediately; there is a wide variety of time scales.

The above led Sornette to the conclusion that the underlying cause of catastrophic events such as the stock-market crash can be traced months or even years before the actual event. This happens through the build-up of cooperative speculation and leads to the accelerating rise of the market price, known as "bubble". According to Sornette, the possibility of predicting extreme events is thus proven through his research.

## DEFINING DYNAMIC POLITICAL AND FOREIGN POLICY CONSTRAINTS



In his presentation, **Erik Peterson**, Senior Vice President, Centre of Strategic and International Studies (CSIS), and Director, Global Strategy Institute, proposed the necessity of identifying the broader constraints within which political and foreign policy changes occur. According to him, the world is in the midst of a unique historical juncture whereby shifts in policies need to be decided upon. Events such as the recent financial crisis reveal profound fissures in international systems.

Increasingly, the most onerous of the constraints are global in nature, posing the issue of looming uncertainties for the future. One of the issues faced is that of shifts in demographic trends. Peterson observed that the world is facing unprecedented population growth and yet is plagued with issues such as economic growth disparity. There is increasing mobility but the integration of migrants into their adopted nation still demands close attention due to its security implications. An aging world population, combined with falling birth rates in some countries, also demands solutions in the area of public expenditures from policymakers. Humanity was also stated by Peterson to be hyper-urbanized, thereby creating the potential for instability. Resource pressure is the inevitable result of these existing demographic patterns. The current consumption pattern is unsustainable and requires

serious public-policy attention. Health care and consumption pattern also need to change.

Peterson posed the question of sustaining the current world resource consumption into the future, stating that it is a difficult question to answer. Currently 44 million people around the world suffer from malnutrition and 28 countries face significant financial turmoil. About 880 million people also face obstacles to clean water and 2.5 billion are without sanitation. It is also estimated that 2.9 billion of the global population will live in water-stressed countries by 2025. Environmental degradation in the form of global warming challenges sustainability, stability and governance and needs to be considered in political and foreign policies.

The economic balance of power has also shifted, noted Peterson. Data from the International Monetary Fund (IMF) show astounding growth of Gross Domestic Product (GDP) and Purchasing Power Parity (PPP) of countries such as China, India, Brazil and Russia compared to the U.S. According to the IMF, the four great economies are responsible for one-third of the world's growth last year, about one-half of the global economic growth. Peterson pointed out the need to examine if the transition from traditional areas of economic dynamism to new ones would be smooth. The Bretton-Woods generation has left two legacies: institutions and regimes in various levels of disrepair.

The fourth area of issues that policymakers need to examine, according to Peterson, is the possibility of super-violence. The 9/11 attacks on the World Trade Center has become the new yardstick for terrorist groups planning their terrorist activities. The threat calculus has shifted and Peterson believed that decision-makers needed to take into account not only the immediate consequence management but also to preposition resilience in organizations across the board.

The question of whether the existing governance system is adequate in facing challenges of the new era was thus posed by Peterson. Sovereign prerogatives must thus be redefined and more consideration must be taken of the issues voiced by companies and NGOs.

## STRATEGIC FORESIGHT AT DEUTSCHE TELEKOM AG



**Rene Rohrbeck**, Senior Researcher, Deutsche Telekom Laboratories, explained the Strategic Foresight or horizon-scanning system of the Deutsche Telekom Company, a multinational company employing 250,000 people. Deutsche Telekom's foresight system performs scanning and issue-driven foresight activities. Continuous scanning activities are directed at identifying and anticipating both opportunities and threats. Issue-driven activities are directed at exploring new business fields. Rohrbeck's talk highlighted the way Deutsche Telekom has built a network of experts to carry out global-scanning activities. He also spoke about the way the company visualizes foresight and insight in order to allow top management to track multiple issues.

Weak signals allow researchers and decision-makers to perceive discontinuities early. Rohrbeck, however,

observed weak signals to be "fuzzy" and unstructured. As weak-signal detection is essentially about looking for the unknown, experts in the area being researched are needed.

In addition, Rohrbeck observed that, in the policy-making context, foresight needs to be confined to those with an understanding for the overall context to judge the value of the information; this is usually senior management. In corporations, there is a need to build foresight activities that are people-centric. Many of the foresight activities remain highly sophisticated, difficult to understand and not transparent.

Rohrbeck then highlighted some methods for performing foresight in the areas of technology, the political landscape and consumer foresight. Continuous scanning thus detects threats and opportunities, identifying the most promising opportunities to be explored, assessed and planned for implementation. Rohrbeck also proposed the use of road mapping coupled with scenario analysis, calling it a very effective tool for aiding decision making for the future.

In conclusion, Rohrbeck shared some lessons from the Deutsche Telekom laboratory about successful strategic foresight activity. Firstly, foresight activity needs to be designed so as to be useful for the decision-maker. It should also be made transparent to earn the trust of those involved and affected by its implementation. There is also the need to engage internal and external partners in order to maximize expertise sharing. Effective collaborations should also be conducted on regular basis. Lastly, both qualitative and quantitative methods need to be used in the activity.

## KEYNOTE PRESENTATION TWO: DAVID SIFRY

### TECHNORATI: A NEW HORIZON-SCANNING EXPERIENCE



**David Sifry**, Founder, Technorati.com, and Founder & CEO, Offbeat Guides, sought to illustrate the power and transformative effects of the blogosphere. Combining an updated set of quantitative data taken from Technorati's crawl of the blogosphere with qualitative survey data from thousands of active bloggers, he provided a detailed profile breakdown of bloggers. He also suggested the potential implications the blogosphere would have on horizon planning and proposed several practical actions that could be taken to harness the ability of the blogosphere.

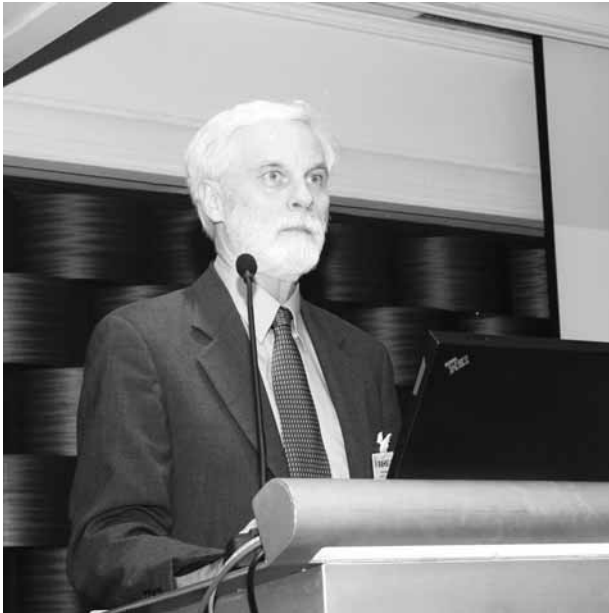
On the state of the blogosphere today, Mr. Sifry provided a concise summary of how blogging has transformed the role of Internet users today. Instead of being mere consumers of information and media content, the majority of Internet users are active participants as well as producers of content.

Following, he then elaborated on the ubiquitous nature of blogging and described the blogosphere as an ecosystem of interconnected communities consisting of bloggers and readers. Proceeding to present the survey findings of Technorati, which has a 133-million blog record index, he provided detailed facts and figures on the profiles of bloggers according to gender, age and location. He noted that a large majority of bloggers blog for personal reasons and more than 75 per cent indicate personal satisfaction as the dominant motivation and reason for success. This success includes significant revenue from advertisements on their blogs or becoming brand advocates for private enterprises and their products. This has given rise to a new category of professional bloggers who are able to commit to blogging full-time due to the increasingly lucrative business relationship between blogging, marketing and advertising.

More importantly, Mr. Sifry commented on the increasing credibility of blogs and their implications for horizon planners. He was of the opinion that blogging would soon be a credible source of information as 37 per cent of bloggers within the Technorati index have been quoted by newspapers. Hence, he believed that the ability to use the blogosphere as a useful horizon-scanning tool should not be discounted. For example, bloggers can act as credible early-warning systems to horizon planners. A critical analysis of Technorati survey results demonstrates that these bloggers are educated, largely affluent individuals who spend a large portion of their time online sharing their expertise, experience or providing frank up-to-date opinions on topics of concern to the general public. They are thus useful for tracking specialized topics and are often as good as, or even better than, other sources of media information.

## PANEL FOUR: CHALLENGES TO HORIZON SCANNING

### MINIMIZING COGNITIVE BIAS IN HORIZON SCANNING



**Peter Bishop**, Associate Professor, Futures Studies, University of Houston, argued that the real purpose of scanning the horizon is not about eliminating the element of surprise altogether. Instead, it is about “being surprised in small ways over a long time rather than in a big way all at once”. He outlined the following criteria for a good scanning hit: the credibility of the source, its novelty, its likelihood of materializing, its potential impact, the relevance of its impact to its target audience, the mode and duration within which information relating to the incident is disseminated, and the time taken for the impending change to take effect.

Nevertheless, effective scanning for weak signals against a cacophonous background is difficult for three reasons. The first was attributed to the role of the human neural system in processing visual stimulus. The objective interpretation of any new information is likely to be framed, and thus mitigated, by our existing repository of knowledge.

Secondly, the human cognitive process predisposes us to pattern recognition such that trends may be detected even when none exists. Moreover, once a pattern has been established, it is likely to remain stable, possibly even when disconfirming information is presented. As some people are inclined to detecting broad patterns while others focus on small details, Bishop advocated a mixed group of both personality types for an ideal scanning team.

The third obstacle is the organizational process. Bishop noted that the propensity for order in organizations tends to reward system maintenance and marginalize challenges to the status quo. He suggested that horizon scanners should be given a quota of weak signals to overcome this institutional problem.

Bishop concluded that the goal of reducing the element of surprise could be mitigated by having in place a systematic programme staffed by the right individuals to achieve the right balance of quantity and novelty.



## OBSTACLES TO EFFECTIVE HORIZON SCANNING



While acknowledging the pragmatic utility of risk assessment and horizon-scanning tools for policy-making, **Timothy Mack**, President, World Future Society, opined that its expansion into the economic and social domains has brought with it new challenges. Three points of concern were highlighted: the quality of data feeding into the horizon-scanning process, the analysis of the data and potential methodological problems with some approaches.

On data reliability, Mack outlined some of the limitations of qualitative and quantitative data. This included the short shelf life of snapshots and the distortion of data interpretation by the media.

Regarding data analysis, limitations include the challenge of objectivity, the tendency to interpret correlation for causation and the proclivity towards mistaking desired analysis for reality. The importance of determining how far ahead to scan and the level of detail based on various contexts were also discussed.

On methodology, Mack pointed out that each scanning tool is constrained by its own set of innate biases, for instance, in terms of assumptions that form the basis of the tool. Hence it is important to be aware of not just the strengths but the limitations of the different tools so as to maximize their potential and avoid flawed analyses.

Mack also stressed that the goal of horizon scanning should not be narrowly focused on achieving accuracy. Rather, it should also be about developing a working mindset for change. This requires an organizational culture of challenging present assumptions, an iterative process of feeding new information into decision-making processes and flexible analysis.

Mack summed up by highlighting the following take-aways. Firstly, he cautioned that analytical bias could arise not only from cultural and psychological causes, but also from data skews and design flaws. Secondly, the critical value of transparency of design and operation should not be underestimated. Thirdly, horizon scanning must balance systematized analysis with unexpected evolution and growth. Lastly, he suggested that the utility of scanning systems should be measured by its assistance in policy decision-making, of which an understanding of the causes of change is critical.

## THE MILLENNIUM PROJECT AS A HORIZON-SCANNING SYSTEM



**Jerome C. Glenn**, Director, The Millennium Project, reflected on some lessons for horizon scanning from

the Millennium Project, a trans-national think tank bringing together government agencies, UN organizations, NGOs, universities and corporations. An objective of the project was to connect local and global views on 15 global challenges that include security, energy, organized crime and sustainable development.

To capture a range of opinions and views, members of the project solicited a range of experts for their views on specific issues within their cultural context. Scenarios were built based on input from Delphi questionnaires, interviews and text reviews. This “collective intelligence” about the global future was in turn used to update the 15 global challenges identified by the project.

Glenn highlighted that a critical component of this process is its feedback mechanism. This enhances not just the learning process of members but also the quality of the analyses fed into the system for better “just-in-time knowledge” that can contribute meaningfully to policy decisions.

## ANCHORING FORESIGHT IN GOVERNMENT STRATEGIC SECURITY PLANNING: THE DUTCH EXPERIENCE



**Stephen De Spiegeleire**, Director, Defence Transformation, The Hague Centre for Strategic Studies, Netherlands, presented on the Dutch government’s experience in anchoring foresight in its

strategic security planning process. Citing challenges to securing the nation, such as stove piping, the expansion of the role of government and the lack of a systematic methodology of allocating scarce resources, he pointed out that governments have lost the “big picture”. Although foresight should be anchored into strategic planning in order to address the current security challenges, there is no real constituency for forward planning as there is little incentive for governments, media and the general public to embrace it.

De Spiegeleire outlined three main activities of the Dutch National Security Project. The first is a bottom-up self-assessment in which all government departments dealing with security critically reflect on both their own department and other departments’ capacity in this area in order for blind spots to be identified and action to be taken. Secondly, a cross-national study of strategic planning in various countries was done. Some of the challenges identified include the lack of a structural framework for prioritizing issues in national security, the lack of risk awareness in many government departments and

the dearth of proactive policy development as a result of stove piping in national security issues. Following from this, the third step is the development of a top-down strategy led by the Directorate General for Security of the Ministry of Interior.

The notion of strategic foresight was anchored into the Dutch system by feeding it into the new national risk assessment (NRA) based on the British model. The NRA provides policymakers with a systematic comparison of various risks that a

country confronts by locating threats on a matrix of likelihood of occurrence and its impact, which facilitates capabilities-based planning. It was in turn "anchored" into the normal budgetary and policy-making process.

However, some key remaining weaknesses highlighted were the differential success in key components, limited buy-in from some departments, the inherent difficulty in charting "unknown unknowns" and the evaluation of its success.

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*Rapporteurs:*  
*Centre of Excellence for National Security*

*Edited by:*  
*Centre of Excellence for National Security*

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## ABOUT NSCS

**The National Security Coordination Secretariat (NSCS)** was set up in the Prime Minister's Office in Jul 2004 to facilitate national security policy coordination from a Whole-Of-Government perspective. NSCS reports to the Prime Minister through the Coordinating Minister for National Security (CMNS). The current CMNS is the Deputy Prime Minister Professor S. Jayakumar.

NSCS is headed by Permanent Secretary (National Security and Intelligence Coordination). The current PS(NSIC) is Mr Peter Ho, who is concurrently Head of Civil Service and Permanent Secretary for Foreign Affairs.

NSCS provides support to the ministerial-level Security Policy Review Committee (SPRC) and Senior official-level National Security Coordination Committee (NSCCom) and Intelligence Coordinating Committee (ICC). It organises and manages national security programmes, one example being the Asia-Pacific Programme for National Security Officers. NSCS also funds experimental, research or start-up projects that contribute to our national security.

NSCS is made up of two components: the National Security Coordination Centre (NSCC) and the Joint Counter-Terrorism Centre (JCTC). Each centre is headed by a director.

NSCC performs three vital roles in Singapore's national security: national security planning, policy coordination, and anticipating strategic threats. As a coordinating body, NSCC ensures that government agencies complement each other, and do not duplicate or perform competing tasks.

NSCC also provides overall coordination and management of the Risk Assessment and Horizon Scanning (RAHS) programme, which has been identified as a key capability for Singapore. RAHS seeks to enable Government agencies to detect and anticipate emerging trends, thus helping to avoid strategic surprise. It also facilitates inter-agency collaboration in an online interactive environment, thereby encouraging a Whole of Government approach to dealing with issues.

JCTC is a strategic analysis unit that compiles a holistic picture of terrorist threat. It studies the levels of preparedness in areas such as maritime terrorism and chemical, biological and radiological terrorist threats. It also maps out the consequences should an attack in that domain take place.

More information on NSCS can be found at [www.nscs.gov.sg](http://www.nscs.gov.sg)

## ABOUT CENS

**The Centre of Excellence for National Security (CENS)** is a research unit of the S. Rajaratnam School of International Studies (RSIS) at Nanyang Technological University, Singapore. Established on 1 April 2006, CENS is devoted to rigorous policy-relevant analysis of a range of national security issues. The CENS team is multinational in composition, comprising both Singaporean and foreign analysts who are specialists in various aspects of national and homeland security affairs.

CENS currently conducts research in three key areas of national security:

- Risk Assessment / Horizon Scanning

The art and science of detecting “weak signals” emanating from the total security environment so as to forewarn policymakers, the private sector and the public about approaching “shocks” such as terrorism, pandemics, energy crises and other easy-to-miss trends and ostensibly distant events.

- Social Resilience

The capacity of globalised, multicultural societies to hold together in the face of systemic shocks such as diseases and terrorist strikes.

- Homeland Defense

The security of land-based, aviation and maritime transport networks and increasingly, the total supply chain vital to Singapore’s economic vitality.

For more information, please visit [www.rsis.edu.sg/cens/](http://www.rsis.edu.sg/cens/)

## ABOUT RSIS

**The S. Rajaratnam School of International Studies (RSIS)** was established in January 2007 as an autonomous School within the Nanyang Technological University. RSIS's mission is to be a leading research and graduate teaching institution in strategic and international affairs in the Asia Pacific. To accomplish this mission, it will:

- Provide a rigorous professional graduate education in international affairs with a strong practical and area emphasis;
- Conduct policy-relevant research in national security, defence and strategic studies, diplomacy and international relations;
- Collaborate with like-minded schools of international affairs to form a global network of excellence.

### **Graduate Training in International Affairs**

RSIS offers an exacting graduate education in international affairs, taught by an international faculty of leading thinkers and practitioners. The Master of Science (MSc) degree programmes in Strategic Studies, International Relations, and International Political Economy are distinguished by their focus on the Asia Pacific, the professional practice of international affairs, and the cultivation of academic depth.

### **Research**

RSIS research is conducted by five constituent Institutes and Centres: the Institute of Defence and Strategic Studies (IDSS, founded 1996), the International Centre for Political Violence and Terrorism Research (ICPVTR, 2002), the Centre of Excellence for National Security (CENS, 2006), the Centre for the Advanced Study of Regionalism and Multilateralism (CASRM, 2007); and the Consortium of Non-Traditional Security Studies in ASIA (NTS-Asia, 2007). The focus of research is on issues relating to the security and stability of the Asia-Pacific region and their implications for Singapore and other countries in the region.

### **International Collaboration**

Collaboration with other professional Schools of international affairs to form a global network of excellence is a RSIS priority. RSIS will initiate links with other like-minded schools so as to enrich its research and teaching activities as well as adopt the best practices of successful schools.

For more information, please visit <http://www.rsis.edu.sg>

## ABOUT REC

Funded by National Security Coordination Centre and managed by Defence Science & Technology Agency, **the RAHS Experimentation Centre (REC)** is commissioned to develop and explore novel concepts and technologies that can enhance the capabilities of the RAHS system. REC provides a unique platform for case studies, experimentation and collaboration with local and overseas government agencies, academic institutions and private industries. In addition, the centre aims to be a vibrant nurturing ground for RAHS experts and practitioners to translate concepts and technologies into reality.

More information on REC can be found at <http://rahs.org.sg>

## ABOUT DSTA

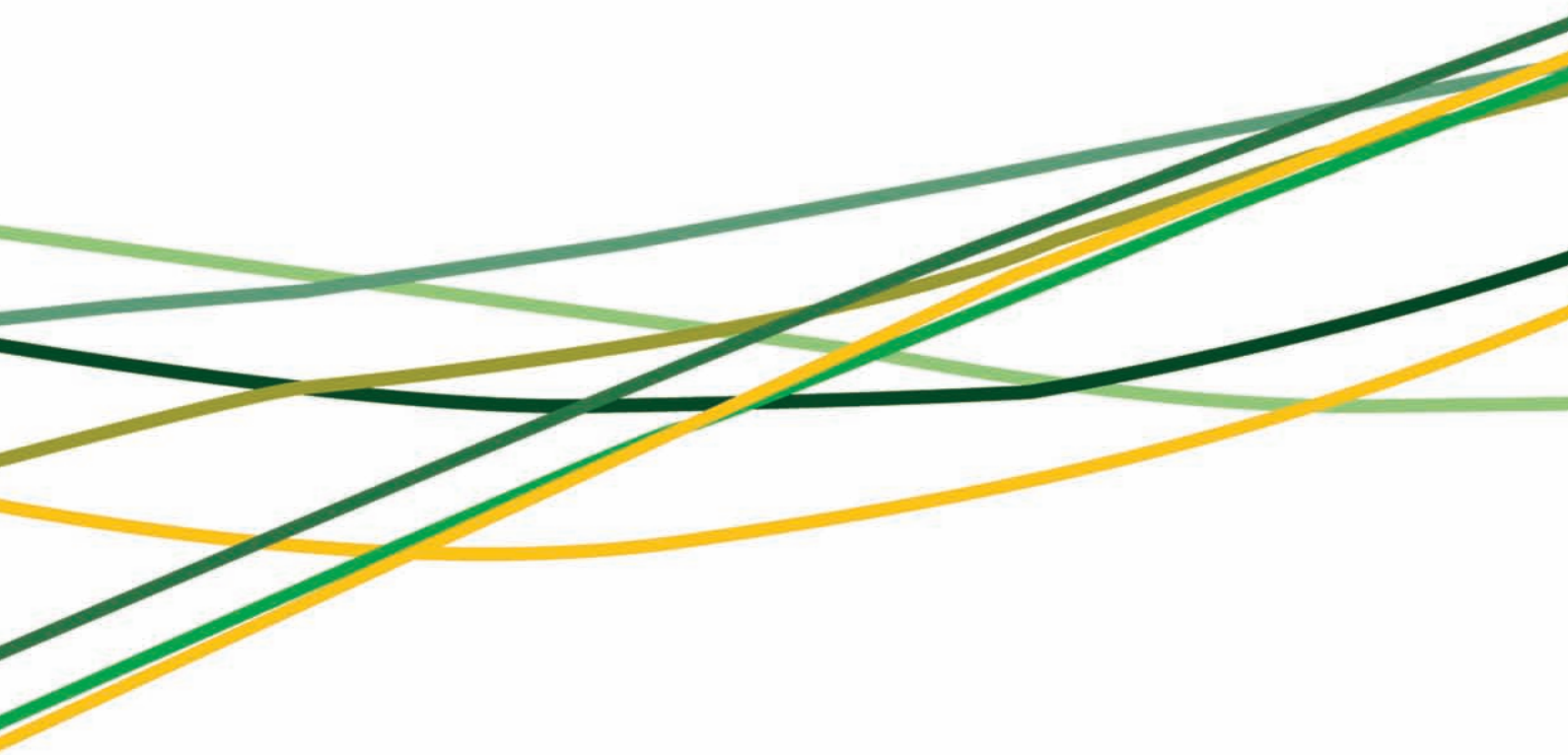
**The Defence Science and Technology Agency (DSTA)** is the first statutory board to be set up under the Ministry of Defence (MINDEF). It is responsible for implementing defence technology plans, managing defence research and development, acquiring defence material and developing defence infrastructure for MINDEF.

DSTA aims to provide leading-edge technological solutions to the Singapore Armed Forces (SAF) so that it continues to be a formidable fighting force for the defence and security of Singapore. To do so, DSTA will tap the best technologies—military and commercial—and foster an environment of creativity and innovation for defence applications. In addition, DSTA will help build up a strong community of scientists and engineers from the universities, research institutes, government and industry to service the defence needs of the nation.

As the executive agent of MINDEF, DSTA's roles and functions are to:

- Acquire weapon systems for the SAF;
- Advise MINDEF on all defence science and technology matters;
- Manage defence research and development;
- Develop military infrastructure;
- Provide engineering and related services in defence areas; and
- Promote and facilitate the development of defence science and technology in Singapore.

More information on DSTA can be found at <http://www.dsta.gov.sg>



**National Security Coordination Secretariat**

5 Maxwell Road #15-00 Tower Block MND Complex Singapore 069110