INTRODUCTION

Two simultaneous, major developments are shaping the future of the Asia-Pacific region. The first is the increasing contribution of countries in the region to the next generation of global technoscientific discoveries and innovation environments. The second is the presence of a growing array of comprehensive security[1] challenges in such issues as water, energy, health and the ubiquity of the internet. Integrating science and technology (S&T) as a core component of national security policy has produced significant benefits for the peoples of the region. But what generates greater regional and national strategic concern is when the S&T-security nexus creates opportunities for misunderstanding. These opportunities assume two forms, rooted in distinct theoretical traditions. First, the possibility for conflict exists where, as proponents of Realism argue, S&T is viewed as a by-product of intense interstate competition for power and influence.[2] The pursuit of Asia's rising giants, India and China, for global S&T and innovation leadership alongside the U.S. will animate international cooperation, competition and conflict that will have a direct bearing on interstate dynamics and the future world order. An examination of the S&T-security linkage provides a better understanding of the parameters, conditions and forms of state-to-state competition and conflict within the context of the Asia-Pacific region.

In contrast to the Realist thinking, the second cause for concern is premised precisely on the erosion of sovereignty: the study of the S&T-security linkage presents a challenge of global governance that entertains the possibility of non-state entities such as private companies, civil society organizations and individuals as additional, if not competing, sources of legitimacy and authority.[3] An analysis of the linkage within this frame will shed light on the paradigm of a reconstituted world order of the future. In this frame, S&T and security as policy subjects share distinct qualities that expose the limitations of state-centric approaches to resolve global challenges and threats. Both generate impacts, associated risks and uncertainties that are borderless, have subsets of policy communities that are specialized and fragmented, and have an increasingly network character in terms of their politicization that demonstrate the need for global governance. In this context, an analysis of the S&T-security relationship achieves two objectives: first, it provides a setting for understanding new approaches to address borderless issues; and second, it leads to the exploration of creative responses to the challenges posed by the intersection of S&T and security issues.

This volume comes out of a workshop held in October 2010. A majority of the contributions were written after the event, reflecting the authors' commitment to document in greater detail the analysis and insights derived from the actual deliberations. The logic of the workshop design flowed from the theoretical considerations discussed above, but the discourse and presentations attended more to the practical issues and challenges of operationalizing the S&T-security interface and did not dwell on the conceptual ramifications of the linkage. Hence, the identification and analysis of the possible S&T areas where insecurities, challenges, opportunities and conflict can proliferate in the Asia-Pacific region in the next 20 years is the centerpiece of the contributions in this volume.

The selection of information technology, biotechnology, energy and the environment as the focus of the workshop illustrate the explanatory power and challenges of both the global governance approach and Realist thinking. They provide the empirical settings for understanding different frameworks to address borderless issues but also illuminate the role of the state and the importance of sovereignty in shaping national S&T trajectories and security strategies in the Asia-Pacific. The region has over half of the world's growing population, is home to the world's rising giants, India and China, and is a major site for the world's increasing security challenges, including energy scarcity and climate change. It would have its fair share of the attendant impacts derived from a worldwide global pandemics should this occur, as well as from the ramifications of the cyberrevolution.

The workshop participants' selection of cybersecurity, energy demand and resources, and water issues as the top three S&T-related phenomena that will have the most significant regional security implications in the next two decades bears out key features of the region's future strategic environment: the presence of an existential cluster of challenges strongly favoring international and collective solutions, the likelihood of needs-driven disruptive innovations and the increasing strategic importance of non-military threat structures. On a broader level, the imperative for a transdisciplinary, transinstitutional and transnational dialogue was made evident in the course of the workshop discussions and presentations. The differentiation of knowledge, institutional/professional experiences and nationality among the participants paved the way for the development of multiple options and considerations critical to understanding the relationship of technoscientific developments and security.

The 20 contributors to this publication come from different countries in the Asia-Pacific region (Australia, Canada, China, India, Russia, South Korea and the U.S.). They are scholars from different disciplines, scientists, policymakers, government officials and security practitioners operating at the interface of S&T and security. Together, they offer a comprehensive overview of the issues and challenges that animate the S&T-security nexus – a valuable contribution to ongoing discussions in the fields of security and strategic studies, international relations, and science and technology studies.

The remainder of this publication is divided into seven sections. A summary of Arun Majumdar's opening keynote speech precedes the first two sections composed of six papers that provide analysis of key features of the security and S&T landscapes of the Asia-Pacific region. The 12 contributors in the next four sections present an overview of trends and challenges in the four S&T areas that were the main focus of the panel presentations. Siegfried Hecker's closing keynote address concludes this section. The final portion provides a summary of the workshop discussions.

In his keynote address, Arun Majumdar discusses the likely sources of the most serious global challenges in the next 40 years. The linkages among these issues provide tremendous opportunities for institutionalizing cooperation and collaboration across countries. Section One provides an overview of some of the dominant security features of the Asia-Pacific region. Ralph Cossa

examines the role of growing numbers of multilateral organizations in the region, exploring both the extent of their effectiveness and their ability to evolve in light of the accelerating complexity marked by a rising China and the U.S. current "re-balancing" towards the Pacific. Mohan Malik argues that technopolitics will shape regional dynamics. The geo-strategic actions of the U.S. and Asia's rising behemoths, China and India, coupled with an array of serious security challenges such as energy and the environment, will underpin techno-competition. Kerry Nankivell's paper posits that the maritime domain and modern sea power will be crucial determinants in the geo-political shape of Asia and the world in the future. East Asia's rise is best understood as a shift in sea power, and she utilizes a maritime frame to examine the ascendance of China as a regional power.

Section Two presents an overview of the critical issues defining the S&T landscape of the Asia-Pacific region. My own contribution examines approaches to the growing concern over resource scarcity and their linkage with the technoscientific discourse in Asia. Scott Hauger provides an overview of the state of climate change and environmental security in the region and examines the challenges and opportunities for collaboration between the S&T and security sectors in Asia. William Wieninger presents a survey of themes attendant to the nuclear issue in the region.

In Section Three, the contributors for the workshop's information technology panel focus on the themes that underpin the increasing strategic relevance of cyberspace and the imperative for borderless cooperation. Richard Schaeffer, Jr. argues that the high level of complexity of the cyberworld also translates into growing and equally complex risks. Robert Childs calls for urgent and strengthened regional collaboration in cybersecurity. Igor Kotenko provides a broad survey of the current and future state of information and communication technologies (ICT) as well as the current and emerging security issues related to ICT.

The security ramifications of biotechnology serve as the focus of the contributors for Section Four. The paper of Lynn Jelinski outlines a trajectory of biotechnology development in the next 20 years. Ashley Dombkowski's brief provides a description and analysis of current developments in biotechnology and the role of the private sector. Cong Cao uses a national perspective to analyze biotechnology development in China.

The theme for Section Five is energy. The authors address the challenges and responses to energy insecurity. Lydia Powell embeds her analysis of India's energy challenges in a comprehensive security setting, identifying linkages between national energy demand and supply, population growth, poverty, the role of women and alternative sources of energy. Kim In-ho looks into South Korea's direct linkage between national security and its defense R&D agenda. Elizabeth Cantwell frames her presentation of understanding the issues and potential security impacts of emerging energy S&T by examining the current global energy resource systems.

Section Six covers the environment. The papers in this section examine two big themes – climate change and the environment-security nexus. Benjamin Santer offers his perspective on recent developments in the field of detection and attribution (D&A) research. David Brunckhorst's paper addresses human-environmental, non-traditional security issues, paying particular attention

to disaster situations and their ramifications for traditional security institutions. Sumeet Saksena looks into the environmental risk transition in Southeast Asia and the role of peri-urbanization in health security. In his closing keynote address, Siegfried Hecker shares his experiences and perspectives on reducing global nuclear risks as well as on the role of science diplomacy in mitigating the risks of nuclear weapons and the spread of weapon-usable nuclear material.

Finally, Section Seven provides a summary of the workshop discussions. The two areas of focus include: first, an assessment of the current environment of the S&T-security nexus; second, the development of the selection criteria for identifying – from the four areas of cybersecurity, biotechnology, energy, and the environment – the top three S&T initiatives or phenomena of most concern to the Asia-Pacific region in the next 20 years; and third a summary of the impact, challenges, opportunities for collaboration and policy implications of these three S&T initiatives. The concluding session, led by William Perry, focuses on the broad considerations for formulating responses to manage the S&T-security interface in the future.

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Notes

1. The understanding of "comprehensive security" is strongly linked to the reality of an increasingly interdependent world that necessitates cooperation across national borders. Per Barry Buzan: "Security is taken to be about the pursuit of freedom from threat and the ability of states and societies to maintain their independent identity and their functional integrity against forces of change, which they see as hostile. The bottom line of security is survival but it also reasonably includes a substantial range of concerns about the conditions of existence." Barry Buzan, "New patterns of global security in the twenty-first century," *International Affairs* 67, No. 3 (Royal Institute of International Affairs, July 1991): 432-433.

2. Hans Morgenthau, *Politics among Nations: The Struggle for Power and Peace* (New York: Alfred Knopf, 1948).

3. Ann Florini, "Rising Asian Powers and Changing Global Governance," *International Studies Review* 13, No. 1 (March 2011): 24-33.