Explorations in Cyber International Relations

Massachusetts Institute of Technology   Harvard University

A Research Collaboration of MIT and Harvard University

The Final Report

Version 1.2

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PART III

EXPANDED ACCOMPLISHMENTS

The "expanded accomplishments" highlighted in Part III refer to s specific aspects of the collaborative initiative. These consist of:

- The production of knowledge materials, such as books, papers, and the like, as well as   and any publications reflecting the overall activities, as well as the development of new courses; and the development of new courses; and

- The education of new scholars, researchers and analysists at MIT and Harvard University

- The   development of sharable resources.

- Policy outreach

- Targeted relevance to the Minerva Program Priorities

- Collaboration with business and Industry

9. PRODUCTION OF KNOWLEDGE MATERIALS

Here we consider the production of knowledge materials to include (a) publications (including theses and dissertations) (b) development of course materials and (c) ECIR Workshop Reports and Poster Sessions. A brief note on each follows.

9.1   *Publications*

Earlier in this Report we highlighted some features of the production of knowledge, and presented some summary statistics. Here we provide a more detailed view of the types of knowledge materials generated by the ECIR Project.   These consist of:

(1)   Books

(2)   Published chapters and articles etc.

(3)   Scheduled publications

(4)   Proceedings of ECIR Workshops for ECIR outreach.

(5)   Working Papers - in progress

(6)   Research Paper on the ECIR website

(7)   Papers posted on SSRN

(8)   Papers presented at Conferences and in Workshop Proceedings

(9)   Editorials

(10) Graduate Student Theses

A detailed list of these items is in the Appendix to this Report. All are available on the ECIR website.

9.2 Development of New Courses

A total of nine (9) new courses were developed during the ECIR Project period. The breakdown is as follows:

9.2.1 MIT Courses

The MIT courses developed during the ECIR project period are full courses.

International Relations Theory for the Cyber Age
Faculty: Professor Nazli Choucri

Cyberspace and International Relations
Faculty: Professor Nazli Choucri, Dr. David Clark, and Professor Stuart Madnick

Digital Evolution
Faculty: Professor Stuart Madnick

Cybersecurity and the Future of Cyberspace
Pilot version: Designed by Professor Nazli Choucri, Dr. David Clark, and Professor Stuart Madnick

9.2.2   Harvard University Courses

Below is the list of Harvard Courses offered during the Project period. These include term modules as well as full courses.

Full Course

International Cybersecurity: Public and Private Sector Challenges
Faculty: Professor Jack Goldsmith

J-Term

IGA-339M – J-term 2011 –
The Future of Cybersecurity
Faculty: Professor Jack Goldsmith

IGA-236M - J-term 2013
Technology, Security, and Conflict in the Cyber Age
Faculty: Professor James Waldo

IGA-130M – Spring 2014
International Regimes and Cyber Issues

IGA-103M, Spring TERM Module,
Faculty: Professor J.S. Nye

The Future of Cybersecurity
IGA 339M: J-TERM Module, 0.5 credits
Harvard Kennedy School, Room L-280
Insructors Richard A. Clarke and Eric Rosenbach

10.   EDUCATION of NEW SCHOLARS, RESEARCHERS, and ANALYSTS

10.1 The Record at MIT

STUDENT/POST-DOC LAST NAME	STUDENT/POST-DOC FIRST NAME	STATUS DURING THE VISIT	CURRENT AFFILIATION
AGARWAL	GAURAV	MS Student, System Design and Management, MIT	Bayer AG, Germany
ALTHUNAYYAN	HAMAD	Visiting Student to MIT from MASDAR Institute of Science and Technology (MIST)	MIST
CAMIÑA	STEVEN	PhD Student, Political Science, MIT	Product Manager, Oracle
CHEN	JING	PhD Student, Computer Science, MIT	Assistant Professor, Department of Computer Science, Stony Brook University
CHEUNG	SINEAD	Undergraduate, Wellesley College	Private Sector
CHO	YISEUL	MS Student, Technology and Policy Program, MIT	User Operation Specialist, Korean Market, Facebook
ELBAIT	GIHANDAW	Postdoctoral Associate, Department of Political Science	Independent Researcher at the MASDAR Institute of Science and Technology (MIST)
EL KHATIB	SAMEH	Visiting Professor, Masdar Institute of Science and Technology (MIST)	MIST
FABRE	GUADALUPE	Electrical Engineering and Computer Science Undergraduate, MIT	

FINLAYSON	MARK	PhD Student, Computer Science and Artificial Intelligence Laboratory, MIT	Research Scientist, Computer Science and Artificial Intelligence Laboratory MIT
FISHER	DARA	MSc Student, Technology and Policy Program, MIT	PhD Candidate, Harvard Graduate School of Education
GAMARO-GARRIDO	ALEX	Research Assistant, MIT	
GOLDSMITH	DANIEL	Research Associate, MIT Sloan School of Management, Program Manager for ECIR	Principal Consultant, PA Consulting Group
GREZEGORCZYK	LIDIA	Visiting Student, Poznan Institute of Technology, Poznan, Poland	Pozman Institute
HILL	JONAH FORCE	Fellow, Belfer Center for Science & International Affairs, Harvard Kennedy School	Consultant, Monitor 360
JOYCE	ERIC	MPP Student, Harvard Kennedy School	Senior Analyst/Policy Advisor, Computer Network Operations, Electronic Warfare Associates
KAYA	ABDULLAH	Visiting PhD Student, Masdar Institute of Science and Technology (MIST)	MIST
LINDSAY	JON	PhD Student, Political Science, MIT	Research Fellow, University of California, San Diego Institute on Global Conflict and Cooperation, Member, Project on the Student of Innovation and Technology in China
LIU	SIDNEY	Visiting Professor, National University of Defense Technology, China	
MALEKOS-SMITH	JESSICA	Undergraduate, Wellesley College	Military

MAURER	TIM	MPP Student, Harvard Kennedy School	Non-resident fellow at the Global Public Policy Institute (GPPi), program associate at the New America Foundation's Open Technology Institute
MILLER	ANDREW	Research Assistant, MIT	Ph.D. MIT
MOHAN	VIVEK	Research Fellow, Science, Technology, and Public Policy Program/Project on Technology, Security, and Conflict in the Cyber Age	Attorney, Sidley Austin LLP's Privacy, Data Security, and Information Law practice group, Washington DC
PERON	VIVIAN	Visiting PhD Student, University of Brasilia	
RADY	MINA	Research Assistant, American University, Cairo, Egypt	
RAMTIN	AMIN	MPP Student, Harvard Kennedy School	PhD Candidate, Oxford Internet Institute, Oxford University
REARDON	ROBERT	Postdoctoral Associate, Explorations in Cyber International Relations, MIT	Postdoctoral Research Fellow, Project on the Atom, Belfer Center for Science and International Affairs, Harvard Kennedy School
RODART	SAMUEL	Visitor	In transition
SALIM	HAMID	MS Student, Computer Science, MIT	Independent Professional Web Sourcing, Boston MA
SECREST	MICHAEL	MPP Student, Associate, Explorations in Cyber International Relations, Harvard Belfer Center, Harvard Kennedy School	Vice President for Threat and Risk Management, State Street Corporation, Boston, MA

SHUKLA	AADYA	MIT Affiliate	Associate, Science, Project on Technology, Security, and Conflict in the Cyber Age, Harvard's Belfer Center
TESTART-PACHECO	CECILIA	MS MIT	Ph.D. MIT
VAISHNAV	CHINTAN	Postdoctoral Associate, Department of Political Science, Computer Science and Artificial Intelligence Laboratory, Sloan School of Management, MIT	Research Associate, Sloan School of Management, MIT
VALLE	EDWARD	MIT Student	MIT Student

10.2 *The Record at Harvard University*

STUDENT/POST-DOC LAST NAME	STUDENT/POST-DOC FIRST NAME	STATUS DURING THE VISIT	CURRENT AFFILIATION	TERM ON GRANT
Bates	Christopher	Graduate student		FY10
Denton	David	Graduate Student		FY10
Deyrup	Ivana	Graduate Student		FY10
Ellis	Ryan	STPP Post-doctoral fellow	STPP Post-doctoral fellow, Belfer Center, Harvard Kennedy School	FY13, FY14
Gaucherin	Benoit	Teaching Assistant, Cyber J-Term 2014	Deputy Chief Information Officer, Harvard University Information Technology	FY14
Gerver	Keith	Graduate Student		FY10
Haber	Jeremy	Graduate Student		FY10
Hill	Jonah	HKS Graduate Student		FY12
Joyce	Eric	HKS Graduate Student		FY10

Kello	Lucas	STPP Post-doctoral fellow	Senior Lecturer in International Relations, Director of the Cyber Studies Programme, Cyber Security, Oxford University	FY12, FY13, FY14
Lockshin	Zara	Graduate Student		FY10
Maurer	Timothy	Graduate Student		FY12
Mohan	Vivek	STPP Post-doctoral fellow	Attorney, Sidley Austin LLP's Privacy, Data Security, and Information Law practice group, Washington DC	FY12, FY13, FY14
Noyes	Matthew	Graduate Student		FY12
Sauter	Molly	Graduate Student		FY11
Shroegel	Philipp	Graduate Student		FY11
Sechrist	Michael	STPP Pre-doctoral fellow	VP, Threat and Risk Management, State Street Corporation	FY11, FY12
Shukla	Aadya	STPP Pre-doctoral fellow	Associate, Technology, Security, and Conflict in the Cyber Age, Harvard's Belfer Center	FY11, FY12, FY13
Toretta	Kristin	HKS Graduate student		FY11
Wall	Andru	Graduate student		FY10
Williams	Robert	Graduate student		FY10

11. SHARABLE RESOURCES, DATA, ANALYTICAL, METHODS and TOOLS

11.1 Cyber System for Strategy and Decision

Expansion of MIT's Global System for Sustainable Development to cover the Cyber domain (GSSD). Ontology-based and quality controlled knowledge data base consisting or tagged searchable abstracts with links to source. Content structure is based on the ECIR framework for integrating cyberspace and international relations. See gssd.mit.edu

11.2 Cybersecurity Wiki

Harvard's Berkman Center for Internet & Society—with contributions from the Science, Technology, and Public Policy Program's Explorations in Cyber International Relations—has developed a Cybersecurity Wiki that is designed to be a curated, comprehensive, evolving, and interactive collection of resources for researchers (not just legal researchers), technologists, policymakers, judges, students, and others interested in cybersecurity issues, broadly conceived. The general aim of the wiki is to collect in one place, and organize intelligently, important documents related to cybersecurity.

Designed to provide scholars, policymakers, IT professionals, and other stakeholders with a comprehensive set of data on national-level cyber security, information technology, and demographic data. The Dashboard allows stakeholders to observe chronological trends and multivariate correlations that can lead to insight into the current state, potential future trends, and approximate causes of global cyber security issues. (See http://coin.mit.edu:8080/Dashboard/).

11.3 Computational Taxonomy Generation Tool

The development of an automated system for content compilation, and comparisons designed to derive taxonomies or ontologies from large-scale database systems . (See ECIR website

11.4 Cybersecurity Model Curriculum

Harvard's Berkman Center's tool for instructors who plan to teach a cybersecurity class, providing them with resources arranged in a coherent, teachable fashion. Not for lay teachers. Provides a structured guide that is adaptable, yet rigorous, permitting professors to take various elements of the course plans and "drag and drop" to create their own customizable syllabi. Developed with

contributions from HKS and HLS faculty and fellows. Website:
http://h2o.law.harvard.edu/playlists/633

12. ECIR POLICY OUTREACH

During the ECIIC project period, two sustained initiatives were maintained throughout:

12.1   ECIR Workshops

Four Workshops were held during the Project period as mechanisms for outreach to the policy and business community. At each Workshop, students were encouraged to present posters for the Poster Session. The *Proceedings* are available on the ECIR Website.

See Appendix A-6 for Workshop titles, details, and   co-sponsorship, as well as information about two Affiliated Workshops

12.2   Harvard – ECIR – Policy Seminar

Professor Joseph S. Nye chaired a bi-weekly seminar series on cyber policy and politics over the entire ECIR period. The seminar continues to date. See the ECIR website.

13. RELEVANCE TO THE MINERVA INITIATIVE

We illustrate the relevance of ECIR research for (a) the Minerva Program, and for (b) the US Department of Defense, in that order.

13.1 Relevance to the Minerva Program

Figure 13.1 below illustrates the convergence between the Minerva Program priority issues and the ECIR research themes and activities. This figure is to be read as follows:

The top segment refers to topics selected from the November 8, 2012 meeting at Harvard. The numbered items refer to the Minerva Program Priorities. The content of the box refers to the ECIR Research Agenda. The arrows indicate connections or relevance.

Minerva Priority Research Topics

Who controls the Internet?   Rules for Escalation Dynamics?   Cyber Power, Social Media, Governance?
What is effective Cyber Deterrence?   Cyber Partnerships? Prospects for Collaboration?
...sample of driving issues for DOD

I. Belief Formation and Movements for Change
(1-A) Belief formation and influence
(1-B) Group identities, cultural norms, and security
(1-C) Movements for change
(1-D) Collaboration and competition between violent groups

II. Models of Societal Resilience and Change
(2-A) Economic factors
(2-B) Energy, environment, and resource factors
(2-C) Other factors impacting societal stability and change

Explorations in Cyber and International Relations   MIT-Harvard

Framework and Foundations of Theory
- Cyberspace Core – Layers of the Internet
- International Relations -- Levels of Analysis
- Intersection Principle

Cyber Power and Cyber Security: Control Point Analysis
- Control of Cyberspace
- Cyberpower in International Relations

Governance: How Behavior is Disciplined
- Mapping Authority and Governance
- Norms for Cyberspace
- Private Authority
- Institutions for Cyber Security
- Analysis of tools for accountability and deterrence
- Resilient Mechanism Design
- Tools for Analysis and Conduct of Cyberspace Law

Alternative Futures: Cyberspace and International Relations
- Drivers of and Dynamics of Change
- Alternative Internet Futures
- Emergent World Orders

Conflict and cooperation   Strategy and policy   Relevance for DoD

III. Theories of Power and Deterrence
(3-A) The role of the state in a globalized world
(3-B) Norms and governance
(3-C) Beyond conventional deterrence

IV. Emerging topics in defense social science

Figure 13.1 ECIR Contributions to the Minerva Program Priorities

13.2 Relevance to US Department of Defense

Based on the work and results so far, select results that contribute to DoD capabilities and implications for national defense and for the U.S. Grand Strategy are of three types: policy and strategy, (such as method to identify leverage points), (ii) new tools, modeling and methods (examples below); and (iii) new theory for the cyber age (i.e., 21st C.. international relations theory, alternative futures predicated on integration of cyberspace and international relations). *Some examples include:*

- The discovery through *control point analysis* of the full range of potential vulnerabilities and points of unwanted interventions or hidden "weaknesses" in the current structure of the Internet and the broader cyberspace context. This work, embedded in a broader international context, has never been done before, and if a medical analogy can be used, we can now determine the degree of robustness and resilience in the overall system, locate weaknesses, as well as those elements that we control versus those controlled by others.

- The development of *new tools* to support evolving capabilities for analysis and policy. These include customizable system dynamics models (for conflict dynamics), automated generation of new knowledge extracted from existing records (of scientific communities' or of adversaries' knowledge content), and work on automated identification of legal precedents

- The design of alternative *cyber futures* – based on the co-evolution of cyberspace and international relations – can serve as the basis for anticipating changes in distribution of power, emerging governance issues, and new contentions – all for a world that is increasingly diverse in its view of Internet "openness" or "closure.

- The construction of the *cyber-IR system* provides a common platform to for exploring potential power projections, developing "cross-domain" strategies, or the selection of "best" leverages and responses to emergent threats.

14. COLLABORATION with BUSINESS and INDUSTRY

14.1 (IC)³ Consortium

One specific product (or output) is the creation of the MIT *Interdisciplinary Consortium for Improving Critical Infrastructure Cybersecurity (IC)³ Consortium.* As a result of the ECIR initiative, IC3 is filling a critical need for critical infrastructure. Security of conventional information systems is recognized as important, but is still not fully effective. The number and magnitude of recent cyber-attacks (Target, Home Depot, SONY, etc.) is growing weekly.

More important, but even less protected, is the security of our Cyber-Physical Infrastructure and IoT (Internet of Things). The computer controlled facilities that produce and deliver our electric power, oil and natural gas, chemicals, water, pharmaceuticals, food, manufactured goods, financial services, telecommunications, healthcare, emergency services, and the buildings that collectively form the infrastructure of a safe and secure world civilization are dangerously exposed to cyber-attacks.

While our critical infrastructure is even more important to secure than conventional information systems, much less research in cybersecurity for critical Infrastructure has been done. This is the research being done by (IC)³.

(IC)³ is focusing on the critical cybersecurity needs for critical infrastructure in the following significant ways:

    (1) Justify top management attention & adoption
    (2) Define actions that can be effective & measured
    (3) Define a culture of Cyber-Safety
    (4) Create a forum for CSO/CISO's to advance Cybersecurity

The MIT Interdisciplinary Consortium for Improving Critical Infrastructure Cybersecurity has already developed in basic research parameters and has launched a set of initial meetings,

See [MIT-(IC)3 - Home](#)

14.2 Co-Sponsors of ECIR Workshop

The ECIR Workshops were co-sponsored by (a) the *Business Executives for National Security*, a non-profit organization that provides business and nation security consulting services. The organization offers cyber security, threat finance, and disaster response consulting services; and (b) the *Council on Foreign Relations*, is an independent, nonpartisan membership organization, dedicated to being a resource for its members, namely, business leaders, journalists, educators and students, interested in international affairs.

END NOTE

The Final Report of the MIT – Harvard University Project on *Explorations in Cyber International Relations* highlights the major research results, the production of knowledge materials, the development of shared resources, the education of students, researchers, and policy analysts, as well as a range of related outputs.

The activities of the ECIR initiative did not generate one single result, rather a set of distinct multidisciplinary findings, jointly contributing to the overarching objectives outlined in the Research Agenda.

This Report is framed in summary form, with direct reference to the lead researcher(s). All source documents referred to in this Report are available on the ECIR web site.

Finally, by necessity this Report captures the most significant, but not all, of the results of ECIR to date. Our purpose here is to be as inclusive as possible, without claiming to be exhaustive.

The Appendix presents supporting materials and added information.