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Risk-intelligent Governance in the Age of Cyberthreats

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Abstract

Cybersecurity is an issue of foremost interest for policymakers in the world's governments, corporations, nongovernmental organizations (NGOs), academic institutions, and other associations. However, remedy for the myriad cyberthreats and vulnerabilities continues to elude technologists and policymakers alike. In this paper, we consider the concept of cyberrisk intelligence, a general concept of understanding the varied phenomena that impact an organization's capacity to secure its digital communications and resources from eavesdropping, theft, or attack. We also consider the deeper economics of information held and transmitted in digital form and how those economics may alter thinking on risk modeling. Finally, we offer guidance on how organizations and entire sectors of business activity may want to alter their thinking on cybersecurity issues beyond a technological framing to include an informational perspective aligned with business activities.

Where is cybersecurity today?

There is a conventional knowledge in cybersecurity that some major corporations know they have had a cyberincident, while others do not. Regardless of that awareness, it is likely that all of them have had a significant cyberincident. Consider:

- Fifty businesses participating in a 2011 study on cybercrime experienced an average of more than one successful cyberattack per company per week—a 44 percent increase over the 2010 rate.[1]
- A 2010 survey of data breaches in 28 countries found that more than 721.9 million data records were compromised over the five years ending December 31, 2009. This works out to the inadvertent exposure of 395,362 records every day.[2]
- In November 2011, a leading cybersecurity company reported detecting four times as many "targeted" cyberincidents as it detected just 11 months earlier, in January 2011.

[1] "Second annual cost of cyber crime study: Benchmark study of U.S. companies," Ponemon Institute, published August 2011, 1, http://www.arcsight.com/collateral/whitepapers/2011_Cost_of_Cyber_Crime_Study_August.pdf.

[2] Suzanne Wildup, "The leaking vault: Five years of data breaches," Digital Forensics Association, July 2010, http://www.digitalforensicsassociation.org/storage/The_Leaking_Vault-Five_Years_of_Data_Breaches.pdf.

> Defined as attacks directed at a specific person or organization rather than at random victims, targeted cyberattacks are considered especially dangerous because they are insidious, long-term electronic "campaigns" that can be extremely difficult to uncover and address.[3]

In light of statistics like these, it is reasonable to assume that most companies either have been or are at risk of being compromised by cyber means. There is great concern regarding cyberattack, as evinced by former defense secretary Leon Panetta's 2012 address on cyber issues, in which he invoked the image of a "cyber Pearl Harbor," a massive surprise attack capable of crippling the United States' capacity to defend itself or function politically and economically.[4] The sort of cyberattack Panetta spoke about is one that matters a great deal to the Department of Defense. It forces the international community to visit law on armed conflict and establish a bar over which cyberattacks gain attention as national security interests.[5]

This is the frightening discussion that touches on the nascent domain of cyberwarfare. A good working definition for this sort of threat is offered by Hathaway, et al., who write, "A cyberattack consists of any action taken to undermine the functions of a computer network for a political or national security purpose."[6] It is not just militaries and defense firms that are the principal targets, but other types of companies, including those in telecommunications, utilities, information technology (IT), oil and gas, aviation, and logistics. They should hold concern that they may face well-crafted malware and sophisticated cyberattacks that are designed to disrupt operations and purloin information. Thus, there is a far broader definition of cyberattack that we often see that comes from the computer security and information assurance disciplines. This broad definition may include everything from a targeted email message to a corporate officer

[3] "Symantec Intelligence Report: November 2011," Symantec Corporation, 2011, http://www.symanteccloud.com/mlireport/SYMCINT_2011_11_November_FINAL-en.pdf.

[4] Elisabeth Bumiller and Thom Shanker, "Panetta Warns of Dire Threat of Cyberattack on U.S.," *New York Times*, October 11, 2012.

[5] Chris Bronk, "Hacking Isn't Cyberwar, for Now," *New York Times*, February 28, 2013.

[6] Oona A. Hathaway, Rebecca Crootof, Philip Levitz, Haley Nix, Aileen Nowlan, William Perdue, and Julia Spiegel, "The Law of Cyber-Attack," Draft Paper, Yale Law School, November 16, 2011, http://www.law.yale.edu/documents/pdf/cglc/LawOfCyberAttack.pdf.

meant to install monitoring software on her PC, to the launching of massive, distributed denial of service (DDoS) campaigns designed to shut down websites and stifle communications.[7]

While most cyberincidents don't make national headlines, they can hurt a business in any number of ways, from simply vandalizing the business' website to shutting down networks, perpetrating fraud, and stealing intellectual property. The financial impact can be significant; however, precise assessment is hamstrung by lack of uniform measurement or widespread disclosure of all varieties of incidents. Then there are the less tangible costs. Cyberincidents can deal a serious blow to a company's brand and reputation, with potentially significant consequences. Concerns about data security may prompt current and prospective customers to take their business elsewhere, and negative reactions among investors may even drive losses in market value.[8]

Although pricing market perception due to cyberincident reporting is complex and abstract, this does not mean that measurable phenomena don't exist in the cyber area, and in particular cybercrime. As hyperbolic theoretical costs have stretched into the tens and hundreds of billions of dollars, industry, government, and academic sources have begun assembling data regarding the price of stolen information, compromised computers and websites, and the annual losses to electronic crime.[9] Russian cybersecurity firm Kaspersky Lab was able to construct a comprehensive pricing index for everything from installation of malware on host computers ($3 to $120 depending on the country of location) to spearphishing botnet access ($1,000 to $2,000 a month) in 2009.[10] A more robust set of economic indicators on cybersecurity is beginning to emerge.

Unfortunately, because of the constantly evolving source of cyberrisk as well as the shift in computing platforms employed by enterprise to do business (such as cloud services and bring-

[7] The October 2012 DDoS attacks against several major U.S. banks falling into this category are considered below.
[8] Ashish Garg, Jeffrey Curtis, and Hilary Halper, "The financial impact of IT security breaches: What do investors think?" Information Systems Security, March/April 2002, 22-33, http://www.auerbachpublications.com/dynamic_data/2466_1358_cost.pdf.
[9] Tyler Moore, Richard Clayton, and Ross Anderson, "The Economics of Online Crime," *Journal of Economic Perspectives*, 23 (2009): 3-20.
[10] "Kaspersky reveals price list for botnet attacks," ComputerWeekly.com, published July 23, 2009, http://www.computerweekly.com/news/1280090242/Kaspersky-reveals-price-list-for-botnet-attacks.

your-own mobile devices), many organizations may not be as effective at managing cyberthreat risk as they are at managing risk in other areas. A telling statistic in this regard is that fully 86 percent of the data breaches examined in a 2011 study were discovered not by the victimized organization itself, but by external parties such as law enforcement or third-party fraud detection programs. As the researchers put it, “If [an] organization . . . must be told about [a breach] by a third party, it is likely they aren’t as knowledgeable as they should be with regard to their own networks and systems.”[11] Despite internal efforts to elevate cyberdefense capabilities, internal capacity for cyberrisk intelligence is rare outside of niche firms in the information security business and government agencies.

Then there is a larger set of policy issues regarding corporate responsibility and the public interest. Recent communications from the U.S. Securities and Exchange Commission (SEC) support the view that cyberthreat risk merits board-level consideration, at least from a disclosure standpoint. Noting that “risks . . . associated with cybersecurity have [recently] increased,” the SEC released guidance in October 2011 intended to “assis[t] registrants in assessing what, if any, disclosures should be provided about cybersecurity.”[12] This guidance, while not an actual reporting requirement, does highlight the extent to which worries about cybercrime’s business impact have infused the public consciousness. In addition, various drafts of cybersecurity bills that circulated in the U.S. Congress in 2012 envisaged a far larger role for the Department of Homeland Security (DHS) in coordinating cyberincident event data to begin the process of stitching together stovepiped corporate cybersecurity capabilities to construct a holistic view of cyberthreat.

Where cybersecurity stands in major organizations

In the wake of incidents, companies are typically able to adequately assess “What happened?” and “How did it happen?” These questions guide the postincident and forensic activities that occur after something has gone wrong. These questions are important to understand, but they do

[11] “2011 data breach investigations report: A study conducted by the Verizon RISK Team with cooperation from the U.S. Secret Service and the Dutch High Tech Crime Unit,” Verizon, 2011, http://www.verizonbusiness.com/resources/reports/rp_data-breach-investigations-report-2011_en_xg.pdf.

[12] “CF Disclosure Guidance: Topic No. 2—Cybersecurity,” U.S. Securities and Exchange Commission, October 13, 2011, http://www.sec.gov/divisions/corpfin/guidance/cfguidance-topic2.htm.

not necessarily help firms to anticipate the cyberthreats they face. The “what?” and “how?” of cyberincident response needs to be informed by a broader set of questions.

In the geopolitical context of cyberincidents and conflict, perhaps the most important questions revolve around “Why?” In cyberdefense activities, the typical mindset has been one in which risks are identified and mitigated based on known vulnerabilities and known threats. The enterprise does its best to put the biggest goalie possible in front of the net. Where organizations often fall short is pulling together all of the different inputs in understanding their vulnerabilities. In cybersecurity plans, processes, and technologies, we do not often see adequate thinking in the framing of why an asset or capability would fall victim to a cyberattack. It is the “Why did this happen?” question that must frame risk management that establishes cybersecurity and cyberdefense strategy in firms.

This question requires business process owners to do some hard thinking about what information they hold is most valuable and which employees would be most susceptible for targeting. On the network, not all users or pieces of information are created equal. Both senior leadership and cybersecurity practitioners must accept that reality. Not everything can be protected, and resources must be distributed in accord with a fundamental understanding of what items or people require the greatest protection.

The information economics of the risk space

Compromise of systems via cyber means should be accepted as a valid risk for almost any entity, but there is need for establishing how an organization should think about cyberthreats. For organizations, risk is not an alien concept. Financial institutions, technology firms, energy companies, and international NGOs all must think about the actions they take in doing their business in which negative outcomes are a possibility. Making the right trade, investment, play, or position involves risk. Organizations typically study the up- and downside of significant activity before making decisions tied to significant investment. Corporations must measure myriad issues, such as competitive forces, technology development, workforce, infrastructure, environmental impact, regulation, and political factors before major capital bets are made. Cyberspace adds a new dimension of risk in the crosscutting informational domain.

Elementary economics regarding the output of the firm identify all inputs under the categories of capital (K) and labor (L). Making products is a process of buying physical plant and technology as well as hiring people. The revolution in information technology over the last several decades has forced economic thinkers to assess where IT fits in how output is measured. Generally, IT is seen as a capital input that enables increased productivity from labor. In the 1980s, Robert Solow argued that investment in IT could be seen everywhere but within the productivity figures, but his point was mooted by IT-driven productivity gains during the 1990s. Today it is quite clear that information connectivity is synonymous with productivity. Global firms depend on IT to interconnect production with distribution, producing highly efficient, low-inventory supply chains. But a great many businesses are also in the business of information. Facebook acquired Instagram, a company of 13 employees that had been operating for a little more than a year, for approximately $1 billion. The company's value was measured in the number of users of the service and their frequency of use—in other words, information.

Talk of the value of information in organizations is an evergreen topic. The organization's employees and their intellectual capacity and output create value for the organization. We used to see this as a body of individuals with repositories of information floating around in their heads. But we should ask now to what degree seeing inside the digital persona of an individual—their email, documents, social media posts, and Internet browsing habits—is useful in understanding their intent, and therefore the direction of their organization. In the last few years, the United States government and the cybersecurity community of researchers, firms, and consultants has sounded the alarm regarding the theft of corporate intellectual property via cyber means. But what may be even more important is to address to where organizations are being fully compromised by digital means, as was the case with the Dalai Lama.[13] The GhostNet operation aimed at the Dalai Lama (and many others) indicates how the cyber vector is being

[13] Ron Deibert and Rafal Rohozinksi, "Tracking *GhostNet*: Investigating a Cyber Espionage Network," *Information Warfare Monitor*, March 29, 2009.

employed to gain the inside view of organizations in ways that conventional espionage could hardly have imagined.

Beyond seeing inside the firm and purloining its intellectual output, there is a third, increasingly important concern, regarding the disruption of organizational activity. In cyberspace, this has traditionally been via the employment of distributed denial of service (DDoS) attacks in which externally facing web servers are overwhelmed by massive data queries. This is not a new problem. The February 2000 DDoS attacks against major Internet firms including Yahoo!, Amazon.com, and eBay, ostensibly launched by a single youth, have evolved.[14] Today, protests against governments and corporations are undertaken by loose confederations of hacktivists, nonstate actors, and possibly governments as well. Several major U.S. banks experienced a degradation of their online banking Internet portals due to DDoS in September 2012. More recently, DDoS has been directed by Anonymous at the oil and gas industry.

The Shamoon malware indicates an even more serious threat to organizations: the development of "wiper" programs designed to widely propagate on an internal network and delete massive amounts of data. Shamoon is reputed to have impacted as many as 30,000 host computers connected to Saudi Aramco's internal network. While large, mature firms typically have resilient backup strategies in place to prevent data loss by unauthorized or accidental deletion, repairing the damage of a massive cyberincident carries a cost in locating the cause and repairing the damage. Ensuring a clean bill of health for a system that has been compromised usually does not entail replacing hardware, but the cost in labor alone is no doubt significant for a Shamoon-type event. While we are left to guess the final cost of Shamoon to the companies impacted by it, there is one ground truth in cybersecurity: the best cyberincidents are the ones avoided.

Cyberrisk intelligence: A proposed method for managing risk

Navigating around cyberincidents, from rather pedestrian cybercrime events and virus outbreaks to the highly sophisticated targeting of critical systems and senior executives or officers, is the

[14] Doug Gross, "'Mafiaboy' breaks silence, paints 'portrait of a hacker,'" *CNN*, August 15, 2011, http://www.cnn.com/2011/TECH/web/08/15/mafiaboy.hacker/index.html.

problem of the moment. In an informal polling of cybersecurity specialists in industry and academia, there exists a general belief that the adversary has the initiative, and that response is ad hoc and often undesirably tardy. The Department of Homeland Security's Eric Cornelius recently asserted, "The delta *t* [or time] between compromise and detection is 420 days." Most of the cyberincidents Cornelius's office at DHS sees are more than a year in the running. This is plenty of time to exfiltrate massive quantities of data, emplace malware Trojans for future use, and observe the digital operations of the targeted organization.

A better way of undertaking the business of cybersecurity is necessary. While prescriptions of "don't click the link" employee awareness campaigns, procurement of security technologies, and increased staffing are all valid, there is also a need to reassess strategy for not just IT, but also for information. In other words, cybersecurity is not just an IT problem to be solved in a subsegment of the organizational IT office. Cybersecurity is a culture, and organizations have culture. In Houston, we see an industry-wide emphasis on the importance of safety in oil and gas operations and the conduct of the manned space program at NASA. Developing this culture will take time, and this change will not likely bring an end to major cyberincidents by itself.

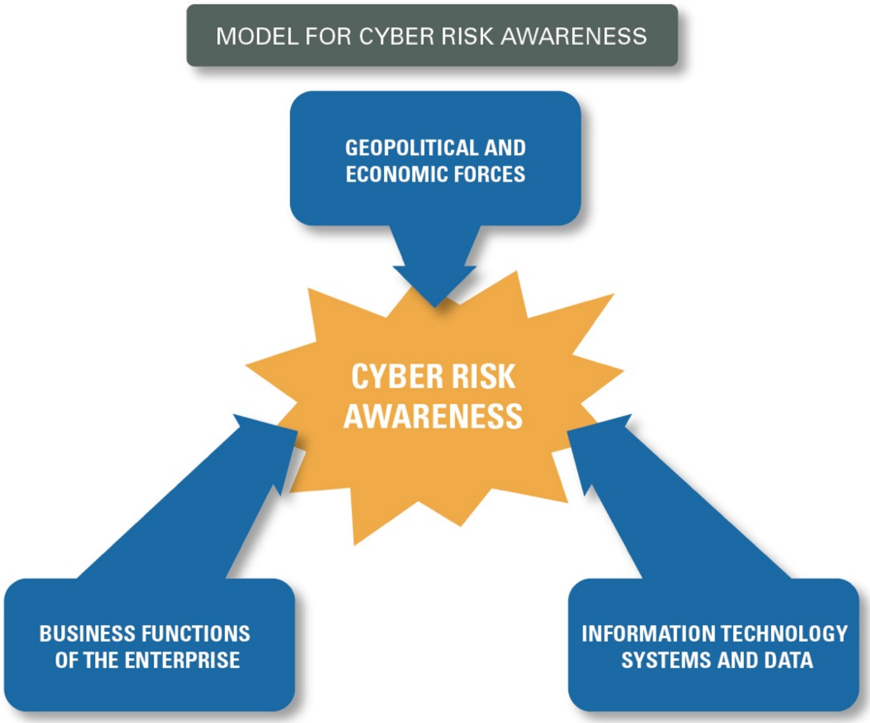
Military thinking on cyberincidents has emphasized development of the capacity to deter.[15] Deterrence, while useful in preventing major conflicts, largely breaks down in the cyber domain. There is much for the attacker to gain, often there is little to lose, and getting caught at all is not necessarily likely. With deterrence not yet practicable, the organizational default has been fortification, and hardening of the network, much as the world's great cities built walls to keep the undesirables out, from bandits to foreign invaders. The problem here is that walling off the network means severing connectivity and functionality. For the global organization, the capacity to conduct business is largely determined by the ability to pass data packets between offices and individuals. Digital connectivity is the lifeblood of global operations. Without the capacity to communicate quickly at a distance, the productivity gains of the last 20 years essentially evaporate. A massive cyberfault doesn't take us back to the Stone Age, but possibly to the 1980s.

[15] Martin C. Libicki, "Cyber Deterrence and Cyberwar," RAND Project Airforce, 2009, http://www.rand.org/content/dam/rand/pubs/monographs/2009/RAND_MG877.pdf.

This argument makes IT important, and it is—if economists are willing to let information stand alongside capital and labor in the measurement of output. What this means is that cybersecurity needs to be considered in the broader scope of the organization. Considering what bad outcomes might occur in the cyber arena needs inputs not just from the IT space but the broader space of operation. We see a holistic model of inputs for cybersecurity that reaches far beyond IT-based indicators. Understanding what is going on within the network is important; however, seeing why the network is threatened is also important.

We see three general flows of information in determining an organizational frame for cyberrisk intelligence: one that encompasses the awareness of the IT enterprise and its apparent health; a second that brings internal business activities into view; and a third that encompasses broader geopolitical and economic forces. These three areas can be combined into a common operating picture for cyberrisk awareness. To the IT security community, this no doubt seems daunting, but each of these areas is important.

Figure: Cyberrisk Awareness


MODEL FOR CYBER RISK AWARENESS
GEOPOLITICAL AND ECONOMIC FORCES
CYBER RISK AWARENESS
BUSINESS FUNCTIONS OF THE ENTERPRISE
INFORMATION TECHNOLOGY SYSTEMS AND DATA

Gauging the health of the organization's overall IT operations is what organizational chief information security officers and chief information officers are expected to know on a day-to-day basis. Such awareness is an output of increasingly advanced security hardware and software as well as increasingly specialized security practitioners inside the organization. No doubt, the larger the organization, the greater the resources and the larger the workforce, but bigger organizations are better known and frequently targeted. There's no reason to be complacent in size and spending power alone.

More abstract is the need to incorporate the activities of the organization. Major manufacturers require global sourcing of materials and components, months or years of lead-time for product design, and frequently the aid of outside experts and vendors. Understanding cyberrisk to the organization translates to understanding what the organization holds, what it values, and where it is headed. In addition, understanding business activities extends to partnerships and other relationships. This makes cybersecurity often a shared exercise, because of the role of external parties. Secret merger talks or a hushed product development may involve the participation of outside help, which leads to questions of how law firms, auditors, or other advisers are protecting information resources. The business factors are relevant cybersecurity factors as well.

Our third category addresses the broader economic and political forces at work. This is the broader space in which the organization is positioned. Today, there are few large organizations that do not also engage in international operations. They can expect that the threats they face, whether friendly competition, evolving market conditions, or overt political acts, to increasingly migrate to cyberspace. Some proof of this may be offered in the widespread DDoS attacks against the Internet portals of some of the United States' largest banks during October 2012, which we alluded to before.[16] Increasingly, we can infer that the cyber vector will be employed to express dissatisfaction and inflict harm to operations through the theft of information and the damage to organizational image.

[16] Dan Goodin, "DDoS attacks on major U.S. banks are no Stuxnet—here's why," *Ars Technica*, October 3, 2012, http://arstechnica.com/security/2012/10/ddos-attacks-against-major-us-banks-no-stuxnet/.

With the rise of chief digital officer (CDO) positions in corporations, we see the indicators that organizations are reconsidering how they orient to the marketplaces dominated by the Internet. These CDOs will likely head up the activity of determining online strategy, but as currently conceived, the CDO position is likely one more oriented with marketing than corporate IT or security.[17] How organizations will match their cybersecurity concerns with their overall digital strategy is an important question, but one perhaps not one being given much thought yet. That said, the hiring of talent, with the wherewithal to consider cybersecurity through multiple lenses rather than via a myopic IT-only view is under way, especially in global multinationals. This indicates that the lines between information security officers and security officers is probably blurring. The executive traveling abroad on business now needs adequate briefing not only on petty crime, kidnapping, and terrorism, but also cyberthreats.

Getting to cyberrisk intelligence

For more than a decade, organizational leaders have wondered how much is enough in cybersecurity. The good news is that we are now growing to better understand why the security of digital resources is a concern. What is unsettling is that there are no means, short of digital disconnection, to completely mitigate the risk of a cyberincident. The current state for many, or even most, organizations is that they are coping with the cybersecurity problem. This raises the question of how organizations can move in front of it.[18] We have several general observations drawn from the world of cybersecurity and also those from the field of intelligence.

First, cybersecurity has largely been viewed as a province of organizational IT. This is logical, as cybersecurity activities are designed to protect IT assets, but field also addresses the protection of information, business operations, and larger issues of reputation and image. Organizations may need to consider how the cyber vector impacts their leadership with deeper thinking about the information at risk. The perception of cybersecurity activity as “an army of ‘no’” inside the organization that seems to only be able to tell the general workforce what it can’t do based upon

[17] Tim Conneally, “‘Chief Digital Officer’ is the next hot executive title, says Gartner,” *betanews*, accessed March 27, 2013, http://betanews.com/2012/10/22/chief-digital-officer-is-the-next-hot-executive-title-says-gartner/.
[18] Sanjay Goel, “Cyberwarfare: Connecting the dots in cyber intelligence,” *Communications of the ACM* 54 (2011): 132-140, http://dl.acm.org/citation.cfm?id=1978569.

known threats and vulnerabilities is one that requires remedy. The ability for an organizational IT security shop to consistently eschew innovation in the field in the name of security ignores the realities of increased productivity and profitability. This sort of risk avoidance runs contrary to the intuition of organizations that embrace or accept risk in doing business.

There's an important lesson here from the U.S. military's experience with social media. In 2009, the U.S. Marine Corps banned its personnel from using social media sites such as Twitter and Facebook, but less than a year later the ban was overturned. On the policy, then-Chairman of the Joint Chiefs Michael Mullen said, "Obviously, we need to find the right balance between security and transparency. We are working on that. But am I still going to tweet? You bet."[19] Mullen's position underscores an important lesson for organizational information security officers: that the case for risk avoidance must be abundantly clear especially if it impacts organizational performance, which in the Marines' case is largely a measure of morale. Cyberrisk intelligence should translate to a more informed dialog on the pros and cons of employing different information technologies rather than begrudgingly accepting new technologies because organizational leadership wants them.

In moving cybersecurity beyond the corporate IT function, a second issue must be examined: how the organization is exposed to competition or harm. Organizations need to think about how their competitors and adversaries may gain from compromising information resources or computer systems. Where organizations generally detect the compromise of information systems is through discovery of atypical system behavior. This makes sense, but organizations will also need to approach the cyber issue from the business perspective. When there is a pattern of failure, executives will need to begin asking, "Is there a cyber issue here?"

For organizations that take the above question seriously, this will be translated into cyber specialists who can not only understand the network operations and data management issues, but also interface with the business. They will need to embrace counterintelligence thinking and practices; work with senior leadership on understanding where things aren't working; and also

[19] Chris Bronk, "Marines' social-media ban is bad for morale—The ban might demoralize troops more than it improves security," *Federal Computer Week*, September 17, 2009.

determine what information may be vulnerable or compromised, and why. In addition, they will have to understand the chains of custody for sensitive information so as to better understand how partners may be creating exposure to vulnerability. An organization with superb cybersecurity practices in place is vulnerable nonetheless if a law firm or accountancy it employs to conduct transactions does not have the same sort of capacity to protect information. Boilerplate legal language on the ethical and legal constraints on the transmission of information tacked on to the end of an email message are meaningless to the cyberadversary who has already accepted that she will function outside the law.

This issue of information custody speaks to the broader issues of how to build a more secure information ecosystem. We often discuss parameters for good hygiene or public health in cyberspace. These include technological practices such as deployment of antivirus software, intrusion detection systems, and email spam countermeasures. There are also good organizational behaviors to foster: once again, a common understanding on the importance of "don't click the link" in countering phishing via email or other platforms. What will become more necessary is the construction of defensive policies and techniques that conform to the unique information resources, communication requirements, and computational infrastructure of the organization.

There is an issue here in scalability, however. The largest corporations or government agencies can allocate far more resources than the smaller players to the cybersecurity problem. More important will be industry-wide efforts that identify key security concerns and meet them with collaborative response. Such activity can be labeled as another form of collective security—the same sort of thinking that guides countries to form military blocs or even broader political and economic organizations. The question in cybersecurity governance is how different industries and arrangements of organizations will come to confront the problem. This is a key issue that needs to be addressed. Without it, the large and well-resourced organizations, many of which are big targets, may be better off, but the smaller entities with which they work and upon whom they depend will still render them vulnerable.

This collective action problem is at the core stumbling point for cybersecurity strategy. What will be interesting to see is how organizations accept the cyber vulnerability issue and are allowed to move beyond isolation in addressing threats and incidents. Today, organizations share data on cyberrisk with others all the time. Consider the traffic in data from customers to the purveyors of antivirus software. Without the constant connectivity between host computers and antivirus labs, the struggle to contain malicious software of a general nature (as opposed to specifically designed pieces of malware) would be impracticable if not impossible. If the practice of cybersecurity is to improve, it will need to embrace the same things that the adversary willingly accepts: agile thinking, constant learning, and a willingness to collaborate beyond traditional boundaries when expertise is needed.

No single technology is likely to alleviate security concerns of the Internet-interconnected organization, nor is any single skill set able to do the same. Cybersecurity is akin to the other security concerns of our age, such as crime and terrorism. There are certain actions that may be taken by the individual and the organization to thwart them, and there are also certain common issues that only government can undertake, particularly when we consider punitive action in response to transgression. But like the other forms of security threat, a fundamental component is in information.

Since the September 11, 2001, attacks, two air travelers have tried to blow up airplanes and been thwarted by fellow passengers and flight crew because there is a clear understanding of what is at stake. People aboard airliners now understand that successful hijacking may mean death. Threats in cyberspace are not so clear and so great, in terms of life and limb. The case is clear that the world's organizations—governments, corporations, NGOs, universities, associations, and others—depend on IT to function. The question for preserving cyberspace is how those organizations pool their attentions and resources to preserve a vibrant and functioning cyberspace that may be used to enhance human endeavor. Without adequately studying new and even unorthodox approaches to security, we may eventually lament the loss of the cyber-connected world we once enjoyed.