Criminal Investigations
and Network Analysis
A DHS CENTER OF EXCELLENCE

2019 ANNUAL REPORT

AN EVOLVING INNOVATION PORTFOLIO TO MEET EMERGING CHALLENGES

DHS Centers of Excellence (COE) represent a unique partnership between academia and the Homeland Security Enterprise (HSE). The cornerstone of this partnership is innovation and evolution, with the COEs assisting the HSE as it is trying to take full advantage of emerging opportunities, and to catch up with evolving challenges. The operational space of our CINA COE, that of criminal investigations and network analysis, exemplifies the need for such a partnership. Today, federal investigators are challenged more than ever by networked criminal activities that pose critical and evolving challenges to the rule of law and national security, as the same technological and networking breakthroughs that are advancing our societies are also providing a fertile infrastructure for worldwide illicit activities. Our CINA Center is harnessing university-based innovation, workforce development, and outreach programs to help the HSE navigate through these evolving challenges. In this second annual activities report, we present some highlights from the last 12 months.

In terms of research, this was a year of evolution for CINA. Our research portfolio grew in two stages. First, it expanded as a result of our inaugural Request for Proposals (RFP) competition that saw nearly 50 submissions from leading institutions nationwide, from which we selected 5 new projects to fund, addressing issues like opioids, cryptocurrency, illicit markets in the dark web, and hotspots of criminal activity (pages 8-9). Then, addressing a specific operational need, CINA researchers collaborated with groups from two fellow COEs to form a multi-site team that pursues the derivation of actionable knowledge for gang activities from open-source content (page 10).

Workforce development activities expanded the number of sponsored students, including more intern placements across DHS components. This year also saw the inaugural CINA Summer Week in Fairfax; we welcomed students and professors from Minority Serving Institutions (MSI) for a week-long immersive experience which complemented our two MSI summer-long research opportunities. This past year, communications and outreach activities reached hundreds of stakeholders with the introduction of our CINA Distinguished Speaker Series and its corresponding digital archive (page 17), sponsorship of two large scale events on opioids and investigations (page 18), and the organization of another very successful COE Summit (page 19).

The activities showcased in this report illustrate how university-based innovation and student-focused programming have a decisive impact on the Homeland Security Enterprise. Whether you are in government, industry, academia or the non-profit sector, we value our collaborators and look forward to exploring new partnership opportunities.

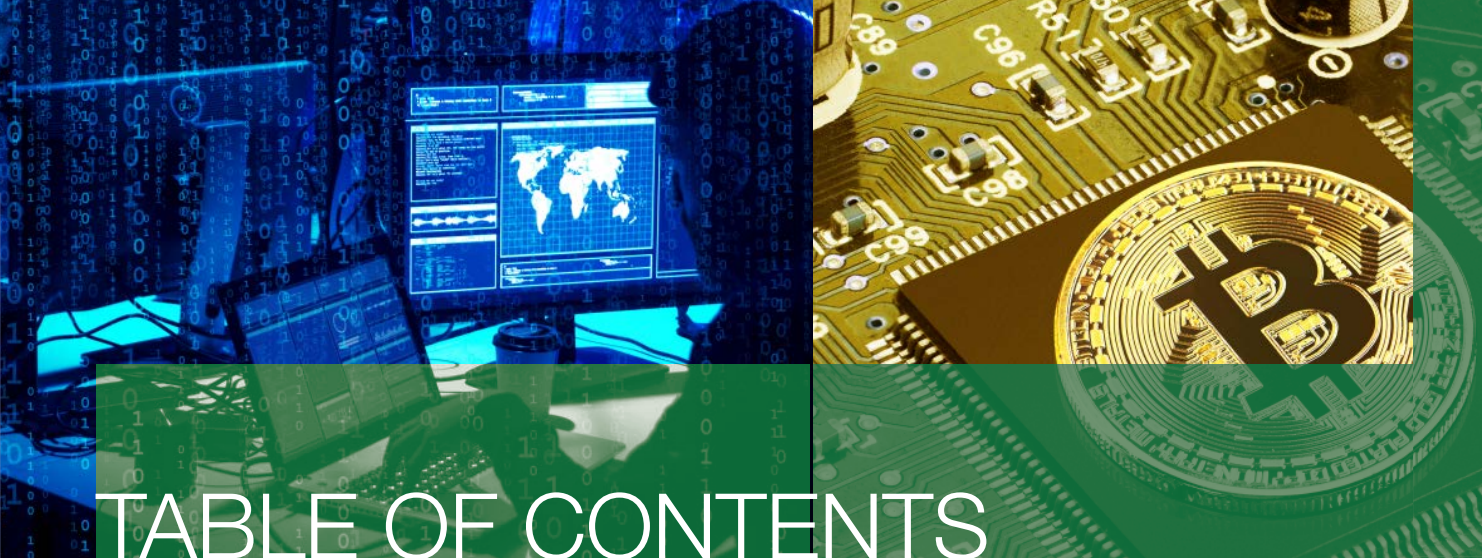Dr. Anthony Stefanidis
CINA Center Director

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CINA OUTLOOK '20

CINA Science Committee members offer their perspective on upcoming challenges and emerging threats faced by the Homeland Security Enterprise. By anticipating concerns, the CINA Outlook adds value to future planning and facilitates collaboration in emerging research domains.

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CINA BY THE NUMBERS:
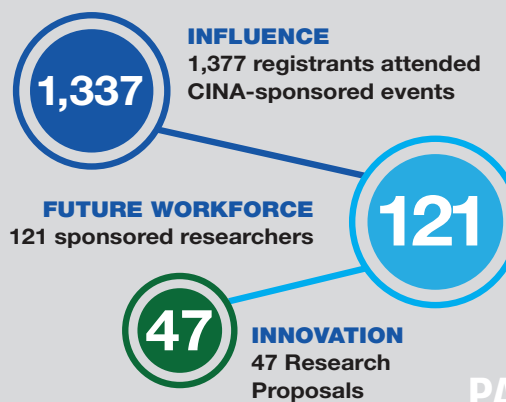
A statistic recap of CINA accomplishments across three domains:

1,337

INFLUENCE
1,377 registrants attended CINA-sponsored events

FUTURE WORKFORCE
121 sponsored researchers

121

47

INNOVATION
47 Research Proposals

PAGE**4**

Disclaimer

The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Department of Homeland Security.

CINA Annual Report 2019

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CINA BY THE NUMBERS

INFLUENCE

650

CINA SPONSORED EVENTS
This year CINA co-sponsored three events in national workshops and conferences, with a total of over 650 registrants:
- NSF Invitational Conference on Disrupting Operations of Illicit Supply Networks
- 2019 Symposium on Evidence-Based Crime Policy
- Migration, Homeland Security, and Gangs

13

THOUGHT LEADERSHIP
CINA affiliates were quoted or appeared in media 13 times

794

ENGAGING VIDEOS
794 CINA YouTube channel views, part of our digital archive featuring distinguished speaker talks and highlights of sponsored events

727

NATIONAL REACH
727 registrants for CINA-hosted COE Summit

1,237

DIGITAL AUDIENCE
1,237 unique visitors to the CINA website over a 30-day period (in June, 2019)

INNOVATION

47
28
17
5

CINA RFP
47 proposals from 28 universities in 17 states received in response to the CINA RFP, with 5 projects selected for full funding

- Initial partners
- New partners
- Workforce engagement

38
18
20

KNOWLEDGE PRODUCTS
38 CINA knowledge products: 18 from CINA-sponsored projects (10 journal or conference papers, 7 white papers, and 1 report), and 20 published works from CINA Science Committee members (3 books and 17 articles)

1

PATENT
1 application

3

PROTOTYPES
3 scheduled for 2019 implementation

FUTURE WORKFORCE

19
6
2

MINORITY SERVING INSTITUTIONS
19 students and faculty from 6 Minority Serving Institutions (MSI) participated in the CINA Summer week in July 2019. 2 MSI teams spent the whole summer working with CINA researchers

9

STUDENT INTERNSHIPS
9 sponsored student internships with various DHS components

121
21
63
35
2

RESEARCHERS
CINA sponsored 121 researchers in 2019: 21 faculty, 2 post docs, 35 graduate students, and 63 undergraduates

OUR MISSION
A STRATEGIC INNOVATION PARTNER

The CINA Center serves as a *strategic innovation partner* for Homeland Security Enterprise (HSE) stakeholders, enhancing their efforts to combat networked criminal activities. By concurrently pursuing scientific advancements and practice breakthroughs, CINA assists the HSE to better comprehend, anticipate and respond to challenges posed by evolving illicit operations, and shapes a workforce that will excel in this complex operational landscape as it strives to protect our homeland.

Accordingly, the CINA Center primary goals in pursuit of its mission include:

- **Goal 1: Innovate to Support Current HSE Needs**
  CINA pursues the development and dissemination of innovative solutions (including methodologies, knowledge products, technologies, and tools) that make HSE stakeholders more effective and efficient in thwarting and prosecuting networked criminal organizations and other homeland-security-related criminals.

- **Goal 2: Anticipate Emerging Challenges and Opportunities**
  CINA informs the HSE of emerging and future capabilities or threats, and assists the HSE as it reshapes and expands its analytical capabilities.

- **Goal 3: Develop the Current and Future HSE Workforce**
  CINA provides professional development opportunities to strengthen the skillsets of the current homeland security workforce, develops inventive academic offerings and immersion opportunities for the future workforce, and supports workforce diversity by cultivating and establishing interaction mechanisms with Minority Serving Institutions.

We pursue our mission and these goals through a comprehensive set of activities comprising three distinct yet interconnected components:

- **Research activities**
  CINA manages an evolving portfolio of research projects at the intersection of the operational needs of the HSE and cutting-edge academic research, to improve current HSE operations (Goal 1) and shape future ones (Goal 2).

- **Outreach activities**
  CINA operates a broad outreach portfolio to highlight opportunities and challenges (Goal 2), to foster team-building in research pursuits (Goal 1) and to advance workforce skillsets (Goal 3).

- **Workforce development activities**
  CINA vigorously pursues and offers numerous academic and training activities, virtually and in person, to expand knowledge and hone critical skills (Goal 3).

Through these activities CINA fosters innovation across a broad spectrum of metrics—one student researcher, one algorithm, one knowledge product, one event at a time.

◎ REVEALING HIDDEN EVIDENCE
IN LOW-QUALITY VIDEO

Video can be a powerful and increasingly abundant resource for improving public safety, yet safety officials and investigators face numerous challenges when analyzing it. Accurate detection, identification and "re-identification" of individuals in video footage is paramount, even when the quality of the footage is very low. Poorly tuned or older legacy devices may record and store video that is inadequate for this task, creating a need for more effective analytic tools that can automatically extract actionable information from protective and investigative video.

CINA researchers at **Purdue University** and the **University of Notre Dame** are developing a system to help DHS components extract, summarize and reconstruct critical information. By using both face and full-body re-identification methods, the tool is now producing reliable results.

This system, scheduled for implementation in the fall of 2019, includes a highly integrated user interface that allows officials to interact with video data and visualize ranked matching results.

As Principal Investigator **Ed Delp** puts it, "We are addressing the problem of what can be done at the 'edge' of the network close to the video camera. This solution will allow DHS to minimize the amount of video data they need to collect."

CINA is evaluating the system with DHS partners, who are providing important feedback to guide further development. Once the evaluation period is complete, we anticipate broader implementation as the tool is shared throughout the DHS network. The project should result in additional efficiencies, reducing the time and cost of investigations, and providing access to information that was previously unavailable.

"This solution will allow DHS to minimize the amount of video data they need to collect." —**Principal Investigator Ed Delp, Purdue University**

Western Caribbean 9%

Eastern Caribbean 7%

Pacific 84%

Galapagos Islands 17%
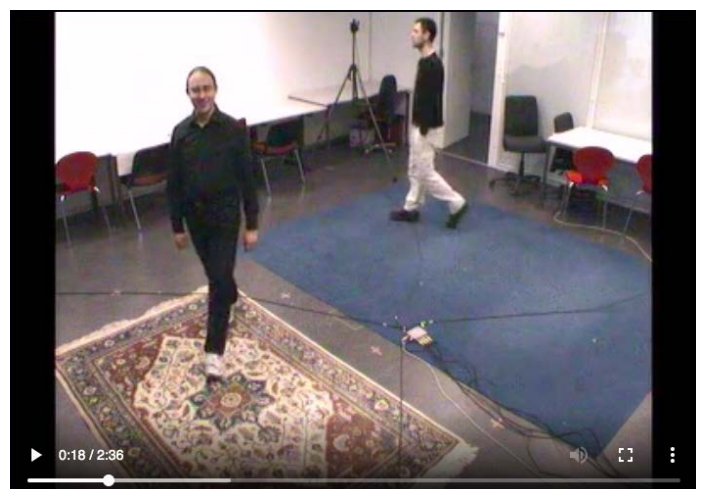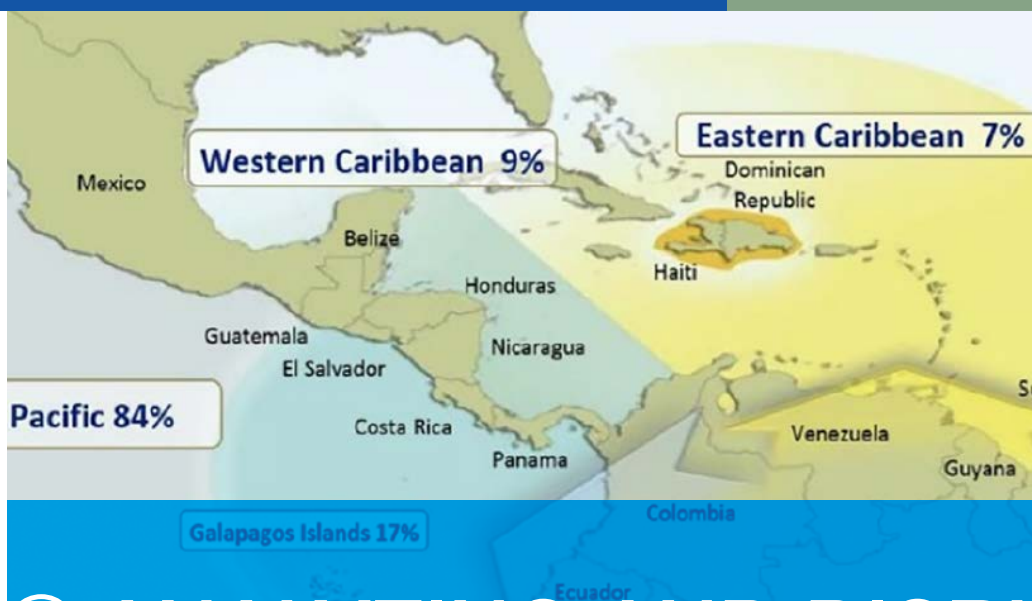
◎ ANALYZING AND DISRUPTING
COMPLEX TRANSNATIONAL CRIMINAL NETWORKS

Transnational criminal organizations typically comprise multiple interacting subnetworks, for example, a network to smuggle contraband into the U.S. and a network to move money out of the U.S. As a result, actions by or impacting one of these subnetworks may have cascading effects to other parts of the organization. Advancing our understanding of the operational structure of these networks is a homeland security priority.

CINA researchers, led by Professors **Boleslaw Szymanski** and **Thomas Sharkey** from **Rensselaer Polytechnic Institute,** are creating new analytical methods to help augment law enforcement investigations of transnational criminal organizations. The first method helps predict missing or incomplete data about the organization, potentially accelerating investigations. The second helps detect 'communities' of criminals, revealing the roles of individual criminals within the networks of the organization. A third method helps prescribe tactics to disrupt the criminal organization by modeling the interactions between its networks, helping to understand when it is effective to interdict different types of networks.

The impact of the team's innovative approaches will allow for more efficient and more strategic interdiction by law enforcement. Szymanski and Sharkey indicate, "metrics may include measuring the impact of the approach on success of interdiction and the value of information, and whether or not it justifies the additional investigative time required to obtain more accurate information."

LAW ENFORCEMENT INVESTIGATIONS

Incomplete Criminal Organization (CO) Data

Augmented CO Data

Identified Roles And Communities In CO

LAW ENFORCEMENT INVESTIGATIONS

Identified Flows Through Networks Of CO
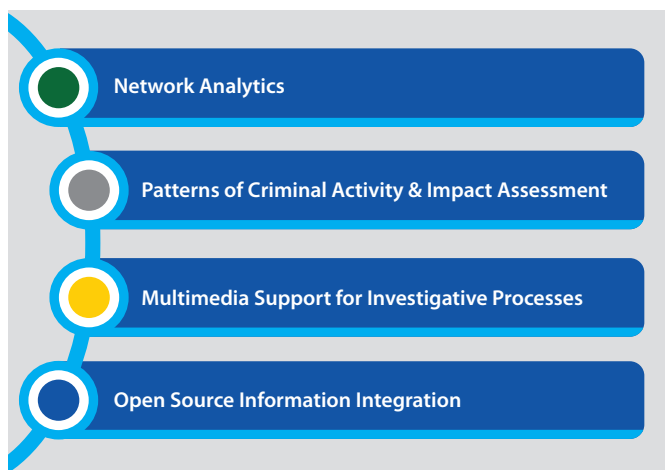
Disrupted Operations Of CO

"Our methodology will enable DHS analysts to best navigate through incomplete information in their pursuit of criminal investigations." **—Principal Investigator Boleslaw Szymanski, Rensselaer Polytechnic Institute**

OUR EVOLVING RESEARCH PORTFOLIO

CINA has established its research foundation to advance science and practice across four *research themes:* 1) Criminal Network Analysis; 2) Dynamic Patterns of Criminal Activity; 3) Forensics; and 4) Criminal Investigative Processes.

While pursuing these themes, CINA has established its academic and operational footprint, characterized by a set of core competencies (Figure 1). These four strengths permeate across research projects, outreach activities, and workforce development efforts, and characterize CINA's operational signature.

Figure 1: *Core competencies of the CINA network*

- Network Analytics
- Patterns of Criminal Activity & Impact Assessment
- Multimedia Support for Investigative Processes
- Open Source Information Integration

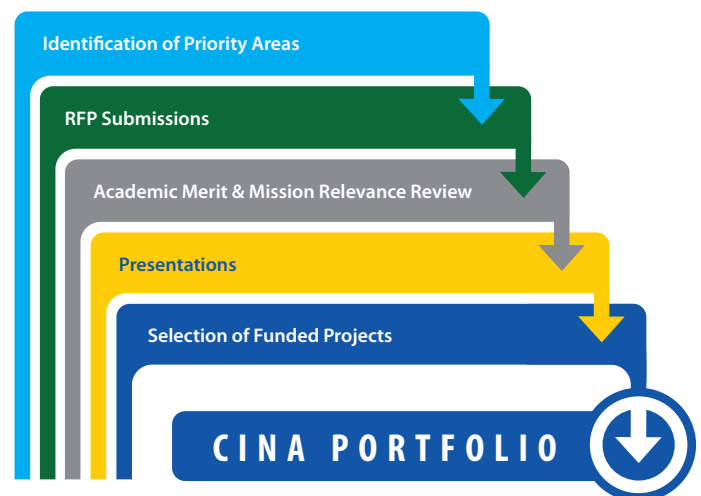## Evolving Research Collaborations

Reflecting our ability to initiate targeted research efforts, we introduced a new project on **"Building an Enriched Gazetteer of Illicit Cartel Activities"** to address a specific operational need. This effort is a collaboration of CINA researchers with groups from our fellow COEs: the Center for Accelerating Operational Efficiency (CAOE) and the National Consortium for the Study of Terrorism and Responses to Terrorism (START), (page 10 for details).

At the same time, we initiated the CINA RFP (Request for Proposals) process, to recruit new research projects for the CINA portfolio. This was a multistage process (outlined in Figure 2) involving input from the HSE and academia to ensure the selected projects are both academically meritorious and mission relevant. Through this process, we received nearly 50 proposals from 28 different universities and were able to select five projects for full funding as identified below.

RFP Themes

This year, our selections focused on two key themes: the ongoing opioids crisis, and the use of cryptocurrency in illicit activities, representing two of the most pressing challenges for the criminal investigations community. The CDC estimates U.S. overdose death rates linked to synthetic opioids increased more than 45 percent from 2016 to 2017[1], while the total economic burden of prescription opioid misuse in the U.S. is $78.5 billion a year[2]. Cryptocurrency also emerges as a major challenge; some studies indicate at least one quarter (or $80B) of the $350B cryptocurrency market is associated with illicit activities. As the HSE is intensifying its efforts to address these substantial challenges, CINA researchers will be ready to assist.

Figure 2: *The multi-stage CINA RFP process*

- Identification of Priority Areas
- RFP Submissions
- Academic Merit & Mission Relevance Review
- Presentations
- Selection of Funded Projects

CINA PORTFOLIO

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[1] https://www.cdc.gov/media/releases/2018/p1221-complexity-drug-overdose.html
[2] https://www.drugabuse.gov/drugs-abuse/opioids/opioid-overdose-crisis

New Research Projects

A multidisciplinary team of researchers from George Mason University, led by **Foteini Baldimtsi,** Associate Professor of Computer Science, is partnering with the **Blockchain Intelligence Group** to pursue a project on "**Money Laundering with Cryptocurrencies.**" The project will pursue big data analysis techniques to assess money laundering activities using cryptocurrencies, and develop automated (probabilistic) tools to serve the operational need of identifying users (i.e., addresses) that are likely involved in illegal activities, in support of relevant investigations.

Diana Dolliver, Assistant Professor of Criminology and Criminal Justice at the University of Alabama, will lead a project on **"Digital Forensic Investigations involving Cryptocurrency Wallets Installed on Mobile Devices."** This project will address the challenges faced by investigators related to the efficacy of seizing cryptocurrencies from software wallet applications and extracting, preserving, and analyzing related data recovered from suspects' mobile devices.

Dan O'Malley, Chair of School of Business at Liberty University, will pursue a project on **"An Extensible Criminal Predictive Analytic Platform (CPAP) for Opioid Abuse Detection and Prediction."** The project will develop a predictive analytic platform to anticipate future opioid hotspots in near real-time using open source intelligence for law enforcement intervention.

A multidisciplinary team of researchers from Georgia State University, led by **Marie Ouellet,** Assistant Professor of Criminal Justice and Criminology, will pursue a project on **"Open Source Intelligence in Online Stolen Data Markets."** The project will advance our understanding of how actors in underground online markets and forums emerge, establish their reputations, and manage the sourcing and sale of online data. Building on this, the PIs will develop effective network disruption strategies.

A multidisciplinary team of researchers from the University of Texas at San Antonio and the University of Washington, led by **Marie Skubak Tillyer,** Associate Professor of Criminal Justice at UTSA, will pursue a project on **"Innovative Spatiotemporal Pattern Detection: Examining Changes in Crime Hot Spots Across 6 U.S. Cities,"** to study changes in crime at the block face level from 2008-2018 across six major U.S. cities, to advance our understanding of the correlation between place and crime and the mechanisms that drive the birth and death of crime hot spots.

NEW RESEARCH PROJECT LEADS

GEORGE MASON UNIVERSITY   THE UNIVERSITY OF ALABAMA®   LIBERTY UNIVERSITY SCHOOL of BUSINESS   Georgia State University®   UTSA Criminology & Criminal Justice   UNIVERSITY of WASHINGTON

# Building an Enriched Gazetteer of Illicit Cartel Activities

Cartel activities occur over space and time at one or more geographical locations, and are based on several possible functional building blocks. However, identifying the space-time characteristics (context) of such geographic locations and the relations between them is not simple, as such information can often be extracted only by exploring the convolution of activity type, actor, and locations over time. As a result, a complete and clear picture of the spatial footprints of cartel illicit activity cannot be obtained, limiting situational awareness and operations.

In order to address this challenge, CINA researchers collaborated with groups from our fellow COEs at the Center for Accelerating Operational Efficiency (CAOE) and the National Consortium for the Study of Terrorism and Responses to Terrorism (START) to form a multi-site team that pursues the derivation of actionable knowledge for cartel activities from open-source content.

The CINA portion of this effort is led by **Arie Croitoru,** Associate Professor, Geography and Geoinformation Science. Croitoru's team is developing a linked illicit activity gazetteer and data analyzer. This gazetteer is constructed by building explicit links between place toponyms, possible colloquial synonyms, non-geospatial concepts and terms, and other (external) available open data and knowledge sources – in particular social media and news articles. The ensemble of these various links combines location information, relations to other locational information, event information, and non-geographic information into a knowledge graph. This graph can then be queried and mined to identify emerging patterns, or test user-driven queries. Summarizing the challenges behind this effort, Croitoru states that "The biggest challenge in our project is to discover the links between different locations which are often implicit. Addressing this challenge will enable delivering to intelligence analysts a much better insight into how cartels operate over space and time."

"Addressing this challenge will enable delivering to intelligence analysts a much better insight into how cartels operate over space and time."

—**Principal Investigator Arie Croitoru, George Mason University**
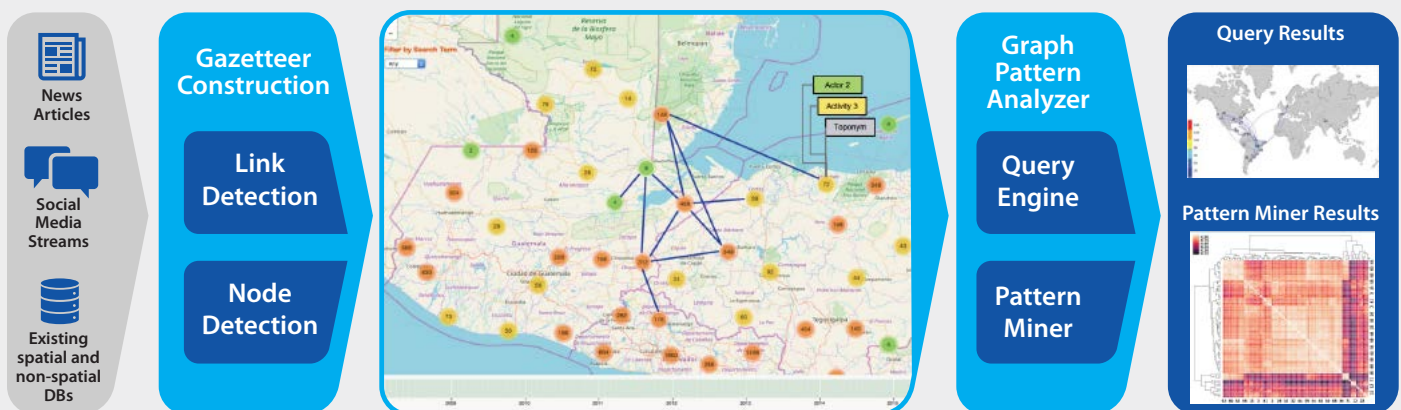
CINA OUTLOOK

THE EXPANDING LANDSCAPE OF NETWORKED CRIMINAL ACTIVITIES

CINA Science Committee members offer views on emerging opportunities and challenges in their respective fields, suggesting priority issues shaping criminal investigations in the near future.

The networking breakthroughs that allowed people worldwide to connect with each other and access information at historically unparalleled levels are also providing a fertile infrastructure for worldwide illicit activities. Recently the role of online classified sites for human trafficking came under the spotlight when the Department of Justice seized Backpage, following lengthy investigations. Similarly, dark web marketplaces have played a key role on the ongoing opioids epidemic, connecting synthetic opioid suppliers in China with their emerging customer base in the northeast and the rest of our country. While our government is able to occasionally disrupt these illicit operations, this only offers temporary relief. Alternatives to Backpage are already emerging, and potential disruptions in China to the current supply chains of synthetic opioids will likely lead to other actors (e.g. India) filling the gaps.

CINA OUTLOOK '20

CINA OUTLOOK

CINA Science Committee members, from left to right. Front row: Allison Redlich, David Weisburd, Louise Shelley, Mary Ellen O'Toole. Back row: Jim Jones, Anthony Stefanidis, Ed Hovy

These illicit activities form a massive global economy sector. While it remains hard to assess their full scope, transnational networked criminal activities are widely estimated to account for up to 5% of the world's $80 trillion economy. These estimates put this illicit economy on par with, or even ahead of, the economies of most wealthy state members of the G7 group, lagging behind only the economies of the U.S., China, and Japan. Driven by such profit potential, these illicit activities are evolving: human trafficking, both inside and across national borders, is becoming increasingly sophisticated; the modern plague of synthetic opioids, arguably the first drug epidemic of the e-commerce era, is ravaging communities across the U.S.; and in the short 10 years since the inception of bitcoin, cryptocurrency presents a fertile financial environment to support illicit activities.

Therefore, monitoring networked illicit activities in an era of hyper-connectivity and massive data will always be a pressing need. Network analysis capabilities are extremely helpful in advancing our ability to comprehend the operational structure of illicit networks and devise optimal disruption strategies. Natural language processing and deep learning remain key priorities (whether they are applied to online advertisements or trade-based money laundering), as it becomes increasingly impossible for individual investigators to navigate through massive amounts of data and identify hidden patterns without them. The CINA Science Committee provides this view of emerging opportunities and challenges in our respective fields, grouped here as priority issues which may shape criminal investigations in the near future.

Artificial Intelligence (AI) Applications

- Accurate **face recognition** (and even long-distance recognition of individual faces in crowds) is already being deployed for commercial and government purposes in some countries. Research on automatically **annotating images and videos** holds increasing promise for accurate text-driven search.

- AI applications in **Natural Language Processing** have strong transformative potential for investigations. This includes entity detection (finding people, companies, places, etc.), topic detection and tracking (following social media and news commentary about an evolving situation), and sentiment detection (determining opinions about topics). Breakthroughs are bolstered by the collection of background knowledge (gathered from the web or other sources) and automated inference (deduction to draw conclusions using learned rules).

- **Knowledge graph techniques** allow us to make information explicit, building networks of actors, interactions, and related elements from structured and unstructured sources, revealing the nature and full scope of illicit operations. Research on trend detection and causality discovery continues unabated, also using techniques developed in (and producing results for) aspects of Economics, Biomedicine, and Physics.

- Securing the cyberspace relies on the use of AI and machine learning generally, but is increasingly supported by a complementary array of breakthroughs in **Biometrics** (to guarantee identity), **computer hardware** (to prevent the introduction of malware and spyware), security of the **Internet of Things, computer networks** (for anonymity and censorship resistance), **software** (for deepfake detection), and **blockchain technology.**

Digital Forensics

- **Data Access** challenges include the need to extract data from an ever-growing ecosystem of devices, to include Internet-of-Things, embedded systems, vehicles, wearables, and many more. Investigators' inability to access encrypted data poses another data access challenge. The final data access challenge is driven by the increasingly distributed storage of data, to include cloud storage in various jurisdictions and the opportunity for data to move between jurisdictions. The cloud also creates technical challenges, as cloud infrastructures are, by design, shared across multiple users and organizations.

- **Data analysis** challenges are driven by the immense and increasing volume of data available. Specific opportunities exist in automation of the triage and analysis processes so that human investigators can focus on leads, relationships, and content most likely to be of value to an investigation.

- **Data integrity** challenges emerge from the development and availability of tools and techniques to manipulate digital content, e.g., images, videos (deep fakes), and audio (voice generators).

- Tools such as The Onion Router (TOR) enable mutually anonymous network connections, private VPNs provide one-sided network anonymity, and compromised systems in the form of bots or live relay points obfuscate **attribution** to the true source of network traffic. Techniques are occasionally developed to trace such connections, but these techniques are often exposed in court proceedings which renders the techniques much less effective against an observant and dynamic cyber-criminal community.

Forensic Science and Interaction with Victims, Suspects and Detainees

- **Rapid DNA screening** technology at the border can counter human trafficking and assist with a broad range of applications (e.g. asylum cases, refugee reunification, and overseas adoption cases), but there are still legal and policy challenges to overcome regarding its use.

- More efficient methods are needed to support **opioid detection** in shipments entering the country, as well as for chemical detection screening to disrupt the flow of opioids into the United States.

- A better understanding of **behavioral analysis** concepts, ranging from pre-offense, offense and post-offense behaviors, as well as training in interview concepts would benefit investigations. This would advance our ability to detect suspicious behaviors at the border which may be associated with the illegal transportation of people or goods.

- We need to advance our understanding of, and our ability to detect, patterns of **warning behaviors** by offenders in the period leading to mass shootings or other acts of terrorism.

- There is an increased focus on immigration issues, including interviewing people at the border and interviewing human

trafficking victims. The increased focus on obtaining (more) information from suspects/detainees, as opposed to obtaining confessions, puts a renewed focus on the development of **robust interview techniques** to obtain more and accurate information.

Strategic Interdiction

- There is a developing interest in **predictive analytics,** to help resource allocation from local to federal scales.

- The Law of Crime Concentration suggests that a small part of a city will host the majority of crime-related problems. This seems likely true of such problems as illegal border entry and related ICE problems. Further research on **hot spot analysis** for problems at the level and geography of ICE concerns will be quite beneficial.

- There has been a growing recognition of the importance of diffusing programs and practices that have proven to be effective. This has led to the development of rigorous program evaluations in fields from health to policing. DHS operations can benefit from **assessments of the effectiveness of DHS investigations.**

- There is a growing awareness of the importance of **assessments of the community impact of investigations and interventions.** This will advance our abilities to proactively identify optimal intervention strategies, and also to better articulate to local communities how such investigations improve the everyday lives of the general public.

WORKING WITH MINORITY SERVING INSTITUTIONS

CINA MSI Summer Week
By John Hollis

Dan Vandiver said the week he recently spent at George Mason University has given him a much better understanding of the many opportunities available to him in the fields of computer science, criminal investigations, and digital forensic science.

A rising senior from California State University – San Marcos, **Vandiver** was part of a group of 18 undergraduate and graduate students and faculty from around the country who recently came to Mason for the Criminal Investigations and Network Analysis Center's (CINA) Summer Immersion Week. The students were introduced to skills used by federal investigators and learned specifics about potential careers within the Department of Homeland Security by engaging with scholars and researchers from Mason and other minority-serving institutions (MSI), as well as DHS representatives.

Anthony Stefanidis, the director of CINA, said the week-long experience provided an excellent opportunity for students to receive a solid overview of educational and research topics that are at the core of the CINA Center.

"It's blown me away," Vandiver said of his experience. "I figured there'd be some software, some tech analysis. But it's really been an amazing week and I've learned so much."

And that was just the point.

Above photo: CINA's DHS interns and MSI research teams meet for a summer program kickoff session.

"We provided these CINA student-scholars with a unique understanding of emerging skillsets that will help them in their future careers," Stefanidis said. "At CINA, we feel very strongly about broadening tomorrow's workforce and this unique summer program is an expression of this principle."

The CINA at Mason researchers who spoke to the group included **David Weisburd,** a Distinguished Professor and the executive director of the Center for Evidence-Based Crime Policy within the College of Humanities and Social Sciences; **Louise Shelley,** a University Professor and the executive director of the Terrorism, Transnational Crime and Corruption Center (TraCCC) within the Schar School of Policy and Government; and **Jim Jones,** an associate professor in the Digital Forensics and Cyber Analysis program within the Volgenau School of Engineering.

The Mason-led consortium aims to use science to further develop cutting-edge solutions to the problems.

"I'm very curious in all the areas of science," said **T'awna Williams,** a graduate student from California State University – Los Angeles who is working on a master's degree in forensic psychology. "Given the diversity of options here, you can definitely find something. The multidisciplinary approach is really interesting and makes young people want to come into the field."

Student engagement opportunities continued throughout the summer with the 2019 DHS COE Summit and two visiting Summer Research Teams (SRT).

MSI Summer Research Teams

In 2019, CINA hosted two Summer Research Teams (SRT). Professor **Vernon Scott** and **Ms. Diana Gomez** from Trinity Washington University worked at the George Mason University Fairfax, Virginia campus on a project examining the relationship between policing and community attitudes toward police. "The Summer Research program was a tremendous opportunity," Professor Scott said. "It provided access to a wealth of knowledge, and exposed us to new and innovative research methods."

From Eastern New Mexico University, Dr. **Omar Camarillo, Ms. Cecilia Torres** and **Ms. Xandra James** were funded to research social media perceptions regarding the ties between U.S.-based gangs and Mexican Drug Trafficking Organizations (DTOs). "My students had a once in a lifetime opportunity," said Dr. Camarillo. "We got to present our research findings to DHS leaders at the DHS COE Summit."

CINA's summer research teams also participated in the 2019 CINA Summer Week for Minority Serving Institutions, attending lectures and training sessions on criminology, human trafficking, network analysis, forensics and cryptocurrency.

Top photo: CINA summer research teams present their findings at the COE Summit event in Arlington, Virginia.

Bottom photo: MSI Summer Week participants gathered for an immersive, multidisciplinary program held at the George Mason University Fairfax campus.

"At CINA, we feel very strongly about broadening tomorrow's workforce and this unique summer program is an expression of this principle." —**Tony Stefanidis**

COE SUMMIT STUDENT GRAND CHALLENGE

As part of the 2019 DHS Centers of Excellence Summit, 30 students from across the COE network participated in a student Grand Challenge to develop groundbreaking, interdisciplinary counter-unmanned aerial systems (UAS) strategies for the Homeland Security Enterprise. Thanks to generous support by General Dynamics Information Technology (GDIT), students from eight Centers of Excellence and their Minority Serving Institution partners attended a series of webinar briefings by UAS and counter-UAS experts from American Military University, the U.S. Coast Guard, U.S. Transportation Security Administration, U.S. Customs and Border Patrol, and the National Urban Security Technology Laboratory.

Participants then convened for an intense two-day session of on-site work in interdisciplinary teams to identify an emerging threat to homeland security posed by unmanned aerial systems and develop a strategy to counter it.

Second place was awarded to a pitch entitled *Drone-based MIR Laser Induced Thermal Imaging for Identification of Chemical Substances,* presented by **Ha Anh Vu Le** (BTI) – University of Houston; **Annette Colón Mercado** (ALERT) – University of Puerto Rico at Mayaguez; **Danielle Dobbs** (MSC) – SUNY Maritime; **Jin Lee** (CINA) – George Mason University.

First place was awarded to the project *Automated Drone Integrated Information System (ADIIS),* presented **Emily Belk** (ALERT) - Northeastern University; **Tristan Goers** (ADAC) - University of Alaska Anchorage; **Keshav Kasichainula** (BTI) - University of Houston; **Trinity Reed** (CIRI) - Southern University and A&M College; **Emiliano Ruiz** (CAOE) - University of Texas at El Paso.

Participants in the Student Grand Challenge also participated in a student poster competition, networking breakfast, and DHS human capital roundtable discussion, all designed to cultivate the next generation of homeland security professionals, acquainting them with DHS strategic challenges, expert perspectives and information on careers in government service. George Mason University student **Jin Lee** described the experience as "a chance to solve a challenging, real-world problem with people from different backgrounds, while networking with other students and professionals in the homeland security field."

Beth DeFares (MSC), who co-chaired the organizing committee with CINA's **Stu Mackenzie,** commented: "Outcomes from the Grand Challenge demonstrated the analytical capabilities of the COE students to think quickly and to form innovative and sound approaches under pressure. The event also highlighted their professional confidence and keen ability to articulate and communicate their ideas."

The Retail Value of Transnational Crime

Counterfeiting	$923 billion to $1.13 trillion
Drug Trafficking	$426 billion to $652 billion
Illegal Logging	$52 billion to $157 billion
Human Trafficking	$150.2 billion
Illegal Mining	$12 billion to $48 billion
IUU Fishing	$15.5 billion to $36.4 billion
Illegal Wildlife Trade	$5 billion to $23 billion
Crude Oil Theft	$5.2 billion to $11.9 billion
Small Arms & Light Weapons Trafficking	$1.7 billion to $3.5 billion
Organ Trafficking	$840 million
Trafficking in Cultural Property	$1.2 billion
Total	$1.6 trillion

Source: *Transnational Crime and the Developing World*

INTRODUCING
THE CINA MULTIMEDIA ARCHIVE

In 2019, CINA launched its **Distinguished Speaker Series** of expert overviews of CINA mission topics followed by audience Q&A. Inaugural talks covered such crucial challenges as illicit trade, tracking cash flows, threat financing, narcotics, interviewing techniques, and the role of cryptocurrencies in protecting the anonymity of criminals. Featured experts included **Channing Mavrellis,** a transnational crime analyst and money-laundering specialist with Global Financial Integrity; **Susan Brandon,** former director of research with the High-value Detainee Interrogation Group; and **Foteini Baldimtsi,** an eminent researcher on cryptography, security and data privacy. These events were hosted at George Mason University, with an option to participate remotely via WebEx.

Federal investigators and law enforcement officers can access these sessions on an ongoing basis within a digital archive of these and other key topic presentations, found on the CINA Youtube channel (bit.ly/CINAchannel). These high-quality videos serve both as a reference library for the HSE, and also as a means of communicating our work and value to potential partners. Additional highlights include panels from the highly successful 2018 DHS Centers of Excellence Summit, and a summary of a recent symposium on Migration, Homeland Security and Gangs. For more program information, go to **cina.gmu.edu/events**

CINA SPONSORED EVENTS

Illicit Supply Networks and Crime and Justice Policy

To foster information exchange and initiate collaborations among practitioners, policy makers, and academic researchers, CINA co-sponsored events highlighting important homeland security community topics. This past year, 500 attendees gathered at CINA-co-sponsored events to discuss crime and justice policy and illicit supply networks.

◉ Illicit Supply Networks

On March 25 and 26, CINA co-organized an NSF-led conference on **"Disrupting Operations of Illicit Supply Networks."** Academic and private sector experts in this field connected with representatives from relevant federal agencies including DHS, DOD, DOJ, USAID, and the U.S. Department of State, to discuss various forms of illicit activities including: trafficking (of humans, arms, drugs, antiquities, wildlife, and organs); pharmaceutical and other counterfeit product trading; financial fraud/money laundering; and cybersecurity/ Darknet trading.

The conference featured keynotes by **Dr. Mark Shaw** of The Global Initiative and **Dr. Lee Schwartz** from the U.S. Department of State. More than 120 experts attended the conference which served as a collaboration venue between academic institutions and law enforcement agencies, as part of an NSF initiative to remove the silos between research and operations.

For CINA, this event presented a unique opportunity to recruit researchers for our research portfolio. After hearing the event's CINA overview presentation, a number of participants submitted proposals to the CINA RFP, including professors **Dolliver** and **Baldimtsi,** whose proposals have now become fully sponsored CINA projects.

◉ Crime and Justice Policy

Criminal justice practitioners, policy makers, and researchers from around the globe gathered at the George Mason University Arlington, Virginia campus with the goal to better integrate science into criminal justice policy. The CINA co-sponsored 2019 Center for Evidence-Based Crime Policy Symposium on June 27 featured 375 registrants from 190 organizations in 35 states and Canada, and 45 speakers from universities, research think tanks and practices.

Symposium attendees discussed improving the overall fairness and effectiveness of criminal justice institutions and programs. Panels described complex issues such as the mental health crisis, identity theft victimization, mass violence in the United States, improving policing through research and analysis, and combating the opioid epidemic. CINA Director **Stefanidis** moderated a CINA-dedicated session on analytics for crime networks and which featured CINA PIs **Szymanski, Holt,** and **Croitoru.**

"This is a meeting place to share new and cutting-edge research," said CINA Science Committee member **David Weisburd,** a Distinguished Professor and the executive director of Mason's Center for Evidence-Based Crime Policy (CEBCP). "We focus on emphasizing that making policy decisions with strong scientific evidence is critical for the criminal justice system."

"This is a meeting place to share new and cutting-edge research. We focus on emphasizing that making policy decisions with strong scientific evidence is critical for the criminal justice system." —**David Weisburd, CINA Science Committee member**

COE SUMMIT 2019

Evolving Threats and Dynamic Solutions

As the Homeland Security threat landscape continues to evolve, the DHS Centers of Excellence again collaborated to bring thought leaders from across the nation together to discuss these challenges and identify how the COEs might partner together with DHS components, industry and each other to provide innovative solutions.

Joanna Ip, Assistant Director (Acting), Operational Technology and Cyber Division (OCTD), HSI, ICE, vividly captured the challenges faced by Homeland Security investigations as part of a leadership panel moderated by Deputy Under Secretary (Acting) for S&T, **André Hentz.** Ip emphasized the importance of big data analytics solutions to support information mining to produce valuable investigative insights. She suggested these solutions need to be agile and nimble to adapt to the increasingly diverse problem sets HSI faces in its mission to disrupt and dismantle transnational criminal organizations that exploit the global infrastructure to pursue illicit activities.

How big is this challenge? In FY18 alone, Homeland Security investigations resulted in 34,000 criminal arrests, seizure of over $1.2B and 10,000 pounds of opioids, and identification and rescue of 859 child victims. These figures convey both the scope of the effort and its societal importance.

CINA organized logistics for the week-long activities surrounding the two-day summit, held July 31 and August 1 at George Mason University's Arlington, Virginia campus. The event connected more than 500 subject matter experts from 350 different academic, industry and government organizations and more than 40 students.

In his opening remarks, DHS Office of University Programs Director, **Matt Coats** addressed the two central themes of the Summit; gray zone threats, and challenges posed by today's hyperconnected world. Director Coats emphasized the role of COEs at the tip of the spear of innovation as DHS evolves to address its current and emerging challenges.

The Senior Official Performing the Duties of DHS Under Secretary for Science and Technology, **William Bryan** further emphasized the importance of COE-led innovation in today's challenging times. Bryan noted such innovation must extend to the next generation of problem solvers. Tomorrow's diverse workforce must be able to combine the art of critical thinking with the necessary technical skillsets to navigate through massive amounts of data. **Watch the COE Summit recap video at cina.gmu.edu/COESummit19.**

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Criminal Investigations
and Network Analysis
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