

A Systematic Process for Vulnerability Assessment of Biometric Systems at Borders

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Project Team Profile

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- Project Start Date: **July 1, 2016**
- Anticipated End Date: **June 30, 2020**
- Project personnel:
 - **Emanuela Marasco; Senior Personnel**
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Problem Statement

- Biometrics and Identity management are critical technologies ensuring the integrity of immigration services.
 - Also a natural target for identity manipulation.
 - Threats to DHS systems have dimensions not accounted for in generic “liveness detection”.
 - *Attacks related to:*
 - *Presentation.*
 - *Workflow*



Hong Kong Polytechnic University Disguise and Makeup Faces Database



A surgically altered finger



Beneficiary / End User Profile: Jobs

- Who are the beneficiaries / end-users of this research (the “jobs”)?
 - Biometric Technology Rallies
 - System evaluators
 - CBP risk analysts
 - CBPO Fraudulent Documents Analysis Unit
 - OBIM – Futures Identity

Beneficiary / End User Profile: Desired Gains

- What are the main outcomes and benefits that the end user desires (the “gains”)?
- Connect human factors motivating travelers, immigrants and refugees to identity concealment efforts;
- Understand and quantify misidentification and concealment risks.

Beneficiary / End User Profile: Pain Points

- Can identity be manipulated at a supervised immigration check point?
- Illegal immigrant used surgery to fake fingerprints and enter Japan.



- Age: 27 years old
- Gender: Female
- Nationality: Chinese
- Background: Arrested for faking a marriage license

1. She paid a plastic surgeon to surgically alter her fingerprints to evade detection. She paid about 15000\$ for the fingerprint transplant surgery. Patches of skin from her thumbs and index fingers were removed and grafted onto the fingers of the opposite hand.
2. She passed through the checkpoint using fake fingerprints.
3. Rong's identity was not detected when she entered Japan illegally.

Collect money for
transplant
fingerprint surgery



Pay a plastic
surgeon



Get skin from
fingers removed
and grafted on
the other hand



Pass through the
checkpoint



Enter the
country



Beneficiary / End User Profile: Pain Points (2)

- What are the main issues the capability/knowledge gap is causing (the end user “pains”)?
 - Lacking description of attack vectors or comprehensive processes to mitigate ID risks
 - Traveler, immigrant and refugee services
 - Connecting motivation, capabilities (technical and resources) and methods
 - Prioritizing defensive measures through risk assessment.

Products & Services

- What products & services are the outcomes of this research project?
 - Knowledge Products (completed):
 - Three technical reports related to motivation, techniques and attack vectors
 - Three papers published so far
 - Technologies (completed and in progress):
 - Abstraction / collection / classification of biometric attack vectors
 - Tools:
 - Risk assessment from attacked vectors
 - Tool created, but revealed a knowledge gap

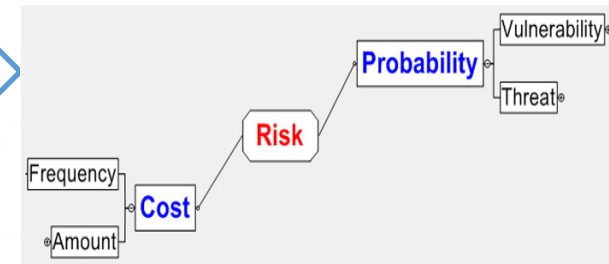
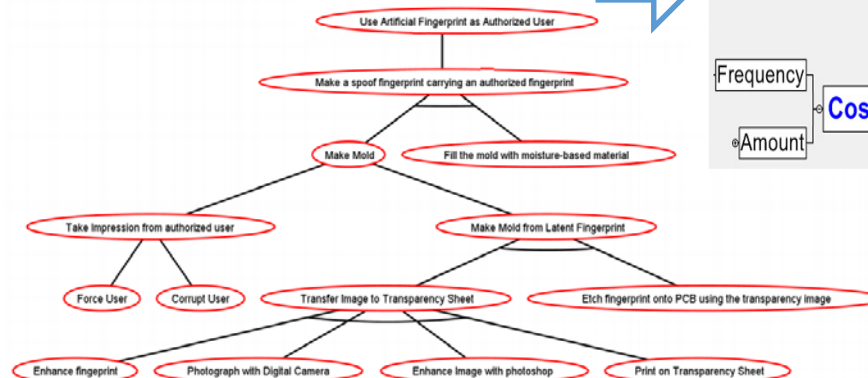
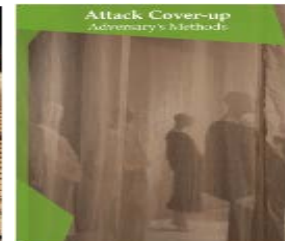
Gains Created: Example

STORY:

A South Korean woman who had been blocked from entering Japan apparently slipped past the screening system by placing special tape over her fingerprints. The silicon covering foiled the scanning device and didn't alert officials that she had been deported in 2007 for overstaying and was barred from re-entry for five years. Immigration officials later found her inside the country. She had succeeded passing the biometric identity check at the airport.

- Security cards – parse the content

- Adversary's Motivations, Adversary's Resources, and Adversary's Methods



- Risk Assessment

- Attack Representation: trees, graphs

Gains Created

- What are the gains achieved and how are they measured?
 - Developed eight biometric identity fraud scenarios (attack vectors)
 - Include motivation factors and perpetrator's capabilities.
 - All vectors come from publicly available stories and interviews.
 - Security risks related to transnational flows of people cannot be studied in stovepipes (biometric spoofs, cyber intrusions (ID manipulation), motivation, expertise, passport fraud)
 - Need coordination and integration of concerns.

Pains Alleviated

- What are the pains alleviated and how are they measured?
 - Identification of common biometric attack vectors through a systematic methodology that describes biometric / process vulnerabilities and attack opportunities.
 - Stories can be properly documented and analyzed.
 - Metrics: deliver at least one attack scenario for each of the populations of interest (travelers, immigrants, refugee management)
 - Delivered at least two in each category
 - Tool support for the analysis process:
 - <http://securitycardsforreview.njs.jelastic.vps-host.net/>
 - Risk assessment from attack trees

Key Accomplishments - Example

STORY:

A South Korean woman who had been blocked from entering Japan apparently slipped past the screening system by placing special tape over her fingerprints. The silicon covering foiled the scanning device and didn't alert officials that she had been deported in 2007 for overstaying and was barred from re-entry for five years. Immigration officials later found her inside the country. She had succeeded passing the biometric identity check at the airport.

Travelers Category

Motivations

Concealment of Crimes Adversary's Motivations

How might the adversary abuse the system to conceal other crimes?

Example Causes: The stolen identity is implicated in crimes

Social Skills: Coercion Adversary's Resources

How might the adversary coerce people into divulging sensitive information?

Example: Buying information from others (e.g., employees of various business or state agencies)

Money Adversary's Motivations

How might the adversary use or misuse the system for financial gain?

Example Goals: Quick need for cash (feeding addictions such as drug habits, gambling debts; or family crises, loss of the job)

Example Actions: Steal fingerprint data, disclose fingerprint data, misinformation

Political Terrorism Adversary's Motivations

How might the adversary abuse the system to perform a terrorist attack?

Example Actions: Placing special tape over the fingerprints to deceive the system at the airport

Resources

Impunity Adversary's Resources

Which kinds of impunity might the adversary have? How might impunity for their actions make adversary free to execute attacks on the system?

Example Causes: Unafraid of incarceration
Example Contributors: Anonymity

Social Skills: Manipulation Adversary's Resources

How might the adversary manipulate people into divulging sensitive information?

Example Actions: Obtain info from people they know (e.g., family, friends); Handle high-stress situations such as the immigration line

Money Adversary's Resources

How might the adversary use money for performing an attack?

Example Goals: Evade detection at the checkpoint

Example Actions: Pay a plastic surgeon to surgically alter fingerprints

Technical Skills Adversary's Resources

Which technical skills does the adversary need to have to execute certain attacks on the system?

Example Actions: Technical knowledge and materials to be used during the fabrication process of artificial biometric samples

Achievements: Travelers – the attack tree



Key Achievements: Immigrant population

STORY:

Miriam obtained F1 visa to study in the US. She arrived to her University using F1 visa and requested that her boyfriend / fiancé be issued F2 visa. Background check determined he served military service in a company associated with Iranian Republican Guard. His visa was denied. Miriam left the university, supposedly because of her boyfriend, and lost F1 visa. Instead of going back to Iran, she went see her uncle in California. While there, she overstayed her visa. She tried to pay individuals to impersonate her while exiting the US.

Motivation

Access or Convenience

How might the adversary abuse the system for life of convenience?

Example Actions:

Obtaining admission to US University without intention to pursue a degree.

Motivation

Malice or Revenge

How might the adversary abuse the system to exact revenge?

Example Actions:

With the dream of life in US threatened, revenge through an adversarial action

Resources

Impunity

How to achieve the goal without risking fines or incarceration?

Example Actions: Pay someone to exit US as her. Access to passport falsification service.

Resources

Inside knowledge

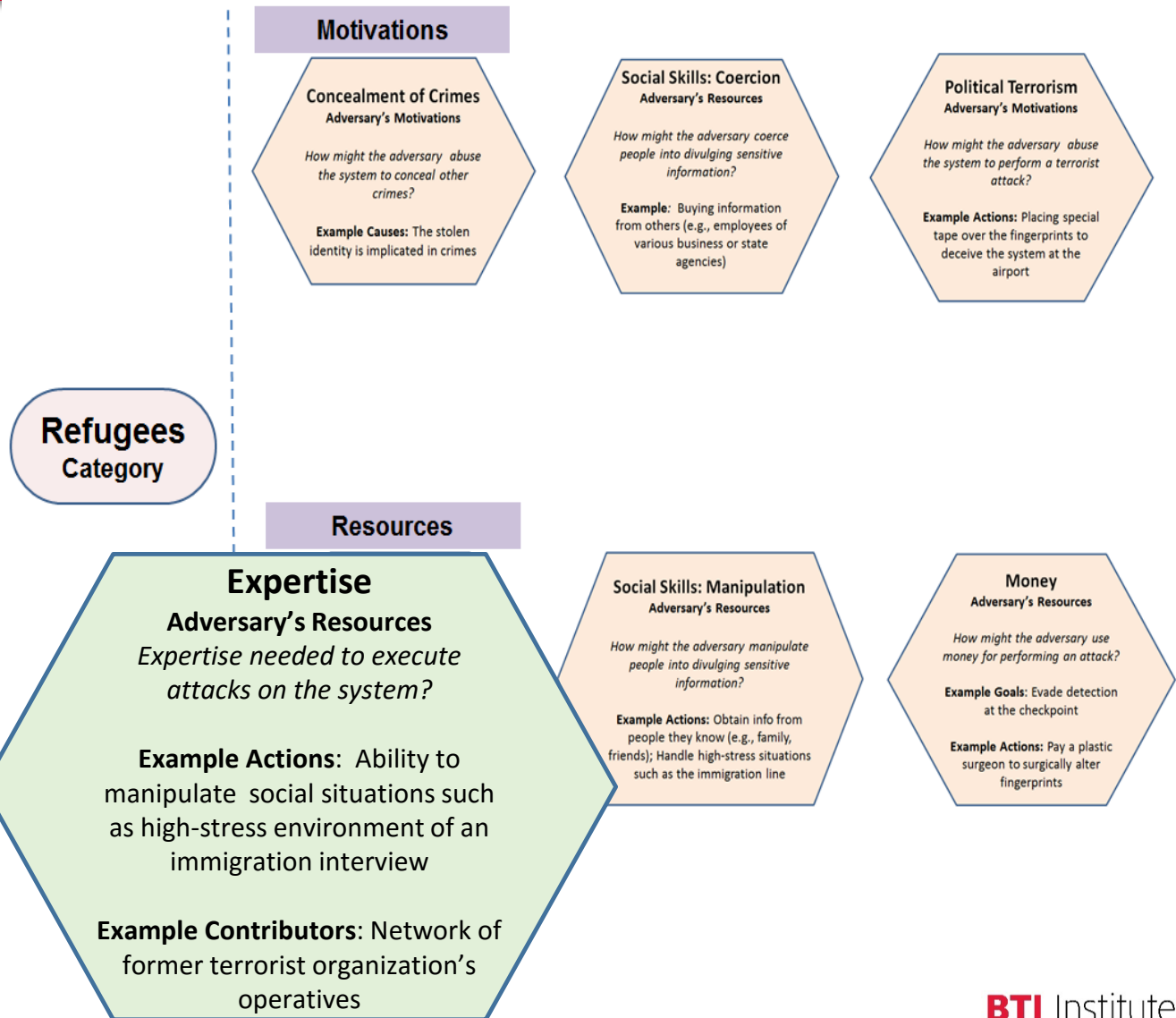
What kind of insider information an adversary needs to succeed?

Example Actions: Studied US immigration processes., befriended a DHS employee.

Achievements: Refugee management

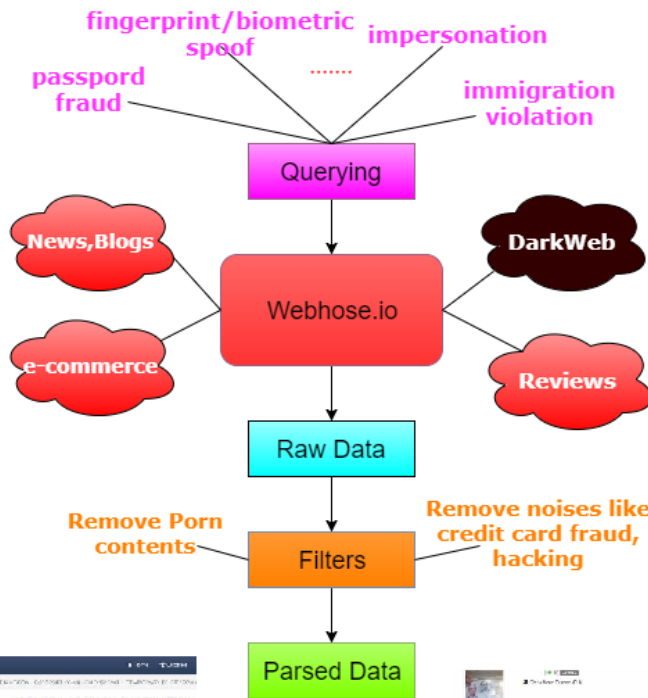
STORY:

Nizar is a refugee from Syria who had been living in an area occupied by a terrorist organization. Nizar and his family were surviving by creating supplies used for terrorist activities. Nizar may have worked in a lab operated by the terrorist organization. The lab has been taken over by the Iraqi forces and fingerprints were lifted from the lab surfaces. Nizar and his family managed to escape and are now applying for refugee status in US.



Achievements: Barriers to Risk Assessment

- Querying dark web for ID manipulation offers



	[+0] [0] Level 1 Ships from: Europe (EU)	3,382.05 ฿ 1.3118	Views: 6620
	EU - Spanish Passport. [+0] [0] Level 1 Ships from: Europe (EU)	USD 3,382.05 ฿ 1.3118	Buy Now Views: 5188
	EU - Italian Passport. [+0] [0] Level 1 Ships from: Europe (EU)	USD 3,382.05 ฿ 1.3118	Buy Now Views: 4828
	Dutch ID [+0] [0] Level 1 Ships from: Europe (EU)	USD 3,382.05 ฿ 1.3118	Buy Now Views: 5601

The screenshot shows the HANSA Market website. At the top, there's a navigation bar with 'Home', 'Forums', 'Support', 'Dashboard', and 'Logout'. Below the navigation bar is a search bar and a 'Go!' button. The main content area is divided into several sections:

- Categories:** A list of categories with their respective counts: Drugs (8693), Fraud Related (1368), Guides & Tutorials (2811), Services (792), Jewellery (13), Digital Goods (6926), Erotica (1014), Counterfeits (498), Electronics (12), Security & Hosting (48), and Miscellaneous (286).
- Welcome to HANSA Market:** A section describing the market as a business payment system with a focus on Bitcoin.
- Key Features:**
 - Multisig escrow:** Optional 2-of-3 multisig for buyers and 2-of-2 multisig as a fallback for buyers that do not want to bother with multi-signature. Funds can only be accessed by the vendor after orders are finalized and can never be accessed by the market staff. That is impossible.
 - No Bitcoin deposits:** Every order has its unique Bitcoin address similar to BIP21's or Coinbase's payment system. Buyers have 15 minutes to pay the order and do not have to wait for deposits to arrive.
 - No Finalize Early:** We do not support FE or partial escrow releases and we don't have to! The multisignature escrow makes it impossible for the site staff or vendors to steal any Bitcoins.
- Top Vendors:** A list of vendors with their ratings and levels, such as 'dutchcandyshop (+488) [0] Level 12'.
- Latest Orders:** A list of recent orders with details like 'USD 1.99' and '฿ 0.8533'.
- Rising Vendors:** A list of vendors whose ratings are increasing, such as 'appleinc (+11) [0] Level 2'.

This screenshot shows a search results page on the HANSA Market website. The page displays a grid of search results for 'EU - Spanish Passport'. Each result includes a thumbnail image of the passport, the product title, a price in USD and Thai Baht (฿), and a 'Buy Now' button. The results are sorted by price, with the lowest price being 3,382.05 USD (฿ 1.3118). The page also shows a search bar at the top and a navigation menu on the left.

Transition Pathways, Engagement

- How will the work reach the end-user? What is the proposed transition pathway?
 - Notional transition plan developed, being discussed with the Project Champion.
 - Major product is not a tool, but a methodology, which may affect organization and workflows.
 - No IP planned.
 - Engagement discussions initiated at this meeting
 - Opportunities for planning test scenarios in upcoming Biometric Technology Rallies.

Transition Challenges

- What does the project team perceive to be the challenges they will face in the near and long term going forward?
 - Discussions related to potentially sensitive information create communication barriers.
 - Transitioning a methodology, rather than IP, with many “process touch points” may require complex coordination efforts.

Next steps

- Current and future tasks
 - Exploring Dark Web for ID misrepresentation services and tools
 - Understanding availability, cost of acquisition, effectiveness
 - Reanalyzing exposed processes and systems.
- Examining attack vector representation and scope
 - Current information indicates that biometric attacks are likely to be part of broader manipulations (documents, fake IDs)
 - Better understanding of availability and support for identity obfuscation will help risk estimates.
 - Exploration of the effectiveness of defense mechanisms.

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