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Glowing Pockets: Modeling Illicit Nuclear and Radiological Trafficking Networks in the Former Soviet Union

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Abstract

Since the break-up of the Soviet Union in 1991, the international community has worked tirelessly to locate and secure loose Soviet legacy stockpiles of radiological and nuclear materials. While significant achievements have been made in this endeavor, some radiological and nuclear materials still remain unaccounted for 25 years later. Since 1993, the International Atomic Energy Agency has registered over 2,330 state-confirmed instances of unauthorized possession of nuclear and radiological materials; many of which had criminal connections or were the result of theft or loss. Nonproliferation scholars and working professionals alike have recognized the key role that former-Soviet states play in illicit nuclear and radiological trafficking networks, particularly those with developing security architectures and frozen domestic conflict zones such as Moldova, Georgia, and Ukraine. However, despite the insightful works that nonproliferation researchers have produced in the public domain, very little has been done to visualize or model the flow of radiological and nuclear materials from origin to destination. In an effort to fill this void, this paper evaluates whether the same models that assist researchers in analyzing transnational organized criminal networks can be used to model the illicit flows of radiological and nuclear materials. Drawing upon the works of Jay Albanese, Tim Hall, and other transnational organized crime researchers, this paper examines the utility of the Locational Approach, the Network Approach, and the Enterprise Approach in modeling these illicit flows in the former-Soviet Union. After careful consideration, a model utilizing components of all three approaches is constructed. The model's utility is then evaluated through an interrogation of the Oleg Khintsagov nuclear trafficking network; one of most well documented networks in recent history. Finally, recommendations for the further testing of this model are put forth for use in future nonproliferation research.

Keywords: Nonproliferation, Illicit Networks, Former Soviet Union

1. Introduction

To date, public research on radiological and nuclear trafficking networks in the former-Soviet Union (FSU) has focused primarily on the actors involved in trafficking and interdicting loose nuclear and radiological materials. Research on other forms of trafficking and illicit trafficking flows has produced broad models that can be used to visualize and explain the creation and maintenance of trafficking networks. These models are shaped around trends and examples seen in real-world case studies and can be used to explain how goods are able to move from point A to point B without being interdicted. However, thus far, nonproliferation researchers have failed to evaluate whether these pre-existing models are sufficient for modelling the flow of radiological and nuclear materials through the former-Soviet space.

Can pre-existing models used to model the creation and sustainment of traditional illicit goods networks be used to visualize and analyze the flow of radiological and nuclear materials in the former-Soviet Union? If not, could these models provide guidance on the construction of a new model that can be used to interrogate cases of radiological and nuclear trafficking in the former-Soviet Union and aid in identifying areas of improvement for counter-proliferation efforts?

This paper begins with a brief examination of current trends and observed structures of radiological and nuclear trafficking networks. Then, three prominent approaches to analyzing illicit networks are evaluated for their utility in modelling nuclear and radiological trafficking flows. Finally, a fourth model that utilizes insights from each pre-existing approach is constructed and used to analyze the Oleg Khintsagov nuclear trafficking network. Network factors that facilitated and restricted the flow of nuclear materials through the Khintsagov network are then identified and used to support recommendations on improving nuclear security in the FSU and neighboring countries.[1]

2. Background

While relatively new in comparison to other forms of smuggling, radiological and nuclear trafficking is unique in that the materials involved are ingredients in a larger product and they pose an enhanced security risk when placed in the possession of malicious state and non-state actors. It should be briefly noted that for the purposes of this paper, radiological and nuclear smuggling will be differentiated in regards to the specific identity of the materials involved, but will be characterized in a similar manner when discussing illicit trafficking of such materials in a broader sense. The classification of "radiological" will be ascribed to materials that are radioactive, yet non-fissile, in their properties.[2] This will include non-fissile radioisotopes of Uranium and Plutonium. The use of the designation "nuclear" will be reserved for the fissile radioactive isotopes Uranium-235 and Plutonium-239. Uranium enriched past 20 percent is considered "highly enriched" while Uranium past the 89% enrichment level is considered "weapons grade." Estimates of the quantity of highly enriched uranium (HEU) and separated plutonium required to build a rudimentary nuclear device range from 8-25kg HEU, depending on enrichment, and 3-8kg Pu-239.[3] [4]

Over the last twenty five years, conventional approaches of analyzing organized crime as a localized phenomenon have evolved into viewing organized crime and transnational crime as interwoven.[5] This is, in part, due to technological innovations that have facilitated greater ease of movement and communication between groups and individuals. Today, human, drug, firearm, and counterfeit products trafficking enjoys the ease of communication that internet and phone services provide for suppliers, intermediaries, and end-users.

Current trends in transnational organized crime (TOC) seem to suggest that the hierarchical structures that have been previously used to characterize organized criminal groups are being replaced by loose, fluid network structures.[6] This change in the operational structure of illicit goods trafficking has forced international bodies combatting illegal trade to reconsider the utility of their traditional approaches in the modern context. Radiological and nuclear counter-trafficking efforts, in particular, are forced to grapple with the fluid nature of today's TOC.

2.1 Radiological and Nuclear Trafficking: Sources, Intermediaries, End-Users, and Limitations

To date, research and observations of transnational radiological and nuclear smuggling have provided valuable information in helping to identify individuals and groups involved in each of the three stages of nuclear trafficking networks: origin, middlemen, and end-users. Lyudmila Zaitseva and Kevin Hand outline the current status of nuclear and radiological supply chains in their 2003 article titled, "Nuclear Smuggling Chains."[7] Additional findings by Louise Shelley, Robert Orttung, Alexander Kukhianidze, Alexander Kupatadze, Friedrich Steinhausler, the Nuclear Threat Initiative, and the James Martin Center for Nonproliferation Studies regarding the multitude of potential actors and involved in the illicit nuclear trade corroborate Zaitseva and Hand's conclusions.[8] [9] [10] [11] [12] [13] [14] [15]

Table 1: Actors and locations of interest identified by Zaitseva and Hand

Stage of Nuclear/Radiological Supply Chain	Actors Involved	Locations of Interest
Sources (Suppliers)	Civilian Personnel, Military Personnel, Facility Guards, Outsiders	Nuclear Enrichment/Dilution/Storage Facilities,[16] [17] Nuclear Power Plants, Fuel Production Factories, Medical/Industrial Facilities Containing Radiological Materials
Intermediaries (Middlemen)	Amateurs, Opportunist Businessmen and Firms, Organized Criminal Groups	Areas with Weak Rule of Law and/or Weak Economies, Transit Points for Existing Illicit Trafficking Networks (Goods, Arms, Humans, etc.)
End-Users (Customers)	Individuals, Organizations, States	States with Developing Nuclear Weapons Programs, Territories Controlled by Terror Organizations, Separatist Regions,[18] Areas with Weak Rule of Law

While Zaitseva, Hand, Shelly, Orttung, and Kupatadze provide an excellent layout of the different individuals involved in radiological and nuclear trafficking, they fail to address the constraints that geography imposes on nuclear and radiological trafficking networks. Justin Hastings attempts to fill this gap in his 2012 piece titled, "The Geography of Nuclear Proliferation Networks: The Case of A.Q. Khan." In the paper, Hastings is able to utilize a geographical perspective to establish a dichotomy within the realm of nuclear and radiological proliferation networks. He differentiates between the "haves" and the "have-nots" of these networks by examining the degree to which a network is geographically centralized.

Hastings classifies the "haves" of proliferation networks as actors, typically state entities, who have access to state resources. These actors have the ability to avoid reliance on commercial infrastructure, and thus, are able to establish and maintain geographically dispersed supply networks.[19] In comparison, the "have-nots" of Hastings' approach are those individuals and groups who must coordinate without authorized access to state resources. These groups must rely on commercial transportation and communication infrastructure, and thus, can be detected through passive and active state surveillance efforts. Hastings states that have-nots must often establish hubs in economically and politically advantageous locations like frozen conflict zones within the FSU which are often opaque to international oversight.[20] He also states that nuclear and radiological trafficking networks involving groups without access to state resources are far more localized and respond more acutely to changes in the operational environment.

After surveying the available literature on nuclear and radiological trafficking networks, there doesn't appear to be any significant conflicts between the conclusions reached by researchers of these networks. The greatest difference between conclusions reached by Shelley, Zaitseva and Hand, Kupatadze, Orttung, and others is the degree to which nuclear and radiological trafficking poses a threat to international security.[21] This could potentially be the result of group think in the nonproliferation field of study or, alternatively, there has not been enough information collected on radiological and nuclear trafficking networks to support differing arguments on the characteristics of these networks.

Furthermore, while Zaitseva, Hand, Hastings, Shelley, and Orttung provide an extensive understanding of the general structure and limitations of nuclear and radiological trafficking networks, they fall short of formulating a generalized model that can be used to explain the existence of these networks. Shelly begins to trace the interconnectors that connect sources to intermediaries to end-users in her 2006 piece, "Trafficking in Nuclear Materials: Criminals and Terrorists," but her analysis remains specific to the connection between organized criminal and terror groups and the nuclear and radiological supply chain. Unfortunately, it does not formulate an explanation or model that can incorporate other groups involved at the source, intermediary, and end-user level of the network.[22]

2.2 The Locational Approach, Network Approach, and Enterprise Model

In an effort to develop a model through which one can visualize and analyze non-state trafficking of radiological and nuclear materials, this paper will evaluate three prominent models employed by researchers of illicit non-state economic activities. The merits and limitations of each model will then be carefully evaluated and a final model will be proposed that looks to work past the limitations of pre-existing models. Before introducing the models that will be examined, it is important to provide the prevalent definition of TOC that is utilized across all three models. According to Jay Albanese, the common consensus among scholars of TOC is that "organized crime is a continuing criminal enterprise that rationally works to profit from illicit activities that are often in great public demand. Its continuing existence is maintained through the use of force, threats, monopoly control and/or the corruption of public officials." [23] With this definition in place, this paper will now evaluate the utility of the Locational Approach, the Network Approach, and the Enterprise Approach in modelling illicit non-state economic activities.

2.2.1 locational approach

The Locational Approach, as depicted by Tim Hall in his piece, "Where the Money is: The Geographies of Organized Crime," is one of the most commonly utilized approaches to modelling illicit networks. The locational approach is common among researchers conducting case studies of "mobbed up regions" that wish to understand the factors that led to their creation and sustainment. These factors are often region specific but are extensively analyzed by scholars conducting case studies of the region in question.[24]

Through the use of the locational approach/model, one has the ability to construct an extensive in-depth analysis of the specific factors of a region that lead to the creation of illicit trafficking networks. However, due to this region-specific approach, the factors that help explain the existence of these networks in one space do not necessarily mean they apply to other spaces as well. In an era that has become increasingly characterized by fluidity between borders and regions, demarcated spaces based on *de jure* borders may no longer serve as holistic units for locational approach case studies. A second limitation of the locational approach is that case studies utilizing this approach often lack an international dimension that takes into account how changes to either the origin, transit, or destination points along a network can affect the conditions of regions belonging to each stage.

For the purposes of the model this paper aims to construct, the locational approach is useful in that it outlines common factors that can exist at the source, intermediary, and end-user stages of illicit transit networks. While these factors are not in any way indicatory of whether illicit networks will exist within a specific region or if regions will even be connected through these networks, they do provide a foundation from which we can begin to examine the intricacies that exist within each segment of the supply chain.

2.2.2 network approach

The second approach that this paper will evaluate is the network approach as illustrated by Tim Hall. The network approach has risen in popularity among scholars of illicit networks as well as state law enforcement and intelligence agencies. According to Hall, those who choose utilize the network approach take up a relational view of society that focuses on the connections that exist between human and non-human "things." The network model employs a socio-spatial analysis rather than a locational analysis as addressed in the previously discussed model. The unit of analysis for the network approach is the interconnections that exist between "things" in a network rather than specific spatial units. Because the network approach is more abstract than traditional approaches to viewing organized crime, scale has very little meaning, and thus, networks can be both local and global at the same time.

When applied to transnational illicit trafficking, the network model maintains an awareness of the multi-locational nature of these illicit networks. It recognizes that nodes and regions are not independent of each other, but rather, are reactive to changes in one another. The network approach is excellent for viewing the flow and interconnection between source, intermediary, and end-user actors, however, it does not come without its limitations. Constructing a visual representation of illicit networks through the network model approach is not only time consuming, but products created by the approach are often representative of only one of many networks that engage in a certain form of trafficking. Extensive detail and information on nodes and interconnectors must be available to researchers in order to form an accurate network model. This is one reason why the network approach is often more fit for use by state law enforcement and intelligence agencies who have access to large swaths of private data, telephone numbers; flight itineraries; financial history; etc.

For the purposes of the final model that this paper will aim to create, the network approach lends merit to the notion that TOC can only be explained through the use of models that have an understanding that illicit trafficking flows are multi-locational in nature and that they are becoming frequently more fluid in nature. However, the final model must remain more broad in it application than network models in order to maintain applicability across nuclear and radiological smuggling networks in different regions of the world.

2.2.3 enterprise model

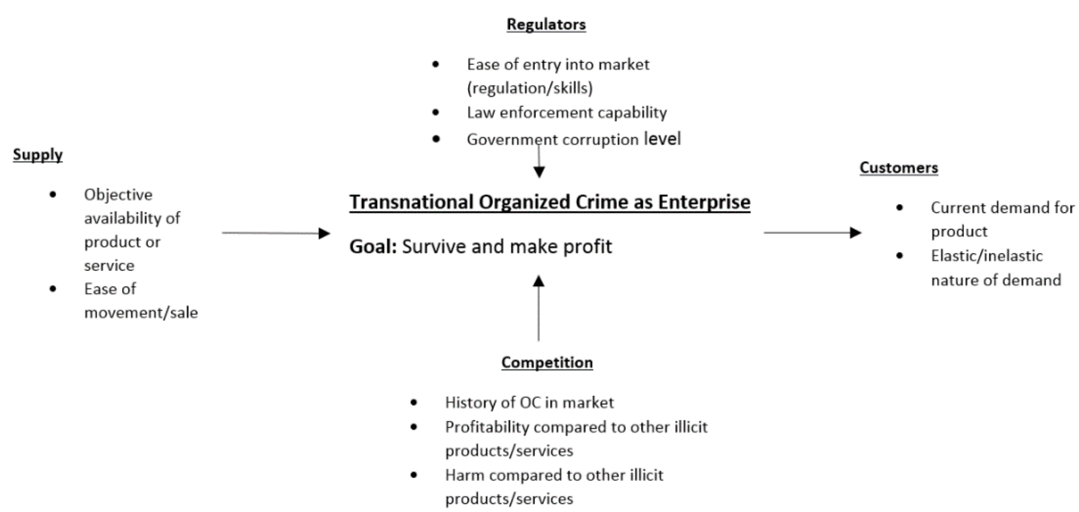

Figure 1: Jay Albanese's Enterprise Model

The third, and final model, which this paper will evaluate is the Enterprise Model as introduced by Jay Albanese.[25] In assembling the enterprise model, Albanese applies general organization theory to criminal activity. He argues that focusing on criminal markets rather than specific groups or networks involved in these networks is a more sound approach for illicit network researchers since traditional approaches of targeting organized criminal groups directly do not appear to stop contraband flow.

Albanese's Enterprise Model assumes that the primary goal of transnational organized criminal groups is to survive and make a profit in illicit markets. He identifies four main components - supply, regulators, competition, and customers - that he incorporates into the model. These components work to visualize how location-dependent factors, as outlined in the locational approach, contribute to the functioning of organized criminal groups. While his model does not explicitly acknowledge spatial variation that regularly exists between supply, organized criminal groups, and customers, it does indicate an awareness of the interconnections that might exist between the three.

The Enterprise Model is unique in its ability to recognize factors in illicit network flows that both assist and inhibit the ease with which materials can go from the source to the end-user. In constructing a model to explain the flow of nuclear and radiological materials from their source to their destination in illicit markets, regulators and competition will be important flow-control factors that can be taken into account in the intermediary stages of the supply chain.

3. Illicit Non-State Nuclear and Radiological Trafficking Network Model (INNRT Model)

By drawing upon Albanese's Enterprise Model, the INNRT model will incorporate the four market factors that facilitate or inhibit the movement of goods along illicit networks: supply, regulators, competition, and customers. As discussed earlier, one limitation of the Enterprise Model is its failure to identify the interplay between the source, intermediary, and end-user levels of the network. For this reason, the INNRT model will be structured to visualize the flow of goods as a continuous motion from source to end-user, using intermediaries throughout the journey to facilitate the transfer. In the new model, the characteristics of the supply end of the network will determine the "push" of materials through the network. Conversely, the market demand will act as a "pulling" force throughout the network. The pressure exerted on the network by both the supply and demand will have external effects on points in between, which will be identified in the INNRT model as transit point(s).

Regulators and competition will remain as market factors that provide resistance, or "clamp down", on the flow of radiological and nuclear materials through the network. The pressure that regulators and competition place on the market will be inversely related to the strength of the flow through the network. These pressures can exist along any point in the network and can vary in scope and effect depending on the idiosyncrasies of the locations involved in the trafficking of the materials. While the factors that Albanese identifies under the regulators and competition categories certainly isn't exhaustive, this can be remedied by incorporating insight from the locational approach as this paper will examine in a moment.

While the Network Approach maintains a satisfactory awareness of the multi-locational, unbounded nature of today's trafficking networks, its scope is often case-specific. For this reason, the INNRT model will refrain from being too narrow in scale by taking a broader level of analysis. Instead of looking to model a specific radiological or nuclear trafficking network which, given recent trends, are highly spontaneous and short-lived, the model will maintain a broad perspective, recognizing both the importance and brevity of these networks. The INNRT model will still take into account the multi-locational characteristics of today's illicit network flows by recognizing the existence of origin, transit, and destination nodes along these flows.

Finally, location-dependent factors identified by the Locational Approach can be used to provide additional factors that can be present at the origin, transit, and destination points along the nuclear and radiological trafficking chain. These factors, when analyzed, provide context for the driving or limiting pressures that are exerted by the supply, regulators, competition, and demand market components. For the INNRT model, the supply-side factors of "Proximity to Markets" and "Facility Safeguards" have been added as a subcomponent of the "Ease of Movement/Sale" factor outlined by the Enterprise Model. Under regulators, "Law Enforcement Capability" now has two addition subsections: "Border Security" and "Criminal Access to Weapons". Under competition, "Profitability/Availability of Licit Economic Opportunities" has been added as an additional pressure on the market flow. Finally, for demand, the "Current Demand for Product" has been separated into both "Real Demand" and "Perceived Demand." Real demand is designated as the demand for nuclear and radiological materials by serious buyers while *perceived demand* is the demand that radiological and nuclear traffickers *believe* is in the market. Perceived demand is often created through media coverage of nuclear and radiological trafficking incidents as well as information that is spread by word of mouth among actors involved in the network.

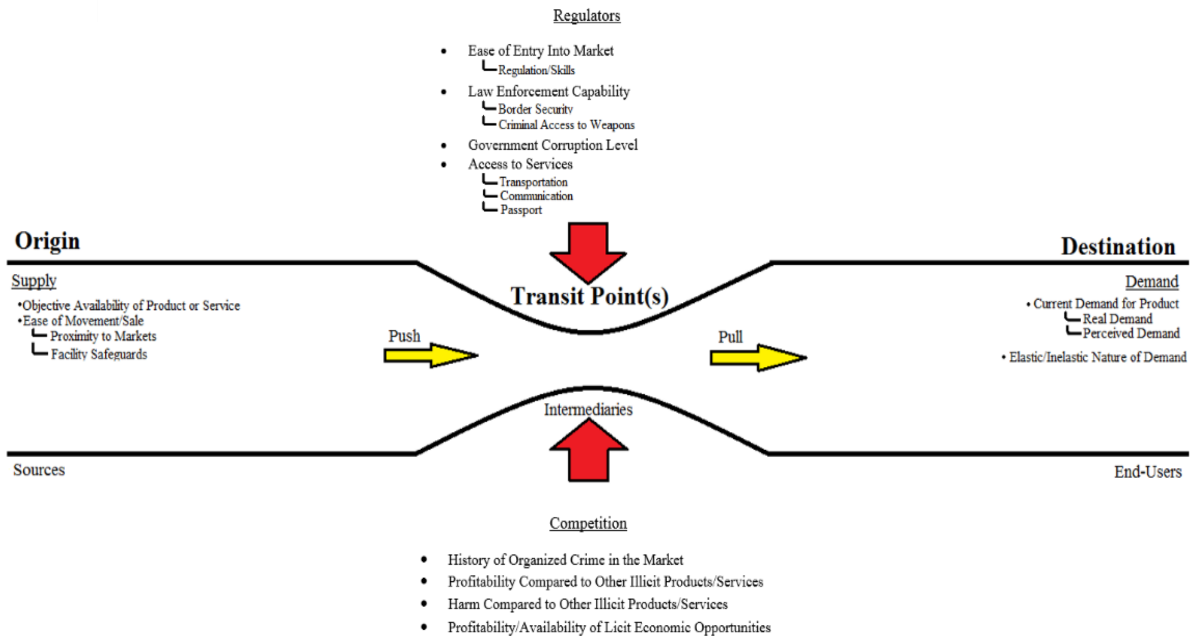

Figure 2: The Illicit Non-State Nuclear and Radiological Trafficking (INNRT) Model

4. Case Interrogation with the INNRT Model

This paper will now analyze, through the use of the INNRT model, the 2006 Oleg Khintsagov network and subsequent seizure of ~100g of HEU in the Georgian capital of Tbilisi. Through this case interrogation, this paper aims to provide an example of its use in helping to visualize and explain how the network was created as well as the driving and limiting factors of the flow of HEU through the network.

The methodological logic behind the case selection for testing of the INNRT model is based, primarily, on the public availability of information for the case, the involvement of ungoverned frozen conflict zones in the former-Soviet Union in facilitating the flow of the materials, and the relative organization of the network actors involved. The Khintsagov network, compared to other nuclear trafficking networks, has been well documented, allowing journalists and researchers to peer into the often secret world of counter-proliferation activities.

4.1 Case 1: Oleg Khintsagov (2006)

On February 1st, 2006, Oleg Khintsagov, Revaz Kurkumuli, Henry Sujashvili, and Vaja Chikhasvili were caught in an attempt to smuggle ~100 grams of 89% enriched HEU. The arrests, a culmination of a weeks-long effort by the U.S. Central Intelligence Agency (CIA) and the Georgian Ministry of Internal Affairs (MIA), were made after the four suspects met up with an undercover MIA agent who was posing as a prospective Turkish buyer for the material.[26] The Khintsagov case remains one of the largest single publicly known instances of nuclear trafficking in Georgia to date. In working to apply the INNRT model the Khintsagov case, this paper will begin by examining the supply-side locational factors that helped "push" the materials through the network. Then, the demand-side "pull" on the flow of materials will be evaluated before examining the restrictive force exerted by the Regulators and Competition at the intermediary stage of the network.

Supply-*Objective Availability*: Assessing the objective availability of the HEU involved in the case is made difficult by the fact that very little information has been made available to the public domain about the material's origin. Some reports of the incident claim that Khintsagov stated that he traveled to Novosibirsk, Russia where he purchased the material for $10,000 from an individual named "Rashid," a name that was likely fabricated.[27] While purely speculation, possible sources for the material *could* be the Novosibirsk Chemical Concentrates Plant in the Novosibirsk Oblast, Russia or the Machine Building Plant in Elektrostal, Russia which have previously been acknowledged as sites that have been subject to material theft. [28] Yuri Vishnevskiy, former head of the Russian nuclear regulation agency Gosatomnadzor, was quoted in 2002 when he stated that the physical protection systems at select Russian nuclear facilities "[do] not fully comply with existing norms and regulations."[29] While the objective availability of nuclear materials appears minimal in the Khintsagov case, there was enough material to facilitate a supply-side push on the network flow.

Supply-*Ease of Movement/Sale*: Determining the ease of movement for the nuclear material involved in the Khintsagov case can be broken down into two components: The proximity of the material's origin to the perceived nuclear markets and the facility safeguards in place to prevent the theft of material. Evaluating the proximity of the material origin to the markets is contingent on where the material was truly acquired by Khintsagov. If his confession was true, and he did receive the materials from a supplier in Novosibirsk, the relatively close proximity of the source to the perceived demand for nuclear materials in Turkey makes it possible for a trafficker with minimal transportation resources to move the materials from its source to other intermediaries or end-users in the network. Khintsagov did not have to traverse any exceptionally large swaths of land or water to reach the target destination. As can be deduced by the very existence of the stolen HEU, the safeguards at whatever facility the material was originally housed were insufficient to prevent or deter theft.

Demand-*Real and Perceived Demand*: Since 1993, there have been over twenty seizures of nuclear and radiological materials in Turkey, supporting the notion that there is a real demand for such materials in the country.[30] In addition to real demand, there appears to be a significantly high *perceived demand* for nuclear materials among smugglers, particularly in Georgia. This perceived demand has been alluded to by Archil Pavlenishvili, the head of Georgia's covert nuclear counter-smuggling unit, when he told reporters that "there's a rumor among smugglers that the main black market for radioactive materials is Turkey." [31] [32] Finally, in regards to the elastic/inelastic nature of the demand for nuclear materials, not enough publicly-available evidence has been reported to conduct a conclusive estimate of the elasticity of the demand.

Regulators-*Ease of Entry into Market*: Khintsagov and his co-conspirators each had the skills and experiences sufficient to enter the nuclear trafficking market. Khintsagov, Kurkumuli, Sujashvili were all known to have engaged in petty smuggling and thus had experience with navigating licit and illicit smuggling networks. Chikhasvili, a low-ranking MIA guard, had experience with the Georgian security apparatus, which would ultimately aid in the groups transport of the HEU.[33]

Regulators-*Law Enforcement Capability*: According to Pavlenishvili, Khintsagov and his fellow traffickers managed to shield the nuclear material from two sets of U.S.-funded radiation detectors installed at the border between Georgia and Russia.[34] In regards to the group's access to weapons, no information appears to indicate that this was a significant or existent factor in the group's ability to traffic the HEU. Fortunately, with the cooperative efforts of the MIA and the CIA, the active detection capabilities of Georgia's law enforcement were sufficient to track and capture the group before the material found itself in the hands of a real buyer. The MIA was able to tap the cell phones of the group members as well as record their conversations through the use of undercover agents with wires.[35]

Regulators-*Government Corruption*: Government corruption played an important role in enabling the nuclear material to flow through the Khintsagov network. According to a report released by the Russian State Security Services (FSB), Khintsagov used his connections to his cousin Miron Garabaev, a former Russian customs officer, to provide "unchecked travel… through the Russian-Georgian border" on four separate occasions.[36] [37] Additionally, Vaja Chikhasvili's position and connections within the MIA may have enabled that material to pass by Georgian law enforcement unchecked.[38]

Regulators-*Access to Services*: According to reports, Khintsagov and his group had access to multiple services which they leveraged to help move the HEU through the network. Reports from the MIA allude to the fact that the Khintsagov group had access to a private vehicle, which they used to transport the materials by land.[39] It is likely that the group used this vehicle to move through the border checkpoints on their way to deliver the material to who they thought was a serious buyer. In terms of access to communication services, the group was forced to rely on commercial communications equipment, mostly cellphones, in order to communicate across long distances. This reliance ultimately resulted in an increase in law enforcement capability for the case because the MIA was able to monitor their communications.[40] Finally, since Khintsagov held a Russian passport, his movement throughout Russia and across the North Ossetia-South Ossetia border is likely to have been made easier due to Russia-South Ossetia visa-free policies.[41]

Competition-*History of Organized Crime in Market*: The long history of organized crime and smuggling networks between South Ossetia and Georgia played a significant role in helping the smugglers navigate and transport materials across the *de facto* South Ossetia-Georgia border. Since smuggling networks are often the only available forms of economic cooperation that are available for Georgians and South Ossetians looking to do business with one another, it is likely that there were numerous trafficking routes already in place that the Khintsagov group could have taken.[42]

Competition-*Relative Profitability and Harm of Illicit Product*: In comparison with other illicit products and services available in the Georgian market, the profitability of nuclear smuggling appears to be leagues greater than the most common forms of smuggling in the region. Compared to the low-volume foodstuffs and drug smuggling members of the Khintsagov group had engaged in in the past, the nuclear materials promised a much greater profitability. According to reports from the MIA, the material was being sold by the group for $1 million, or $10,000 per gram of HEU.[43] There is little to suggest that the group considered the potential use of the material for a nuclear device as a major deterrent for selling the material to the prospective buyer, despite the buyer's claim to be a representative from a "very serious organization."[44]

Competition-*Profitability/Availability of Licit Economy*: All four individuals involved in the case had access to licit economic opportunities, however, the profitability of those activities appears to have been insufficient to deter their participation in nuclear smuggling. Vaja Chikhasvili, the Georgian government security guard, likely received a decent salary as a low-level official, but nothing close to what had been promised by the Khintsagov network. Likewise, Revaz Kurkumuli, who was involved in multiple legitimate, but failed, small businesses, may have been dissuaded from sticking with licit activities when presented with the option to traffic nuclear materials. Henry Sujashvili, a small-time smuggler and a taxi driver, did not work in the most lucrative of positions, making the big payoff of selling the HEU all the more appetizing. Finally, Khintsagov was also known as a small-time trader of food and other goods before he became involved in the nuclear trafficking business. Not much is publicly known about when and how he became involved, but some reports state that he had started dealing in furs in locations from Nogir to Novosibirsk.[45]

5. INNRT Model Insights

Analyzing the Khintsagov network through the use of the INNRT model has provided valuable insight into the nature of material flows through the network. The objective availability of the materials involved remained significantly small, however, it remained large enough to provide the "push" needed to move materials through the network. Insufficient facility safeguards at the source location appeared to help ease the movement of the material. When evaluated in terms of real-world implications, the model is able to exemplify the significance of adequate facility safeguards for nuclear materials. While this is not new news by any regard, the model supports the argument that securing and eliminating loose stockpiles of nuclear materials will help decrease the prevalence of supply-driven network flows.

On the other end of the network flow, perceived demand appeared to play a significant role in driving materials through the network. In the Khintsagov network, the perceived demand appeared to come from prospective Turkish buyers who, in actuality, were undercover Georgian law-enforcement agents. While this perceived demand has partially been fabricated by Georgian internal intelligence for use in sting operations, other cases suggest that there exists a *real* demand for radiological and nuclear materials in Turkey as well.[46] This insight can have real-world policy implications for how the international community addresses and eliminates the demand for trafficked nuclear and radiological materials. If Turkey does, in fact, have a large *real* demand for nuclear materials, enhancements in active and passive detection in and around Turkey could serve to decrease demand-driven network flows.

Despite corruption in government and the capabilities and skills of the traffickers, active detection techniques by the MIA and their international partners ultimately led to the interdiction of the materials in the network. In the Khintsagov network, competition factors appeared to ease rather than provide resistance to the network flows. But what ramifications does this have for future nonproliferation efforts focused at the transit points in a network? First, it can identify areas for improvement. For instance, in the Khintsagov network, corruption within a select few members in the Georgian MIA and Russian Customs provided considerable assistance to the traffickers as they transported the material. While the Georgian and Russian governments have drastically reduced corruption rates within their respective countries, it appears that it only takes one corrupt official placed in a strategic position to help facilitate nuclear and radiological network flows. Efforts aimed to increase accountability and oversight for border and customs officials may serve to mitigate the threat posed by insiders and corruption.

In the Khintsagov network, passive detection law enforcement capabilities appeared insufficient to detect the radioactive materials. While this has been a known issue by law enforcement and intelligence agencies since the implementation of radiological border sensors, very little progress has been made to alleviate this problem.[47] Through the use of the INNRT model, the utility of active detection is demonstrated. The model supports conclusions made by Kupatadze which state that international bodies and countries involved with radiological and nuclear trafficking should shift their focus away from technical issues and instead work to gather and analyze intelligence on these networks.[48]

Finally, the INNRT model helps identify competition factors that can be targeted by international bodies to provide more resistance to the flow of nuclear and radiological materials through trafficking networks. While Georgia's history of organized crime and the profitability and harm of nuclear and radiological smuggling compared to other illicit products and services aren't expected to change anytime soon, efforts can be focused on the profitability and availability of licit economic opportunities at transit points. In the Khintsagov network, licit economic activities appeared to be far less profitable than involvement in the trafficking network. The model indicates a utility in providing licit business opportunities to areas identified as transit point for nuclear and radiological networks. While this strategy would require time and significant resources, in the long term, it could prove to place more resistance on the network flows.

6. Prospects for Future Research

Due to limitations in time, the *full* version of this paper was only able to address one case of radiological and one case of nuclear trafficking. While these two cases aren't enough to definitively assess the utility of the INNRT model in analyzing nuclear and radiological network flows, they provide an indication and example for how the model can be applied and insights extracted from each case. Further case interrogation with the model is needed to help support the conclusions reached by addressing the Khintsagov network. Additionally, the testing of cases in other states belonging to the FSU will be needed to determine the model's applicability to nuclear and radiological trafficking networks in other former Soviet States.

Extensive anti-corruption measures have been put in place since the 2004 Rose Revolution in Georgia. While reports have indicated that these efforts have vastly improved the condition and legitimacy of the Georgian government, there has been very little review of how or if these changes have affected interdiction rates for nuclear materials being trafficked through Georgia.[49] Interviews with MIA officials about recent cases of nuclear and radiological smuggling interdiction efforts may provide a more up-to-date understanding of the regulator factors and law enforcement capabilities that are present in Georgia. Conducting these interviews may also work to provide a more diverse array of opinions in the field of nuclear and radiological trafficking networks, decreasing the probability of group think.

7. Acknowledgements

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8. References

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