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Initial Strategies to Effectively Verify Denuclearization

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1. Introduction

The initial declaration of a state undergoing denuclearization(or, Host State) provides the foundation for future verifications. When discrepancies between the initial declaration and results of verification arise, the verification team can interpret them as a false alarm or a deliberate violation. However, as it is impossible to completely verify a state, determining whether it was unintentional or deliberate is ambiguous. This is especially important for highly politicized issues such as the denuclearization of a former nuclear proliferating as it influences future verification strategies.

The objective of this paper is to introduce situations when discrepancy occurs during the verification process and the potential technologies that can be used to confirm its deliberateness. After briefly summarizing key concepts, techniques and technologies of verification, it analyzes activities verifying Iraq's nuclear program as a reference case to extract factors explaining unintentional and deliberate discrepancies. Using these factors, this paper proposes scenarios of discrepancy initial declaration and verification results. It concludes by offering technology that can be used for each scenario and implications for North Korea.

2. Verification Concept, Techniques, and Technology

Verification is "the process of gathering and analyzing information to make a judgement about parties' compliance or non-compliance with an agreement." [1] Generally, 100% verifiability is not achievable nor is it necessary since low levels of verification can effectively deter a potential violator by creating uncertainty on the detectability of cheating. Negotiating a denuclearization agreement is much more difficult as some may be wary of the credibility of the verification regime while others may decide joining goes against its national interests.

Verification systems are designed to cater to the needs of specific treaties. The basic framework includes elements such as (1) declarations of data–baseline, periodic and final; (2) compilation, analysis and cross-checking of declared data and/or other information; (3) verification of declared information, remote and/or on-site through continuous monitoring and/or on-site inspections; (4) cooperative measures; (5) clarification mechanisms in case of technical ambiguities; and (6) fact-finding missions or challenge on-site inspections.

These elements can be categorized as *remote*(any monitoring that takes place usually outside territorial limits of the Host State) or *on-site*(any activity within the Host State). These are supplemented by space-based, aerial surveillance, and ground-based verification technology which allows for rapid and systemic collection, collation, manipulation, analysis, storage, retrieval and dissemination of information. [1]

Table I: Verification Techniques

Type	Techniques	Characteristics
Remote	Information/data declarations, exchanges, notifications	Provide information related to compliance
	National Technical Means(NTM)	Nationally owned or operated technologies/techniques used to monitor obligations of another state
Remote & On-site	Fact-Finding Missions	Range from conducting interviews, gathering evidence outside the State's territory to intrusive inspections
On-site	On-site Verification (routine, short-notice, random, challenge inspection)	Provides information necessary to operate verification process Supplements or helps confirm data from other sources

Table II: Verification Technology

	Technology	Characteristics
Space-based	Government, Commercial satellite	Allows remote monitoring No permission required Time, type of monitoring flexible
Aerial Surveillance	Aircraft, helicopter	Has closer proximity to ground Requires permission of state
	Unmanned Aerial Vehicles(UAV)	Can carry variety of sensors, has wide coverage, fly for long periods Expensive
Ground-based	Ground-based sensor	Continuous monitoring w/o human intervention Detects change in monitored items
	Environmental sampling	Detect environmental traces
	Tagging	Continuous monitoring w/o human intervention Specifies permitted items(useful for random sampling)
	Tamper-proof seal	Continuous monitoring w/o human intervention Ensures equipment/rooms remain untouched

Verification system design depends on various factors such as number of treaty parties(bilateral or multilateral), objectives(reduction, limitation, dismantlement, elimination and/or banning), treaty specified items, and shows the treaty defined items and its measures by verification regime. Hence, designing an effective

denuclearization agreement that is credible enough to satisfy both the Host State and verification team especially when discrepancies arise is crucial. How these discrepancies are explained influences the level of intrusiveness and coverage of the technology that the verification team will use. Accounting for these discrepancies and the possible strategies for each scenario will be important in determining the degree of verifiability and credibility of the agreement.

3. Application

3.1. Case Analysis: Verification of Iraq's Nuclear Weapons Program

In the 1980s, Iraq secretly developed a nuclear weapons program while being party to the Nuclear Non-Proliferation Treaty (NPT) and IAEA Safeguards Agreement. Iraq pursued several methods of enrichment and sought to obtain plutonium through reprocessing to develop an intermediate-level implosion. [2] To inspect Iraq's compliance with policies concerning its nuclear weapons and WMD program, the United Nations Security Council passed Resolution 678 (April 3, 1991) establishing the United Nations Special Commission(UNSCOM). Iraqi leadership's lack of cooperation with UNSCOM led to the US and UK to launch air strikes known as operation Desert Fox. Afterwards the United Nations Security Council passed Resolution 1284 (December 17, 1999), creating the United Nations Monitoring, Verification and Inspection Commission(UNMOVIC), which mission lasted until 2007.

Authoritarian systems are extremely concentrated in power which allow leaders such as Saddam Hussein to be less constrained by institutional limits. In these systems, leaders prefer to form nuclear or WMD decision-making with a small group of loyal advisers which lead to the compartmentalization of information. This also erodes information processing as advisers, officials and bureaucrats commonly misrepresenting one's true preference to show submission or loyalty to the leader. [3] In Iraq's case, while there were coordinated efforts to conceal their nuclear weapons and WMD program, there were also cases of incompetence and disobedience. For example, lack of a clear guideline on how to cooperate with UNSCOM inspectors led officials to sometimes omit information that was in the initial declaration. Also, despite explicit orders from the leadership to hand in items and documents, officials kept them for their own personal gain. [3]

3.2. Scenarios to Explain Discrepancy

The 16 years of verifying Iraq show discrepancies between declaration and verification is not always deliberate. Iraq did intentionally seek to conceal its materials and weapons resulting in diversion of treaty specific items. However, unintentional factors such as *misinformation* due to compartmentalized information and/or falsified preferences, *incompetence* of individuals implementing the obligations of verification, and *disobedience* for personal gain should be considered separately from deliberate intentions.

Table IV: Scenarios to Explain Discrepancy in Verification

	Scenario	Actor	Explanation for Discrepancy	
			Unintentional	Deliberate
1	V>D=A	Verification Team	- OSI equipment produces results within error range	-Political interests of verification team
2	V<D=A			
3	D>V=A	Host State	-Misinformation -Incompetence	-Diversion -Smuggling
4	D<V=A			-Bluffing

This paper assumes two possibilities for discrepancy and divides them by intent into four scenarios. The first possibility is based on the assumption that the Host State is telling the truth while the discrepancy was made due to a mistake by the verification team. Hence, the declared data(D) is equal to the actual data(A) existing in that State. The second possibility is assuming that the Host State is lying either unintentionally or deliberately creating the difference between the verification result and the declaration. Calculating the actual data within the Host State is extremely difficult, which is why complete verifiability cannot exist. However, to offer a standard explaining intention, this paper assumes that the actual data can be calculated.

Table IV displays the four scenarios to consider when discrepancy between the initial declaration and its verification results arise.

(1) Scenario 1&2: The verified data should equal the declared data since the information in the Host State's declaration is true. However, the results of verification are greater or smaller than the declared data due to error caused by the verification team. Unintentional error can be explained by technical errors from the verification equipment. Political interests of the individuals within the verification team can make them biased during the verification process, deliberately recording the verification results differently from what they observed.

(2) Scenario 3&4: the verification results accurately reflect the data existing within the state, but the initial declaration fails to reflect these due to an error on the Host State's part. If this was unintentional, it may be due to misinformation based on characteristics of the authoritarian system or incompetence and/or disobedience caused by individuals. However, if this was deliberate, it can be divided into two situations: when the verification team found less than the declared data, which could indicate possibility of diversion. In this case, undeclared materials and facilities within the Host State territory may exist. Also, individuals may have smuggled treaty-specific items for their own personal gain. When the verification team found more than the declared data, this could indicate bluffing. For instance, the Host state may have over exaggerated its

nuclear capabilities to ensure deterrence against regional adversaries.

4. Implication

Denuclearization verification for North Korea will be different from typical arms control verification since it requires complete elimination of nuclear weapons and weapon-grade nuclear materials, and the majority of nuclear weapon-related facilities to be dismantled. Much of the denuclearization roadmaps/action plans for North Korea focused on creating a comprehensive plan while failing to explain specific details on fact-finding for discrepancies.

Fig. 1 displays verification techniques that can be used to confirm the deliberateness of discrepancies based on the degree of intrusiveness and coverage. Space-based, aerial surveillance and ground-based technologies can be used to supplement each other, but their accuracy is limited to their proximity to the object monitored(coverage) and permission required to utilize the technology(intrusiveness). The wider the coverage, the verification team can gather more information although it may be lacking in accuracy. The higher the intrusiveness, the verification team can collect information that has a smaller error range.

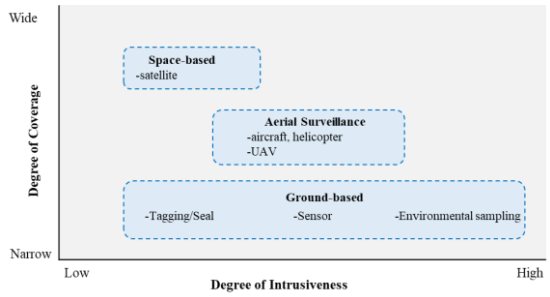

Fig. 1. Level of Verification Technology

Verifying North Korea's compliance to the denuclearization agreement focuses on scenario 3 and 4. Here if the discrepancy was unintentional, the verification team should focus on using technology that has a wider coverage but less intrusive. They should also supplement the technology with personnel interviews or guidelines on recordkeeping to check if the error was made by human incompetence. However, if the verification team suspects coordinated efforts of diversion(or to a lesser extent smuggling by individuals), technology that is highly intrusive with narrow coverage is necessary to ensure there are no undeclared facilities or materials. This should also occur in tandem with technologies with high coverage and less intrusiveness to detect any suspicious or ambiguous activity.

5. Conclusion

Denuclearization verification for North Korea will be verified through technologies with varying degrees of intrusiveness and coverage. Selecting technology that is less intrusive will be able to induce more cooperation from North Korea while avoiding unnecessary conflict that could potentially derail the verification process. Further research is required to find an acceptable "correctness range" that satisfies both the verification team and the Host State. Additionally, a list of verification techniques and technologies with varying degrees of intrusiveness and coverage should be developed in order to craft a more detailed verification strategy.

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