The Logic of Engaging the Democratic People's Republic of Korea: Principles, Practice, and Experience*

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Abstract

Since 2002, faculty from the L.C. Smith College of Engineering and Computer Science have been working with engineers and computer scientists from Kim Chaek University of Technology in the area of information assurance and security. This effort is part of a broader collaboration led by the Maxwell School for Citizenship and Public Affairs and The Korea Society. This paper describes our thinking, principles, practices, content of our classes, and our experiences.

1 Introduction

In 2002, the faculty in the L.C. Smith (LCS) College of Engineering and Computer Science were approached by Professor Stuart Thorson of the Maxwell School of Citizenship and Public Affairs to meet with North Korean researchers from Kim Chaek University of Technology (KUT) to explore the idea of a "research collaboration" in the area of information technology. This collaboration was led by the Maxwell School and The Korea Society.

Were the researchers from almost any other country this request would have been routine. However, this request involved the Democratic People's Republic of Korea (DPRK)—reputed to be one of the most repressive and isolated regimes in the world. We worried in 2002 if such an engagement would in fact support the kind of society we abhorred. Some of us who are not of Korean origin (including this author), worried that a collaboration with the DPRK would offend our Republic of Korea (ROK) colleagues or compromise them in some way.

Five years later there is a larger and growing base of support for engaging the KUT faculty as well as a sense of pride among those who have been involved from the very beginning. Of course, we are still very concerned about the nature and methods of the DPRK government. Nonetheless, we are hopeful that by engaging our colleagues in KUT, we will help transform their society to one that is more open and transparent as a result of our efforts. We hope that our KUT colleagues will be more able and willing to engage the international engineering and computer science communities.

This paper briefly documents our thinking and experience over the last five years. In Section 2 we outline some of our initial concerns prior to our initial series of lengthy engagements. Section 3 discloses the guiding principles we used as an ethical framework to help us think about whether or not to participate as engineers to work with the DPRK researchers. In Section 4 we discuss how we applied the guiding principles that led to our participation and how the principles informed the criteria we used to select topics, content, and tools. The technical content and tools of

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our part of the collaboration is presented in Section 5. We relate our experience in Section 6. We conclude in Section 7 with some personal observations.

2 Initial Concerns

Our initial concern centered around being potentially duped into supporting a repressive regime and working against the essential values of transparency and openness that are both necessary and revered by engineering scholars. Our secondary concern was to avoid legal difficulties with U.S. laws such as the International Traffic in Arms Regulations (ITAR) [1].

Ultimately, our ITAR concern was easily addressed as we only provided content that was publicly available and tools that were developed outside the U.S. by Cambridge University in the United Kingdom. We discuss the details of what we distributed in later sections. What required more thought was the decision whether or not to engage the DPRK researchers, and once the decision was made to engage them, determining the appropriate material and tools to provide them given their isolation from our scholarly communities. The guiding principles we used to make these decisions are discussed next in Section 3.

3 Guiding Principles

Our decision to begin our technical collaboration with the KUT researchers and how we selected specific topics, content, and tools for them was based initially on simple curiosity (which wore off quickly) and sustained by an ethical viewpoint best understood within the context of Mohandas K. Gandhi's philosophy of non-violent resistance known as *satyagraha*.

The late Joan Bondurant—a spy in World War 2 who later became a noted Gandhi follower and scholar at University of California–Berkeley and University of the Pacific—defined satyagraha this way [4]:

> [S]atyagraha is a compound of two Sanskrit nouns: satya, "truth" (from sat, "being", with a suffix-ya) and agraha, "firm grasping" (a noun made from the verb agrah, which is the root grah, "seize, grasp", with the verbal prefix a, "to, toward").

Categories of Satyagraha Principles	
Category	**Principles**
Problem Bounding	Principle 1: common interests
	Principle 2: irreducible minimum
Integrity	Principle 3: believes and acts
	Principle 4: sincerity
Confidence Building	Principle 5: trust
Non-Violence	Principle 6: suffering
	Principle 7: same standards
	Principle 8: no humiliation
	Principle 9: pure motives
	Principle 10: no exploitation

Table 1: Categories of Principles

Bondurant describes the objective of satyagraha as:

> [T]he constructive transforming of relationships in a manner which not only effects a change of policy but also assures the restructuring of the situation which led to conflict. This calls for a modification of attitudes and requires fulfillment of the significant needs of all parties originally in conflict. The fulfilling of needs is both an objective and a means for effecting fundamental change.

Bondurant's description of satyagraha's objective precisely and accurately describes our larger objectives: to further mutual understanding and collaboration leading to a transformation of attitudes and relationships. The successful application of satyagraha in Gandhi's liberation of India from British rule and Martin Luther King's use of satyagraha to lead the civil rights movement in the U.S. are compelling examples of its effectiveness.

At this point the reader may be wondering wondering how satyagraha is applicable to engineering and scientific collaborations with the DPRK. If one replaces phrases such as *"violence is less likely"* with phrases such as *"engagements/positive outcomes are*

more likely" in the ten principles of satyagraha that follow, one can begin to see the logic that informed our engineering collaborations with the DPRK researchers.

The ten principles of satyagraha are summarized in the list below based on [10]. We categorize the principles as shown in Table 1.

1. **Common Interests:** Cooperation starts based on common interests and beliefs of opponents. These beliefs and interests must be clearly stated.

2. **Irreducible Minimum:** The likelihood of reconciling differences is reduced when people are unwilling to compromise on *non-essential* issues. Demands made must be the irreducible minimum.

3. **Believes and Acts:** Opponents are less likely to be violent if they understand each other's thinking and actions. People must say clearly what they believe and act accordingly.

4. **Sincerity:** Conversion of an opponent is furthered by personal sincerity as evidenced by a lack of distortion of the opponent's point of view.

5. **Trust:** Satyagraha is based on the observation that the only way to make a person trustworthy is to trust him or her and the surest way to make him or her untrustworthy is to distrust him or her.

6. **Suffering:** The best ways of convincing an opponent of sincerity is the willingness to make sacrifices for the cause and continued resistance.

7. **Same Standards:** Cooperation is fostered if people are not hypocritical. Opponents are not to be judged more harshly than one judges oneself.

8. **No Humiliation:** Violence is more likely on the part of opponents if they are humiliated or provoked. It should never be the intent to embarrass an opponent.

9. **Pure Motives:** Violence is less likely if motivations for actions are completely free from a desire to injure the opponent.

10. **No Exploitation:** A position of weakness (if it is not the result of satyagraha, but extraneous reasons) in an opponent should not be exploited. Temporary advantages are not to be used to embarrass an opponent.

A categorization of the above ten principles is shown in Table 1. The categories are as follows:

Problem Bounding: Principles 1 and 2 establish the boundaries of the conflict, what the parties have in common and where they differ.

Integrity: Principles 3 and 4 speak to actions whereby people and organizations develop a reputation for honesty.

Confidence Building: Principle 5 advises taking risks by trusting one's opponent.

Non-Violence: Principles 6 through 10 advise people to: (1) sacrifice to resist an opponent and suffer for it, (2) be consistent in judgments, and (3) be concerned for the opponent's safety. This last consideration of safety for one's opponent is crucial. This says that one must operate in ways that neither humiliate, injure, nor exploit the weaknesses of one's opponent.

The above principles and categorization of principles constitute our ethical framework. How this framework informed our thinking and actions in deciding to engage the KUT researchers is described in Section 4.

4 Practices from Principles

In this section we discuss how the principles of satyagraha applied to the specific question of whether or not to engage the DPRK researchers and the criteria for selecting activities.

Deciding to Engage Our decision to engage the KUT researchers was informed by the principles constituting the categories of *problem bounding* and *integrity* as shown in Table 1.

Under the category of problem bounding, our common interest as scholars and researchers is the pursuit of truth as it applies to information technology, security, and assurance. (Later on we will see that the *"pursuit of truth"* is the literally the objective in formal verification of correctness and security using computer-assisted reasoning tools such as theorem provers). At that time and now, as scholars and researchers we have no known fundamental disagreements personally or professionally.

In the category of integrity, we were assured by Professor Thorson that the U.S. State Department approved of the engagement and that the KUT researchers understood the ITAR limitations. As engineers, recognizing that we are neither diplomats nor government officials, we interpreted the request to collaborate around information technology, security, and assurance as scholars at face value. We were told, and we believed, that the goal was to contribute to a positive transformation of our relationship with the DPRK. Hence, we decided to engage.

Criteria for Topics, Content, and Tools Having decided to engage, we focused our efforts on deciding what topics to bring up, what the specific content of our talks would be, and what tools, if any, we would share.

The principle challenge we faced was this: given the rapid pace of change in information technology research coupled with the severe isolation and communication restrictions faced by DPRK researchers (they had no Internet access, nor could they receive or send email directly from/to us), what could we do with them that was of value?

Specifically, what could we do with them that satisfied the following criteria?

1. Research activities that are of lasting value to the DPRK researchers, and be recognized as such by them when they finally emerged and joined the international scholarly community.
2. Research activities that could be worked on by DPRK researchers in relative isolation for long periods of time.
3. Outcomes that meet the highest of intellectual standards and be recognized as such by the international research community.
4. Methods and tools that enable KUT researchers to verify their own work as well as verify that we had dealt with them truthfully and not wasted their time.

The above criteria are specializations of the principles in categories of integrity, confidence building, and non-violence.

Criteria 1 is an expression of the satyagraha principle of sincerity. Our hope for the DPRK researchers is that they will emerge and be capable when they do.

Criteria 2 is an expression of the satyagraha principles of sincerity and no exploitation. It would have been easy for us (at least in the first series of meetings) to give talks whose content was ephemeral or of little consequence. Given the isolation of the DPRK researchers, most likely they would not have been in a position to know immediately whether or not we were wasting their time.

Criteria 3 is an expression of the satyagraha principle of same standards. As scholars, we believe in intellectual standards. We would be upset if someone wasted our time. We do our utmost to prepare our students and colleagues to meet the highest intellectual standards. To do less anything less for the DPRK researchers than we would do for ourselves is hypocritical.

Criteria 4 is an expression of the satyagraha principles of confidence building, trust, and no exploitation. As we will describe shortly, we provided the DPRK researchers with automated reasoning tools that would enable them to check their work as well as ours. In effect, we made ourselves intellectually accountable to them and gave them the means to verify the truth of what we told them at their leisure[1].

[1]The concept of trust as *delayed accounting* is developed extensively by Annette Baier, Professor of Philosophy at the University of Pittsburgh in [3].

In Section 5 we give an overview and thinking behind the technical content and tools we presented. In Section 6 we discuss our experiences with the classes we held for them in 2003 and 2004.

5 Technical Content and Tools

The axioms that informed our thinking in selecting technical content and tools were the following:

1. When people are able to secure their information and control who has access to their information, they will feel less vulnerable and safer. Feeling safe makes people more willing to share information and belong to a community. This follows closely the safety principles under the nonviolence category of satyagraha principles.

2. The highest standard in engineering is verifying the truth or validity of a conclusion by formally proving it using formal rules of logic and mathematics. This is typically the most difficult approach and the most convincing. This is consistent with the satyagraha principles of sincerity and using the same standards.

3. Human proofs of engineering systems are large, unwieldy, and prone to error. Having proofs checked by computer-assisted reasoning tools, e.g., automated theorem provers (computer programs that check proofs), give the engineer assurance that his or her proofs are correct and enable third parties to independently verify the proofs. Using these tools enables DPRK researchers to check their work as well as check our work and the work of others. This is consistent with the satyagraha principles of trust and using the same standards.

4. Due to the relative isolation of DPRK researchers and what we assumed was the relative scarcity of computers, software and information technology in general in the DPRK, we anticipated that the DPRK researchers would have a high tolerance for "pencil and paper" analysis, i.e., their analytical skills would be high to make up for their lack of computer-aided design tools. In other words, they would be more willing than most to spend as much time as necessary to understand a proof or a program if they perceived it would help them. This was indeed the case based on our observations in Pyongyang in 2002.

Given the viewpoint characterized by the above axioms in our thinking, we decided to focus on the following material.

Information Assurance and Security: This area was intended to cover the basic principles of security based on encryption, access control, and formal verification. Its content and selection was guided by Axiom 1. These topics included:

- Public key and secret key cryptographic algorithms and protocols described in the open literature
- Reasoning about access control and delegation based on an access-control logic developed by Abadi and colleagues [8, 2, 6].
- Formal hardware verification using theorem provers

Fundamental Logic: This topic was similar to a core graduate course, CSE 607—The Logical Basis for Computing [9]. Its purpose is to teach logical reasoning that is the basis for verifying correctness and security. The selection of this area was informed by Axioms 2 and 4. Included in the topics were:

- Propositional logic
- Predicate calculus
- Tableau-based inference rules and proofs

Higher Order Logic (HOL) Theorem Prover: HOL [7] is a theorem prover created and maintained by researchers at Cambridge University in the United Kingdom. The selection of this as a topic was based on Axioms 2, 3, and 4. HOL is based on the ML programming language [5] and is a completely open system. The key is that the implementation of HOL is freely available. Its code is open. HOL users world wide have contributed numerous verified theories that are

reusable components for larger theories and serve as tutorials for logical reasoning using HOL. HOL is considered by many to be the best and most thoroughly checked theorem prover in use. Included in the topics were:

- Installing and running HOL
- Forward and backward reasoning in HOL
- Example proofs of hardware
- Formally defining the syntax and semantics of languages and algebras in HOL
- Modal logic in HOL

The above areas are a very rigorous set of topics. Our feeling was that if the DPRK researchers did nothing else but disappear and verify all their designs and theories in HOL, when they emerged, their work would be recognized as having met the highest of standards and their researchers would have had the benefit of building on the work of others in the international theorem proving and verification community.

Our experiences are discussed in Section 6.

6 Experience

In this section we relate our experiences working with DPRK researchers from KUT, some of the challenges we faced, and how greater familiarity and comfort allowed us to work more effectively as time passed.

Our First Series of Classes In 2003 we had our first series of classes for the DPRK researchers. In the end we had eleven 50-minute classes with two 2.5 hour classes that were more "hands-on" in terms of software installation and using the HOL theorem prover. These classes spanned a period of about one month.

Initially, we did not know what education and training they had. To start, we decided to emphasize the information assurance and security topics over fundamental logic and we had a brief introduction to using HOL. Essentially, we treated them as we would have treated any group of Ph.D.-level researchers coming from a reputable U.S. university. Our presentation was consistent with assuming they had mastered fundamental logic and were familiar with installing and using Unix programs on personal computers.

While we strongly suspected that their level of preparation would be substantially different from what we were normally used to, we did not want to do anything that conveyed to them that they were less than equal to us or less than well prepared.

The initial lectures in 2003 were given by myself. We did not want to use any graduate students in teaching roles initially because we did not want to do anything that might be perceived as being disrespectful, i.e., that they were not worthy of our full time and attention. Thus, our initial lectures were professor-to-professor so as not to embarrass or humiliate them.

During my lectures, it became readily apparent that most were unfamiliar with fundamental logic and proofs. Even more of a problem was the language barrier. My lectures were in English. At best, their English was "Russian English." The senior member of the DPRK research delegation, Sin Thae Song, had studied in the former Soviet Union and had learned English there—what he called "Russian English." While he could follow my lectures for the most part, it was clear that the rest of the DPRK researchers were not following my words much less the technical content. Our combined group did have two interpreters: the DPRK had an "escort" whose English was excellent, but he was not an engineer and did not have a technical background. We had Professor Jongwoo Han, an adjunct professor of political science in the Maxwell School and a citizen of the ROK. Professor Han also was not trained as an engineer, so translation of technical terms and asking questions and giving answers was difficult at best.

In retrospect, while this was initially a tremendous inconvenience, it was actually a blessing in disguise. To address the technical language barrier, my then Ph.D. student (now Byoung Woo Min, Ph.D.) was brought in to serve as a technical translator. Min was fully versed in formal hardware verification, fundamental logical reasoning, and HOL. He was introduced to them in a supportive role and he proved his worth by quickly, accurately, and precisely convey-

ing their questions and comments. The lectures went much better. Min could assess their preparedness and where they had gaps in their knowledge. With this assessment, we adjusted our remaining lectures and HOL laboratory sessions to cover more fundamental concepts.

Min's acceptance by the DPRK researchers was a major victory on a personal basis. When Min first met the DPRK researchers at a one of the first meals, he was greeted by stony and expressionless faces that reflected the researchers' suspicion of him. However, after Min's able technical translation, and one memorable picnic in a N.Y. State park near Syracuse where Professor Han's family and Min's family cooked galbi (Korean barbecued short ribs), the ice was broken and Min was accepted. He was able to lead (more effectively than I) laboratory sessions using HOL. This also cleared the way for another Ph.D. student of mine, Thumrongsak Kosiyatrakul, to teach classes in fundamental logical reasoning, which were a condensed version of my core graduate course CSE 607—The Logical Basis for Computing. In fact, my course notes were used for these lectures, problems, and examples.

By the end of their month with us, we felt that they at least had a chance to incorporate logic and HOL into their research methods.

Our Second Series of Classes Our second series of classes took place over two weeks in April 2004. They requested, and we followed their request, to focus on logic and HOL in this much shorter time. Of the five classes, roughly half the classes were devoted to HOL and the other half were devoted to fundamental logic and doing proofs. We also introduced modal logic (the logic of possibility and necessity) and its application to verification. These classes were taught by Byoung Woo Min and Thumrongsak Kosiyatrakul. The classes went smoothly and both Min and Kosiyatrakul were immediately accepted, even though this was an entirely new group of researchers. Due to our experience with the prior delegation, we had a good idea what they needed from us to succeed, and we structured our classes to meet those needs. This group of DPRK researchers was also very focused on learning as much as they could in a short period of time, much as their predecessors had been. Again, while it it not possible to become adept using logical reasoning and theorem provers such as HOL in two weeks, our hope is that given a sustained effort back in the DPRK, they would master these tools.

7 Conclusion

A wise friend of mine taught me to ask after every meeting, *"who was helped today?"* After these series of classes and in subsequent meetings with DPRK representatives in Beijing in 2005, I have often reflected and asked those with knowledge of our effort if we had done any good or were we in fact doing more harm than good.

Not surprisingly, some high-level Syracuse University officials took a dim view of our effort. Some of these administrators (non-Korean in origin) suggested strongly that ROK citizens and the ROK government would be strongly against our engagement to the point where our careers would be damaged, if we continued our collaborations. While I fundamentally disagreed with their conclusions, I could not entirely rule out the possibility that they could be right.

Since our initial engagement, I have taken every opportunity to ask our faculty of Korean origin and visiting officials from South Korea what their thoughts were about the wisdom of engaging the DPRK the way we have. Universally, all have supported this engagement.

Most recently, I had the opportunity to meet with Ahn Byong Man, the Chair of the Korean Fulbright Foundation, and Choi Young-jin, the ROK ambassador to the United Nations. When asked why they thought engagement did more good than not, and how they would address the concerns of skeptics, they made the following points.

- While it is true that we cannot tell now who will survive the inevitable changes coming to the DPRK, we must take every opportunity to influence the next generation of scholars. Some of these people will be the next leaders.
- Look at China's example: Zhou Enlai, China's

premier from 1949–1976, advocated peaceful coexistence and was instrumental in the construction of China's economy and the reformation of China's society. He was greatly influenced by his experiences and education in France in the early 1920's.

- We do not yet know who the DPRK's Zhou Enlai will be. But, he or she may be among the group of DPRK scholars we have or will engage.

On a personal note, I have grown quite fond of the DPRK scholars and researchers I have come to know since 2002. In particular, I think warmly of my computer science/engineering counterpart, Sin Thae Song, who is the Director of KUT's Information Center. In our meetings since 2003, he has joked about my "logical way of thinking" and he knows about and has witnessed my love for noodles, in particular Pyongyang cold noodles, when I visited him as part of the first Syracuse University delegation to visit the DPRK in 2002.

As a result of many days, classes, jokes, and meals together, it is no longer possible for me to view the DPRK monolithically or stereotypically. I now know real people and have shared experiences with them, mostly positive and mostly hopeful. While I cannot predict nor control the future, it is my hope that we are shaping it in a positive way.

Hopefully, in the not too distant future, we will not think it so odd to see our DPRK colleagues in workshops, symposia, and our college campuses.

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