

Modeling the Political Health of the Nuclear Industry

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INTRODUCTION

“Most people – recognizing nuclear war as a grave and terrifying prospect, and nuclear policy immersed in technical complexities, official secrecy, and bureaucratic inertia – tend to practice what psychiatrists call denial: putting the agonizing problem out of our heads, since there seems nothing we can do about it.” – Carl Sagan (1983)¹

Nuclear science and engineering, as a field, exists in a space unlike any other technological discipline. When prompted to discuss matters concerning the nuclear discipline, the mind of average citizen tends to think of disasters such as Chernobyl, Three Mile Island, and Fukushima. The average citizen will think of Hiroshima and Nagasaki. The venerable citizens will remember the shadow of the Cold War, recalling such practices as “duck-and-cover”. Indubitably, history has left a poor taste for nuclear in the minds of many Americans. While it is imperative that the United States pay respect to the great and occasionally ominous history of nuclear science and technology, it does not seem proper for the nuclear industry to face the challenges of public image that it currently experiences. Consider, for example, the aviation industry. When prompted to discuss matters pertaining to aviation, the mind of the average citizen will think of breaking the law of gravity to soar through the clouds, of fighter jets passing overhead football games, and the words “one small step for man, one giant leap for mankind.” The venerable citizen will recall Howard Hughes, and the sex appeal of Pan-American World Airways.² The people of the United States have been in a perpetual romance with aviation since the Wright brothers first launched a glider in Kitty Hawk at the turn of the twentieth century. It is very rare that the mind of the average citizen will think of the Hindenburg, of Challenger, of Malaysia Airlines Flight 370, or of that day in September 2001 responsible for permanently redefining the tone United States foreign and domestic policy. Little Boy would have never made it to Hiroshima without Enola Gay, yet it is the nuclear engineers who have had to answer for that horrendous act, leaving the aerospace engineers unscathed in the arena of public image. Recognizing this unique position that history has assigned the nuclear discipline is paramount in promoting the health and prosperity of the field as effectively and efficiently as possible.

MOTIVATION AND PURPOSE

“Insanity: Doing the same thing over and over again and expecting different results.” – Albert Einstein, attributed.

Rather than attempt to solve this crisis of image through conventional means, such as standard advocacy and public education, it is appropriate for the nuclear discipline to take a new approach. That doesn’t mean standard advocacy and public education should be abandoned, however. Such activities remain vital to the promotion of the nuclear discipline. Yet the methods employed by the nuclear discipline thus-far have failed to sway public opinion on the scale necessary to ensure that the United States both responds to the environmental and national security threat of climate change while maintaining, let alone improving, the economic status-quo of our energy grid.³ This work serves as a compass on how to affect the greatest positive change in the political health of the nuclear discipline by recognizing the characteristics of the current United States political system and modeling the future of said political health through the dynamics of political capital. These dynamics are intuited based upon complexity theory, assuming that the structure of the system is due to self-organization as opposed to a top-down global conspiracy.⁴

Defining Political Capital

Political capital is a term that is often encountered, yet received as colloquialism by many. This reception is inappropriate, as political capital has a very real definition. Inspired by Pierre Bourdieu’s interconvertability theory, Kimberly L. Casey both defines political capital in a way similar to economic capital, and provides a framework for its quantification. Casey quantifies political capital as

$$PC = IC_{sc} + HC_{sc} + SC_{sc} + EC_{sc} + CC_{sc} + SyC_{sc} + MC_{sc} \quad (1)$$

Where PC is political capital, IC_{sc} is ones institutional capital score, SC_{sc} is the social capital score, EC_{sc} is the economic capital score, CC_{sc} is the cultural capital score, SyC_{sc} is the symbolic capital score, and MC_{sc} is one’s moral capital score.⁵

The weighting of each factor contained in equation (1) as well as the capacity for exchange between capital forms are subject to the style of government an individual operates in. In a monarchy or feudalistic society, for example, symbolic capital is for the most part set. You are either born into serfdom or the ruling elite, and will almost certainly remain in that class for life. Similarly, economic and political capital are one in the same for a plutocratic society, as all other forms of capital are irrelevant to the equation. Therefore, as the system of governance approaches pure plutocracy, political capital dynamics may be modeled by classical economics with absolute accuracy/precision.

Analysis of Current Political Climate

In order to model political capital dynamics with the greatest accuracy for the purposes of this work, it is necessary to modify equation 1 to represent the style of governance with which the United States operates. This process is no different in spirit than modifying a differential equation through the application of initial and boundary conditions. This work will address the political capital dynamics within the federal government only, as it is the federal government which has the most power over nuclear matters. As a two-party Democratic Republic, social, institutional, and symbolic capital have the most official and obvious effect on an individual's political capital in the United States. Social capital is a measure of a candidate's ability to rally otherwise apathetic minds. Institutional capital is a measure of how much support you have from your party or institution. Symbolic capital is a measure of how much respect is commanded by one's office. The success of politicians without college degrees such as Scott Walker suggests that formal education does not have as large a weight.⁶ Therefore, human capital will be weighted less than social, institutional, and symbolic. Human capital is a measure of what the individual brings to the table in terms of personal capability and knowledge. Traditional human capital milestones are formal degrees and certifications, such as passing the Bar and possessing a driver's license. The prevalence of carpet-baggers, such as Hillary Clinton, who spent the majority of her time in Arkansas yet became Senator of New York, suggests that cultural identification with a given region is not of terrible importance in determining political capital.⁷ Moral capital is incredibly confusing in the current political climate. The Christian Right claims to have a monopoly on morality in politics, yet their brand of morality is refuted by the majority of American citizens.^{8,9} Even the Supreme Court refutes morality as defined by the Christian Right, as evidenced by *Roe v. Wade* (1973) and *Obergefell v. Hodges* (2015). Due to the incredibly controversial and regionally varying nature of moral capital in the current United States political system, the term will be omitted from the equation. Economic capital is of particular interest to the current

political system in the United States. The Supreme Court ruled in *Citizens United vs. the Federal Electoral Commission* (2010) that both non-profit and for-profit corporations, as well as labor unions and private individuals, have the right to donate unlimited sums of money to politicians.¹⁰ In fact, analysis of 467 congressional races in 2012 found that winning congressional candidates outspent their opponents twenty-to-one, and that candidates who out- fundraised their opponents were nine times more likely to win their elections.¹¹ Therefore, economic capital plays a massive role in the determination of political capital in the current political system of the United States. Taking these characteristics into account, equation (1) is modified to become

$$PC = 5IC_{sc} + HC_{sc} + 5SC_{sc} + 10EC_{sc} + CC_{sc} + 5SyC_{sc}. \quad (2)$$

Having defined political capital, it is now necessary to model the dynamics of political capital as it relates to affecting policy in the federal government. The first principle is that a politician's political capital is at a maximum immediately upon being elected to office. This is to be expected, as political capital is the currency used to affect movement in Congress. The legislative process consists of five major steps. First, the potential legislation is drafted as a bill. The bill is then submitted to the appropriate congressional committees for review. Upon receiving committee approval, the bill is introduced to the House and Senate floor for a vote. Finally, in the event that the bill passes both the House and Senate, the bill is sent to the oval office for final review where the President may either veto the bill or sign the bill into law.¹² Let us now follow the dynamics of a politician's political capital as a bill they have authored passes through this process. The drafting of a bill does not require a large investment in political capital, however it is certain that the bill will not pass committee unless the politician who has authored it has sufficient individual political capital. The exception to this rule is for policy that is called for due to some a priori insertion of political capital due to some unforeseen event, such as the passage of the Patriot Act in response to 9/11. However, this insertion of political capital was not directed toward an individual, but to the ideas contained within the act themselves. A politician gains individual political capital when said politician votes in accordance with ideas that are rich in political capital. Due to the random and sporadic nature of these idea-directed political capital insertions, they are relegated to outside of the design base for the model. Assuming the proposed bill makes it out of committee to the house and senate floors for a vote, the next payment in political capital is due. This payment is subject to the success of the bill. If the bill is rejected by both the house and senate, the politician who has proposed the bill loses the largest amount of political capital. Passage in only one half of congress results in a more modest loss of political capital, while absolute success in congress results

in the lowest payment. In the event that the bill is signed into law, the politician(s) who have authored the bill actually receive(s) a boost to their political capital.

The tools are now in place to chart out the best path to political success for the nuclear discipline. To do so, a case study will be performed on the Joint Comprehensive Plan of Action (JCPOA). Negotiated by the Obama administration to secure the United States regional security interests as they pertain to the Middle East, the JCPOA's primary goal is to prevent the Islamic Republic of Iran from acquiring nuclear capability.¹³ Nuclear capability, as defined by Collin's dictionary, is "a country's possession of and ability to use nuclear weapons." As it currently stands, Iran does not have nuclear capability. According to the White House, the JCPOA will increase Iran's breakout time from 2-3 months to 1 year. Like all policy decisions, there are more than one viewpoint and characterizing the JCPOA as a "good deal", or one which the United States should officially adopt, requires careful consideration of all aspects of the deal. The research performed for this analysis has shown that the greatest negative testimony for the deal concerns the sunset clauses of the JCPOA. Policy experts have expressed concern as to the potential results of the deal 10 or 15 years down the line. In a testimony to the Senate Armed Services Committee, Michael Singh of the Washington Institute went so far as to say "The nuclear deal with Iran has strong points and weak points. My judgement, however, is that it leaves Iran with significant nuclear capability."¹⁴ This judgement directly contradicts the results of the deal as reported by the White House. Research into Singh's professional history uncovers that he served as professional assistant to Condoleezza Rice and Colin Powell. He also served as middle-east advisor to the Romney/Ryan presidential campaign.¹⁵ To give Singh the benefit of the doubt, a calculation of Iran's breakout time was performed utilizing data from International Atomic Energy Agency (IAEA) as reported by the Arms Control Association alongside a report from the Institute for Science and International Security, both before and after the deal.^{16,17} To provide the most conservative estimate possible, it is assumed that all Iranian centrifuges are operating at maximum capacity and enrichment can begin instantaneously. The results of the calculation show that the breakout time increases by a factor of approximately 4.5 with the JCPOA. Therefore, in providing his testimony to the Senate Armed Services committee, Singh either did not do his due diligence prior to providing testimony, or misrepresented the information collected. The question then arises, what would motivate a respected and established policy analyst to provide such inaccurate testimony? The unfortunate truth is that this testimony is a result of the ever increasing polarization of American politics and politicization of matters which have effectively unanimous support from the community of experts. Were the JCPOA negotiated by a Republican, it is almost certain that Singh would provide positive testimony and the negative

testimony would be heard from an analyst with ties to the Democratic Party. This politicization is further evidenced by the House going on record against the deal in a 'symbolic' vote. Mitch McConnell even went so far as to "blame" the Democrats for the deal.¹⁸ Taking the politicization and partisanship that runs rampant through Washington into account, another modification to the political capital equation is necessary to truly represent the current U.S. political system. Thus, the most accurate equation to quantify political capital is:

$$PC = 10IC_{sc} + HC_{sc} + 5SC_{sc} + 15EC_{sc} + CC_{sc} + 5SyC_{sc} \quad (3)$$

In order to affect the greatest positive political change for the nuclear discipline, one must simply refer to the above equation to identify where to invest the effort.

Consideration of equation (3) shows that the most efficient method for promoting the political health of the nuclear discipline is by addressing the institutional and economic capital associated with the industry. The health of the nuclear industry will not improve until sufficient economic capital is invested to properly compete with its primary competitor: Oil and Gas. Lobbying trends of the past decade show that the nuclear lobby (read: the Nuclear Energy Institute) has only spent approximately 1% of that spent by the Oil and Gas lobby.^{19, 20} If the nuclear industry truly wishes to compete in a meaningful way in the current U.S. political system, lobbying investments MUST increase substantially. Additionally, the politicization and partisanship rampant in Washington is dragging the integrity of expert technical analysis through the mud. Recognizing the necessity to "leave no shot unanswered," it is imperative that the experts of the nuclear discipline respond in a formal manner whenever a politician or policy analyst undermines the integrity of the field.²¹ The most appropriate form of response would be for the American Nuclear Society (ANS) to release an official statement in any event that technically inaccurate testimony appears to be gaining traction within the minds of Congress. In doing so, the nuclear discipline can say that it is making the best effort to keep politicians honest and mitigate politicization.

RESULTS

"If it disagrees with experiment, it's wrong. In that simple statement is the key to science. It doesn't make a difference how beautiful your guess is, it doesn't make a difference how smart you are who made the guess or what his name is. If it disagrees with experiment, it's wrong." – Richard Feynman

Promotion of the nuclear discipline in the modern political climate of the United States requires a paradigm shift concerning the accepted modus operandi. Standard advocacy and public education is no longer as effective due

to the growing divide between the general public and political institutions, alongside the increased power of economic capital in politics and the politicization of matters too complex for the average citizen to understand. Recognizing the necessity for a paradigm shift, the quantification and dynamics of political capital is modeled. Utilizing the characteristics of electoral success, alongside the progression of the JCPOA as it pertains to official adoption by the United States as “boundary and initial conditions” to the equation for political capital, the equation is modified to best represent the current United States political climate. Reference to this modified equation shows the most efficient avenue for affecting change. The results suggest the nuclear discipline ought invest its efforts on affecting the status quo concerning economic capital and institutional capital investments, thereby affecting the greatest shift in the political status quo. This is performed by increasing the budget of the nuclear lobby as well as adopting a “leave no shot unanswered” policy concerning technical inaccuracies that arise in the debate of policy.

APPENDIX A: ANALYSIS OF IRANIAN ENRICHMENT CAPABILITY PRE AND POST-JCPOA

Based upon reported Iranian centrifuge inventory and a requisite 1500 Separative Work Units (SWU) to acquire enough fissile material for a weapon, the breakout times are estimated. This is an incredibly conservative estimate and assumes that enrichment begins instantaneously upon Iranian desire.

TABLE A.I. Pre-JCPOA Enrichment Capability

Centrifuge	Quantity (Units)	SWU/yr/Unit	Total SWU/yr
IR-1	18000	1	18000
IR-2m	1000	5	5000

$18000 \text{ SWU} + 5000 \text{ SWU} = \text{Total } 23000 \text{ SWU/yr}$ (A.1)

$1500 \text{ SWU} \times (23000 \text{ SWU/yr})^{-1} = 0.065 \text{ yr}$ (A.2)

TABLE B.I. Post-JCPOA Enrichment Capability

Centrifuge	Quantity (Units)	SWU/yr/Unit	Total SWU/yr
IR-1	5060	1	5060

$1500 \text{ SWU} \times (5060 \text{ SWU/yr})^{-1} = 0.296 \text{ yr}$ (B.1)

The ratio of B.1 to A.2 is 4.554, signifying an increase in breakout time by a factor of approximately four and a half.

NOMENCLATURE

PC = Political Capital
IC_{SC} = Institutional Capital Score

SC_{SC} = Social Capital Score
EC_{SC} = Economic Capital Score
CC_{SC} = Cultural Capital Score
SyC_{SC} = Symbolic Capital Score
MC_{SC} = Moral Capital Score
SWU = Separative Work Unit
Yr = Years

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