Forecasting the Storm

Power Cycle Theory and Conflict in the Major Power System

Dylan Kissane[1]
School of International Studies
University of South Australia

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ABSTRACT: Just as picnickers and holiday makers regularly curse TV weather presenters for failing to forecast the rainstorms that detract from the happy times which were planned. If international relations can be imagined as a peaceful picnic, then conflict is the storm that wrecks havoc among family and friends. The goal, then, of those within the discipline who study conflict is to forecast these international storms and, in power cycle theory, there exists a method which is of some utility to this end. This paper introduces power cycle theory, explaining its components and methodology before introducing the specific changes to the method that are the result of the author's Honours research. The strong, positive correlation between conflict and 'critical points' on the power cycles of states is established and it is concluded that this reformulated power cycle theory may provide analysts with the ability to 'forecast the storms' of international power politics.

Many a picnic has been spoiled by inclement weather and, in response, many a weather presenter has been cursed by disappointed dads, miserable mums and families fed-up with faulty forecasts. Washed out weekends and ropeable relations are the ultimate result of the smiling weathermen and women who fail to forecast the storms that send personable picnickers back inside shaking their heads in disbelief that, although humans can send a man to the moon, they cannot predict the weather more than a few days in advance. In response, the weather watchers point to the complexity of the system they are charged with predicting. Despite consistent references to seemingly simple synoptic charts and satellite photographs that dominate TV weather reports, the weather is a significantly more complicated than many would believe. Subject to chaotic processes and ultra-sensitive to initial climatic conditions, local weather remains almost impossible to predict long-term. Indeed, even if a meteorologist was provided with all the data available with regards to wind speed, barometric pressure, cloud cover and temperature records accurate to hundredths of degrees Celsius it would be unlikely that any 10 day forecast would prove completely correct and that any month long forecast would be likely completely wrong. So complex are weather systems that, in the final analysis, the picnickers predictions sometimes proves more accurate that the professionals.

In the international system we have another complex system that is also difficult to predict. Like the analysis of weather, there are many elements that need to be assessed in providing forecasts of international futures. Instead of clouds, temperature and pressure, the international political system is composed of hundreds of states, thousands of institutions and non-government organisations and billions of individuals. It

[1] Dylan Kissane is a graduate of the University of South Australia's School of International Studies. He was awarded the University of South Australia Medal in April 2005 and work based on his Honours research has been published in the peer-reviewed journals *Politikon* and *Security Challenges*. Thanks and acknowledgement to Dr David Lundberg for his support and supervision.

encompasses political, economic and diplomatic spheres with potential effects being felt at the international, regional, national and sub-national levels. The system is demonstrably complex, with units at all levels of analysis affecting actors at all others.[2] Thus, like the prediction of local weather, forecasting in international affairs is fraught with difficulties: as every state, institution and individual has the potential to impact on the entire system, international relations analysts are sometimes no more accurate than the local TV weatherman.[3]

If the international system can be compared to complex weather systems, then the conflicts within the system are the storms so despised by the picnicking familles. The study, explanation and prediction of conflict in the international system have formed an integral part of international relations scholarship since the birth of the discipline. Hobbes and Machiavelli both theorised reasons why groups went to war and their tradition was carried forward in the work of more modern writers such as Carr, Morgenthau and Waltz.[4] Today scholars like John Mearsheimer, Michael Mandelbaum and Robert Keohane continue to provide explanations for and, from time-to-time, predictions of conflict likely to emerge in the future.[5] Mearsheimer, in particular, is an international relations meteorologist of sorts, with his papers on Europe, the United States and great power politics in general serving as predictions of what will happen, if still lacking the quality of the best forecasts, being when.[6]

In power cycle theory is found another explanation for conflict in international systems. Taking into account the material capabilities of states relative to their peer competitors, power cycle curves trace the rise and fall of states across time and predict that – at critical points on a state's trajectory – conflict is more likely.[7] Indeed, so strong is the correlation between conflict and critical points on the respective curves of the states that it is almost impossible to conclude other than that relative material capability and foreign policy role have some important affect on the incidence of conflict in international systems.[8] This correlation holds true in spite of the systems assessed (power cycle theory has been tested on international regional and sub-regional state systems) or the number of actors assessed within that system (variances from three states to as

[2] See, for example, Helen Milner. 1991. 'The Assumption of Anarchy in International relations Theory: A Critique.' *Review of International Studies* 17(1): 67-85, pp.82-85.
[3] Charles F. Doran. 1999. 'Why Forecasts Fail: The Limits and Potential of Forecasting in International Relations and Economics.' *International Studies Review* 1(2): 11-41.
[4] The seminal works of these authors which incorporate such discussions are: Thomas Hobbes. 1985. *Leviathan*. St Ives: Penguin Books; Nicolo Machiavelli. 1977. *The Prince*. New York: Norton; EH Carr. 1946. *The Twenty Years Crisis: 1919-1939*. 2nd edition. London: Macmillan; Hans Morgenthau. 1948. *Politics among Nations*. New York: Knopf; Kenneth Waltz. 1979. *Theory of International Politics*. Reading: Addison-Wesley.
[5] For example, John Mearsheimer. 1994. 'The False Promise of International Institutions.' *International Security* 19(3): 5-49; Michael Mandelbaum. 1998. 'Is Major War Obsolete?' *Survival* 40(4): 20-38; Robert Keohane. 1986. 'Theory of World Politics: Structural Realism and Beyond.' in *Neorealism and Its Critics*, edited by RO Keohane. New York: Columbia University Press;
[6] See John Mearsheimer. 1988. 'Numbers, Strategy and the European Balance.' *International Security* 12(4): 174-185; John Mearsheimer. 1990. 'Back to the Future: Instability in Europe after the Cold War.' *International Security* 15(1): 463-510; John Mearsheimer. 2001. 'The Future of the American Pacifier.' *Foreign Affairs* 80(5): 46-61; John Mearsheimer. 2001. *The Tragedy of Great Power Politics*. New York: Norton.
[7] Charles Doran and Wes Parsons. 1980. 'War and the Cycle of Relative Power.' *American Political Science Review* 74(4): 947-965, p.963.
[8] Ibid.

many as nine).[9] In power cycle theory, then, international relations analysts have a tool by which the storms of international politics can be explained and perhaps predicted in advance.

Power cycle theory, however, is a product of its time. Steeped in Cold War discourses of international affairs, power cycle theory is state-centric and focussed primarily upon the military and, to a lessor extent, economic capabilities of states.[10] As well, resulting from the relative lack of access to relevant capability information for states, classic power cycle theory only records capabilities and their shifts every five years.[11] Finally, the methodology that forms the basis of classic power cycle theory is both difficult to operationlise and requires specialised computer programs to employ. As a result of such limitations, power cycle theory has seen adherents introduce methodological revisions in recent years. Some scholars have adapted the method to fit specific regional circumstances with specialised capability indicators[12]; some have added indicators drawn from other conflict programs such as the Correlates of War (CoW) project[13]; further still, power cycle theory has even been adapted to the corporate sector, with Marianna Kozintseva recently applying the method to a study of multinational corporate competition.[14]

This paper presents another reformulation of classic power cycle theory, one that includes elements of all of the revisions above. It introduces new actors, including non-state actors, new capability indicators and a better balance between Cold War, realist understandings of power and the nature of power in today's increasingly regionalised and ever more globalised international environment. This reformulation will be shown to have great benefits over the classical method, particularly in terms of its parsimonious processes and the correlations that emerge from it. Indeed, this reformulation will be shown to be superior to the classical methodology in many respects but particularly with regards to accounting for the conflicts of the twentieth century. Next, this paper will produce two hypotheses based on extrapolations of the reformulated method: one in relation to East Asia and the other relating to an emerging Europe. In concluding the paper, it will be argued that this reformulation provides a better basis by which international weather watchers might forecast the storms ahead in the international climate.

Before the reformulation is introduced it is necessary to etsbalish from what it is reformulated. Thus, it is necessary to return to the decisive 1980 paper of Charles Doran and Wes Parsons

[9] For example, Andrew Parasiliti. 2003. 'The Causes and Timing of Iraq's Wars: A Power Cycle Assessment.' *International Political Science Review* 24(1): 151-165; Sushil Kumar. 2003. 'Power Cycle Analysis of India, China and Pakistan in Regional and Global Politics.' *International Political Science Review* 23(1): 113-122; Brock Tessman. 2005. *Multilateral Capability Shifts, Role Surplus and Role Deficit during the 1905 Moroccan Crisis: A Power Cycle Interpretation*. Paper presented at the 40th International Studies Association Convention, 1-5 March 2005.
[10] Doran and Parsons 1980.
[11] Ibid.
[12] Daniel Geller. 2003. 'Nuclear Weapons and the Indo-Pakistani Conflict: Global Implications of a Regional Power Cycle.' *International Political Science Review* 23(1): 137-150.
[13] Tessman 2005.
[14] Marianna Kozintseva. 2005. *Competitive Enterprise: Using Power Cycle Theory to Estimate Firm's Relative Capabilities and Market Response*. Paper presented at the 40th International Studies Association Convention, 1-5 March 2005.

which has laid the foundation for all power cycle work that has followed.[15] This section of the paper will present the methodology and a worked example (in the shape of Great Britain) in order to demonstrate both the practicalities and the possibilities of the power cycle method. In doing so, both the major strengths of the method will be highlighted alongside the obvious weaknesses in need of revision. It will be demonstrated that power cycle theory is not a dead theory but it certainly one could be improved with a little theoretical resuscitation.

For power cycle theorists the state is the primary unit of analysis and states exist within a wider system. The definition of the system, the entry and exit dates of system members and the states considered to be part of the system are largely issues left to the individual analyst.[16] Doran and Parsons' original paper set the system for examination as the major power system, composed of states largely congruent with other interpretations within the discipline of this system.[17] For Doran and Parsons, the states that compose the system, and their respective entry and exit dates, are represented in Figure 1.[18] Note that in Figure 1 an exit year of 1975 indicates that the state remains a part of the major power system – 1975 is simply the last year for which adequate data was available for all states in 1980.

Nation	Period of Membership	No. of Years
Great Britain	1816–1975	160
France	1816–1975	160
Prussia/(W.) Germany	1816–1975	160
Russia/USSR	1816–1975	160
Austria-Hungary	1816–1918	103
Italy	1860–1943	84
United States	1898–1975	78
Japan	1894–1975	82
China/PRC	1950–1975	26

Figure 1: States of the Major Power System (Doran and Parsons)[19]

With the system identified, the next step in power cycle analysis is to identify the material capabilities to be assessed. For Doran and Parsons, these material capabilities reflected the important indicators of the Cold War world, highlighting military and, to some extent, economic potential of a state. Doran and Parsons suggest that these material capability indicators can be understood under two headings: size and

[15] Doran and Parsons 1980.
[16] For example, Geller 2003; Kumar 2003.
[17] Dylan Kissane. 2005a. *Curves, Conflict and Critical Points: Rethinking Power Cycle Theory for the Twenty-First Century*. BA (Hons) Thesis. Unpublished, p.33 (Figure 4). See also Jack Levy. 1983. *War in the Modern Great Power System*. Lexington, KY: University Press of Kentucky, pp.29-43.
[18] Doran and Parsons 1980, p.953. The exit dates for powers which remained in the major power system post-1975 (where Doran and Parsons' research concluded) are not provided. Thus, a blank space implies a current system member. Figure One extracted from Kissane 2005a, p.33.
[19] Doran and Parsons 1980, p.953.

development.[20] The former encompasses iron and steel production (in '000 tonnes), total population ('000 people) and the total size of the armed forces ('000 personnel). The latter encompasses energy consumption ('000 coal-tonnes equivalents) and urbanisation ('000 people in cities of greater than 100,000 people).[21] For each capability indicator, Doran and Parsons record the states result every five years for the entire period that the state is a member of the major power system.[22] Once all the results are known, the relative share of each indicator for the system is determined for every state.[23] These relative shares of each indicator – weighted equally – are then averaged to determine the relative share of system power for that year within the system for that state.

Consider the example of Great Britain in 1901. Figure 2, below, displays the indicator scores for Great Britain for the year 1901.

Iron-Steel	Armed Forces	Energy	Population	Urbanisation
4983	521	181916	41538	13769

Figure 2: Material Capability Indicators, Great Britain 1901[24]

For a power cycle analyst, such figures on their own indicate little about the power of Great Britain. As the power cycle method is a relative comparison, the Great British scores must be ranked alongside those of the other states in the system and a relative share of the total system power determined. Thus, Figure 2 requires a system-wide material capability indicator score table and a share material capability indicators table, both reproduced below and overleaf as Figures 3 and 4, respectively.[25]

State	Iron-Steel	Armed Forces	Energy	Population	Urbanisation
Great Britain	4983	521	181916	41538	13769
France	1425	603	47064	38980	5350
Germany	6137	630	122975	56874	9123
Russia	2228	1142	35093	134800	6990
Austria-Hungary	1099	309	20859	47327	3255
Italy	129	262	5077	32530	3208
United States	13690	112	280242	77584	14723
Japan	6	206	9593	44359	4051
Total	29697	3785	702819	473992	60469

Figure 3: Material Capability Indicator Scores, Major Power System 1901

[20] Doran and Parsons 1980. pp.953.
[21] Doran and Parsons 1980, p.953.
[22] Ibid, p.953.
[23] Ibid, p.954.
[24] Kissane 2005a, p.35.
[25] Figures 3 and 4 are extracted from Kissane 2005a, pp.35-36.

State	Iron-Steel	% Share	Armed Forces	% Share	Energy	% Share	Population	% Share	Urbanisation	% Share
Great Britain	4983	16.78	521	13.76	181916	25.88	41538	8.76	13769	22.77
France	1425	4.80	603	15.93	47064	6.70	38980	8.22	5350	8.85
Germany	6137	20.67	630	16.64	122975	17.50	56874	12.00	9123	15.09
Russia	2228	7.50	1142	30.17	35093	4.99	134800	28.44	6990	11.56
Austria-Hungary	1099	3.70	309	8.16	20859	2.97	47327	9.98	3255	5.38
Italy	129	0.43	262	6.92	5077	0.72	32530	6.86	3208	5.31
United States	13690	46.10	112	2.96	280242	39.87	77584	16.37	14723	24.35
Japan	6	0.02	206	5.44	9593	1.36	44359	9.36	4051	6.70
Total	29697	100.00	3785	100.00	702819	100.00	473992	100.00	60469	100.00

Figure 4: Share of Material Capability Indicators, Major Power System 1901

Determining the annual relative share of total system power, as opposed to a share of iron and steel production alone, for example, applies an unweighted approach. In justifying the decision to weight all indicators equally, Doran and Parsons argued:

> …neither an empirical nor a theoretical argument could be found to give the indicators other than unitary weights. This decision conforms to the observation by Wainer (1976 (sic)) that weighting components is unlikely to alter the nature of the final index. This is especially true when, as in this study, one is interested not in absolute capability levels but in the pattern of change in relative capability.[26]

The determination of the relative share of total system power for Great Britain in 1901 is therefore not a difficult exercise: the relative shares for that country for each indicator are averaged across the six indicators and the result is the percentage system share for that year. In 1901, Britain maintains a share of approximately 17.59% and is well placed in the system, trailing only the United States (25.93%) and ahead of European rivals Russia (16.53%) and Germany (16.38). Figure 5, below, indicates the final total relative shares for all states in the major power system for 1901.[27]

State	% System Share
Great Britain	17.59
France	8.90
Germany	16.38
Russia	16.53
Austria-Hungary	6.04
Italy	4.05
United States	25.93
Japan	4.58
Total	100.00

Figure 5: Relative Shares of Total System Power, Major Power System 1901

[26] Doran and Parsons 1980, pp.953-954. See also Howard Wainer. 1978. 'On the Sensitivity of Regression and Regressors.' *Psychological Bulletin* 85(1): 267-273. NB- The original text refers to Wainer 1976 but the correct citation is Wainer 1978.
[27] Figure 5 is extracted from Kissane 2005a, p.37.

The assessment of material capability indicators for each state in the system is continued in intervals of five years until the entire period within the system for each state has been quantified. These points are added to a simple Cartesian plane and it is to these points that the power cycle curve is then fitted. Using a complicated growth-and-decay formula, Doran and Parsons suggest a method of fitting the curve that is difficult but results in curves that emerge as in Figure 6, the power cycle curve of Great Britain from 1816-1975, below.[28]

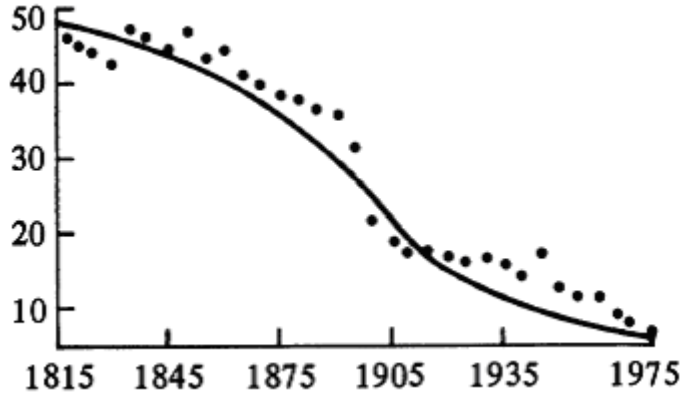

Figure 6: Great Britain Power Cycle, 1816-1975

Despite the immediately apparent decline apparent in Great Britain's curve, the most significant elements on the curve for power cycle analysts are what are known as critical points. These are the points in which the curve is maximised, minimised, declining or rising at the fastest rate.[29] This is easily determined by calculating the equation of the curve and deriving it ($f'(x)$) – allowing maxima and minima to be identified – and then deriving the derivative ($f''(x)$), allowing the points of inflection on the curve to emerge.[30] To identify and differentiate the various critical points from each other, power cycle theorists refer to H-points (High points), L-points (Low points) and I-points (Points of Inflection).[31] I-points are further divided into I_1 (rising inflection points) and I_2 (declining inflection points). For Great Britain's curve in Figure 6, the critical points are at the years 1817 (H), 1904 (I_2) and 1975 (L).[32] Critical points are essential to power cycle analysis; indeed they prove the utility for the method, as they correlate strongly with conflict. That is, where critical points emerge on the power cycle curves of states, there is a greater likelihood that the state will engage in conflict with other members of the international system.[33] While not predicative in themselves, the critical points on a power cycle curve correlate so statistically significantly with conflict (>0.75) that, at

[28] Figure 6 is extracted from Doran and Parsons 1980, p.956. Doran and Parsons (1980, p.954) describe the Pearl equation thus:
> "The logistic curve was explored by biologist Raymond Pearl (1924) who deduced that human populations grow nearly exponentially until reaching an inflection point and then level off to approach an asymptote. Because the Pearl logistic curve models growth in the context of limited resources (homologous with growth of a major power's share of relative capability in the international system), it provides a theoretically justified, readily applicable method of finding crucial points in the growth of a nation's capability."

[29] Doran and Parsons 1980, p.948.
[30] Ibid.
[31] Ibid, Figure 1.
[32] Ibid, p.956.
[33] Doran and Parsons 1980; Brock Tessman and Steve Chan. 2004. 'Power Cycles, Risk Propensity and Great Power Deterrence.' *The Journal of Conflict Resolution* 48(2): 131-153.

the very least, it can be assumed they exhibit some sort of explanatory role. This explanatory role has been established not only by Doran and Parsons but also Tessman and Chan and others who have analysed conflict and conflict systems using the power cycle method.[34]

The weaknesses in the classic power cycle approach, however, are easy to identify. In particular there are five that stand out as particularly pointed in the context of the post-Cold War, globalised international system: the state-centricity of the method, the lack of annual assessment, the lack of an indicator accounting for technological development, the lack of equal weighting of the elements (as opposed to the indicators) of power and the mathematical complexity of the method for fitting the power cycle curves. This paper will consider each of these in turn and suggest why and how the power cycle method can evolve if it is to maintain utility in for twenty-first century analysts.

The charge of state-centricity is not one that power cycle theory suffers alone. Indeed, almost all realist theories have been criticised in the past for their focus on states either as the sole important or the primarily important actor in the international system.[35] While some realists have broadened their analysis to include institutions or non-state actors in their calculations, power cycle theory has, to date, not done so.[36] This negates the utility of the method in a world that is exhibiting significant regional institutionalism and where intergovernmental institutions are playing a larger role – militarily, economically and politically – in relations between actors at the international level.[37] While there are obvious empirical difficulties in including *all* actors in a relative power assessment, it would certainly seem useful to broaden the base of assessment to international institutions that maintain significant power independent of the states that contribute to them.[38] In particular, the European Union (EU) stands as a clear candidate for assessment within the major power system.

Where Doran and Parsons had difficulty to quantify all material capability indicators for all states in all years in their research, the emergence of information technologies, the continued impact of international statistics collection agencies and academic exercises such as the Correlates of War (CoW) Project have

[34] See Tessman and Chan 2004; Parasiliti 2003; Charles Doran. 1989. 'Systemic Disequilibrium, Foreign Policy Role, and the Power Cycle: Challenges for Research Design.' *The Journal of Conflict Resolution* 33(3): 371-401.
[35] For example, William Robinson. 1998. 'Beyond Nation-State Paradigms: Globalization, Sociology, and the Challenge for Transnational Studies.' *Sociological Forum* 13(4): 561-594; Pauline Kerr. 2003. *The evolving dialectic between state-centric and human-centric security*. RSPAS Working Paper 2003/02, Australian National University, Canberra, Australia; Muhttin Ataman. 2003. 'The Impact of Non-State Actors on World Politics: A Challenge to Nation-States.' *Alternatives: Turkish Journal of International Relations* 2(1): 42-66.
[36] See Jeffrey Legro and Andrew Moravcik. 1999. 'Is Anybody Still a Realist?' *International Security* 24(2): 5-55, p.41.
[37] Consider the post-WW2 rise of such regional and intergovernmental institutions as the UN, NATO, APEC, ASEAN, the EU, the African Union and the OAS. See also Robert Keohane and Lisa Martin. 1995. 'The Promise of Institutionalist Theory.' *International Security* 20(1): 39-51; Barbara Koremenos, Charles Lipson and Duncan Snidal. 2001. 'The Rational Design of International Institutions.' *International Organization* 55(4): 761-79.
[38] Kissane 2005a, pp.65-80.

made obtaining information on indicators much easier.[39] So significant has this change been, it is now possible to find unambiguous, reliable and generally complete data sets for all indicators for all years and for all actors.[40] Indeed, the CoW datasets alone, very popular among academic analysts in the discipline, quantify all of Doran and Parsons material capability indicators.[41] In light of a constantly and consistently dynamic international environment in a globalised world, it seems nonsensical to continue to assess actors only twice a decade. With material capability data readily available, there seem few problems to prevent the analysts from measuring all indicators for all actors annually.

A further criticism arises from the lack of engagement with the technological developments that have enabled some actors to rise to major power status without the need to compete militarily with other major powers (for example, Japan).[42] Across the indicators assessed by Doran and Parsons' method, there is not one that accounts for technological development. In terms of military power, a large standing armed force and extravagant defence expenditures are implicitly considered an advantage over, for example, targeted spending on technology for a smaller, specially trained armed force.[43] There is requirement, then, for the introduction of an indicator which assesses the impact of technological research and development in order to bring the power cycle method up to date.[44]

While Doran and Parsons weight all the material capability indicators equally, there is a lack of equal weight between their two elements of power, size and development: the former includes three indicators and the latter only two. In this age of globalisation where economic and military power are not only sometimes indistinguishable but also usually equally effective arbiters of actor power, there needs to be a balance between these two elements of power.[45] Furthermore, in light of the arguments of the liberal, soft-power theorists, it seems more and more likely that assessments of national power which exclude cultural and media influences will be potentially flawed.[46] Thus, the critique of power cycle analysis in relation to the

[39] Brock Tessman. 2005. Personal Communication: "I also now use the 6-indicator CINC dataset from the COW project. This incorporates military spending into the model. I think it is a more mainstream method. As you can see, I have taken some measures to change power cycle theory into what I feel is a more effective method."
[40] The Correlates of War datasets are stored online at http://www.correlatesofwar.org/.
[41] The specific datasets are the *State System Membership List* (v2004.1) and the *National Material Capabilities* (v3.02) dataset.
[42] Henry Kissinger. 2001. *Does America Need a Foreign Policy? Towards a Diplomacy for the 21st Century*. New York: Simon and Schuster, p.22. See also Haans Maull. 1990. 'Germany and Japan: The New Civilian Powers.' *Foreign Affairs* 69(5): 91-106.
[43] Classic power cycle method, as espoused by Doran and Parsons 1980, measures only the size of the armed forces and the gross defence expenditure of a state. Thus, a large standing force which is expensive to maintain and equip is considered more powerful than a smaller, better equipped force which costs less to arm. Again, this is reflective of the Cold War and 19th and 20th century context within which the theory was developed.
[44] This is particularly necessary in light of recent deployments in Afghanistan by US and Australian special forces troops and also in relation to the growing recognition of asymmetric conflict. In the former case, small groups of special forces troops were able to extract significant victories against forces of greater number. See, for example, Donald Rumsfeld. 2002. 'Transforming the Military.' *Foreign Affairs* 81(3): 20-32. With regards to asymmetric warfare, notable examples and explanation of the concept can be found in Vincent Goulding. 2000. 'Back to the Future with Asymmetric Warfare.' *Parameters: US Army War College Quarterly* 30(4): 21-30; Wesley Clark. 2000. 'How to fight an asymmetric war.' *Time* 156(17): 40; Russell Watson and John Barry. 1997. 'Tomorrow's New Face of Battle.' *Newsweek* 130(22): 66-67.
[45] Joseph Nye. 2002. *The Paradox of American Power: Why the World's Only Superpower Can't Go It Alone*. Oxford: Oxfod University Press, p.39.
[46] Ibid; Kissane 2005a, pp.55-59.

elements of power is two fold: first, that the elements and indicators both need to be weighted equally in assessing actor power and, second, that there is a need to broaden the elements quantified to include soft power.

Finally, the mathematical complexity of the power cycle method – particularly the application of Pearl's growth-and-decay algorithm – work against the utility of power cycle theory for analysts.[47] Requiring specialised computer software and training in order to both input the date and produce the cycles of relative power, power cycle theory is left on the edges of international relations theoretical discourse.[48] More inaccessible than realism and liberalism and with a scholarship dwarfed by constructivism, power cycle theory languishes in almost total obscurity. As Lee Sigelman, editor of the *American Political Science Review*, commented, "it is an analysis that has attracted very little attention in the major political science journals".[49] Without a parsimonious method it seems unlikely that power cycle theory will be rescued from the outskirts of international relations theoretical discourse for the benefit of statesmen, students and scholars.

Hence, at least five areas need to be addressed in the power cycle method in order that the resulting methodology better suit the modern international environment. Some are relatively minor – for example, introducing a new capability indicator has been done before by other theorists including Andrew Parasiliti and Brock Tessman.[50] Similarly, while it has not yet been attempted, the quantification of the power of a non-state actor, such as the EU, would not seem to present any practical problems, in spite of the obvious paradigmatical shift it implies.[51] Annual measures would also seem to present few problems for a reformulation of the method, merely a methodological revision. In incorporating soft power and reforming the method with an eye to parsimony, however, there are greater challenges though, as will be shown, these are not insurmountable. Indeed, the reformulated method that emerges essentially responds to all the critiques thus far presented without losing any of the utility found in the original Doran and Parson formulation.[52]

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[47] Cf. 26. The original equation was extracted by Doran and Parsons from Raymond Pearl. 1924. *Studies in Human Biology*. Baltimore: Johns Hopkins.

[48] A search of the JSTOR political science and international relations journals for the term 'power cycle theory' produced only 20 articles. Subsequent searches for 'realist theory', 'Marxist theory' and 'liberal theory' produced 242, 354 and 390 articles, respectively.

[49] Lee Sigleman.2005. Personal Correspondence. Extracted from a letter rejecting an article of the author's for publication in the *APSR*. The article, since revised, has been accepted for publication elsewhere.

[50] Parasiliti 2003; Tessman 2005.

[51] This understanding of paradigm shifts is taken from the author's readings of Thomas Kuhn. 1962. *The Structure of Scientific Revolutions*. Chicago: University of Chicago Press.

[52] Further extensive theoretical, paradigmatical and empirical justifications for the reformulated method exit in Kissane 2005a. Thus, the purpose of the following section of this paper is to inform of the elements of the reformulation rather than justify the changes in more detail than has already been addressed in the previous section.

The first element of the reformulation is a broadening of the types of actors to be assessed. By incorporating non-state actors – and in the major power system this, at the present, only involves a broadening to the EU – the reformulated power cycle method recognises the increasing regionalisation in the modern, post-Cold War international environment.[53] Furthermore, it recognises that international institutions and supranational organisations can and do exercise power at the international level significantly and independently of the nation-states that constitute its membership.[54] Further, while research has thus far focussed on the major power system, there would seem no reason why analysis of other systems and sub-systems with significant non-state and institutional actors should not include them in power cycle calculations. Thus, future assessments of the South-East Asian region might include ASEAN, trans-Atlantic assessments of military power might include the WEU and NATO as institutions and assessments of the South-West Asia might well include OPEC. Understanding the impact of institutions in the modern world is one of the challenges facing all within the discipline of international relations and power cycle theorists should not be left behind.[55]

The second element of the reformed power cycle theory introduces a new element for assessment which is expected to provide some utility in assessing the technological capabilities of states. The indicator to be quantified is "military spending per soldier" and is expected to act both as a balance against the problems that emerge from only assessing spending and armed forces personnel and also recognise the research and development that the most successful military states now must engage with in order to maintain or build a superiority in the field.[56] Data is widely available from 1816 to the present and, thus, there are no real reasons why such an indicator could not be included for other systems and sub-systems besides the major power system, on which it was first tested and within which it evolved.[57] By introducing this material capability indicator, the reformulated power cycle theory engages with the evolving technological conditions of the modern world and ensures that power cycle theory is not relegated to historical studies of Cold War theory as a result of its indicator choice.

The third differentiating element of the reformulated method involves assessing each indicator for each actor in each year that they are a member of the system under examination. Though a simple change to advocate in today's information rich world, there is also a good theoretical reason for making annual

[53] Don Marshall. 1996. 'National development and the globalisation discourse: confronting 'imperative' and 'convergent' notions.' *Third World Quarterly* 17(5): 875-901, p.876; Shaun Breslin, Richard Higgott and Ben Rosamond. 2002. 'Regions in comparative perspective.' in *New Regionalism in the Global Political Economy: Theories and Cases*, edited by S Breslin, C Hughes, N Phillips and B Rosamond. London: Routledge, pp.1-19; Samuel Kim. 2004. 'Regionalization and Regionalism in East Asia.' *Journal of East Asian Studies* 4(1): 39-68.

[54] Kissane 2005a, pp.79-80.

[55] Keohane and Martin 1995.

[56] This capability indicator is already in use as part of the World Military Expenditures and Arm Transfers (WMEAT) reporting conducted by the US Department of State. See Department of State. 2003. *WMEAT 1999-2000*. [viewed 17 May 2005] http://www.state.gov/t/vc/rls/rpt/wmeat/1999_2000/.

[57] This indicator can be quantified with reference to the *National Material Capabilities* (v3.02) dataset at http://www.correlatesofwar.org/. The total military expenditures (including research and development) are simply divided by the total number of personnel in the actor's armed forces.

assessments instead of twice-decade assessments. The modern world changes so quickly that assessing capabilities only every five years is significantly limiting. It is easy to imagine an assessment of the Soviet Union in the years 1980, 1985 and 1990 that displayed a world power before a 1995 assessment that showed a devastating slump in power following the end of the Cold War.[58] Besides this, there is the matter of states that enter the system very late in comparison to their systemic rivals. China, for example, has only ten assessment years from its entry in 1950 to the year 2001; under the reformulated method China would, like all other state, be assessed 51 times, allowing for better trends to be extrapolated from a larger dataset.[59]

The fourth differentiating element borrows heavily from the work of Joseph Nye and his tri-level conception of power across the military, economic and soft power spheres.[60] The reformulation balances its material capability indicators across these three elements in order that both the individual indicators and the elements of actor power are weighted equally. Hence, as Figure 7 (below) shows, the capability indicators in the reformulated method recognise all factors involved in modern internationally powerful actors.[61]

Military Capability	Economic Capability	Soft Capability
Military Expenditure	Iron and Steel Production	SP1
Military Personnel	Energy Consumption	SP2
Military Expenditure per Soldier	Urban Population as a % of Total Population	SP3

Figure 7: Elements of Power in the Reformulated Power Cycle Theory[62]

Each of the three elements of power is represented by three capability indicators though, in the case of soft power, these are essentially proxies.[63] At this time there exists no calculus with which to quantify soft power in world politics and, thus, while the element is included in the reformulated method it is not quantified for any of the actors assessed.[64] In the future it is expected that this gap in the research may be filled as soft power becomes more recognised and accepted among governments and academics; when this is the case, the reformulated method can be tested in full but, until then, the proxies for soft power will remain as a direction for further research in the field.[65]

[58] Indeed, some cyclic modelling of international relations predicted that the USSR would take over from the US as the dominant world power in the fist decades of the twenty-first century, obviously not accounting for the relative decline of that state. See George Modelski and William Thompson. 1988. *Seapower in Global Politics 1494-1991*. London: Macmillan Press.
[59] See Kissane 2005a, p.93.
[60] Nye 2002, p.39.
[61] This balancing of power elements is applied in the author's forthcoming article on Australian security strategy in the Asia-Pacific to 2030. See Dylan Kissane. 2005b. '2015 and the rise of China: Power Cycle Theory and the Implications for Australia.' *Security Challenges* 1(1) (forthcoming).
[62] Kissane 2005a, p.84.
[63] Ibid, p.6; p.86.
[64] Ibid, pp.61-62; p.86.
[65] Research is already underway towards quantifying soft power. See Gregory Treverton and Seth Jones (eds.). 2005. *Measuring National Power*. Santa Monica: RAND, pp.12-14; p.17.

The fifth and final change to the original power cycle theory method is the one that is perhaps the most significant. The challenges faced by power cycle theory – both for the theorists themselves and also in popularising the difficult mathematical analytical technique – are essentially overcome by replacing the Pearl growth-and-decay algorithm with a simple least squares regression, R^2 maximising curve fitting technique easily accomplished by PC using the widely available Microsoft Excel program.[66] This reformulated method allows for anyone with a high-school mathematics education and an average personal computer to analyse international relations systems and the power cycles of international actors from their desktop with no need to invest in training or specialised software.[67] It is hoped that this will not only make the analysis of systems faster but also allow for a relatively inaccessible mode of analysis to become accessible to scholars and students alike.

While it is one thing to suggest changes to a theory, it is another to make them and a third to ensure that the changes do not impact negatively on the overall utility of the original theory. After all, if the changes suggested for power cycle theory result in a significant decline in the positive correlation of critical points and conflict, or if it results in curves that are radically different to the original curves, then it could be judged that the reformulation has produced more harm than good. Achieving parsimony could potentially result in the destruction of any utility. Thus, this section of the paper will demonstrate that the reformulated method not only maintains the utility of the original method via a robust and positive critical point\conflict correlation, but it also *improves* the correlation when the twentieth century is assessed in isolation to the rest of post-1816 history. The reformulated method will be assessed in two parts: firstly, the shape and nature of the curves and, secondly, the location and correlation with conflict of the critical points.

As might be imagined, a changed method might produce changed curves. The reformulated power cycle method actually produces three different types of curve pairs with the Doran and Parsons method which can be classified as very similar shapes, mildly similar shapes and vastly different shapes. Of the first type, Great Britain and the United States stand as the best examples (see Figure 8 and 9, overleaf). As can be seen, the shape of the curves for both the British and American curves are very similar, exhibiting similar rises and falls and also similar positions for the points to which the curves are fitted.

[66] Brock Tessman was among the first to initiate such parsimony into the power cycle method.
[67] Indeed, the level of calculus needed to derive the equations of the power cycle curves is less than would be required in order o correctly answer the questions of the 2002 South Australian PAS Maths 2 Examination. See SSABSA. 2002. *2002 SSABSA Examination Papers*. [viewed 2 November 2005] http://www.ssabsa.sa.edu.au/ex-2002.htm.

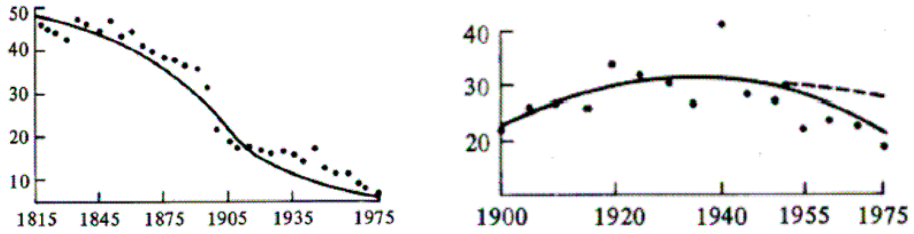

Figure 8: Doran and Parsons' Curves, Great Britain (L) and the United States (R)[68]

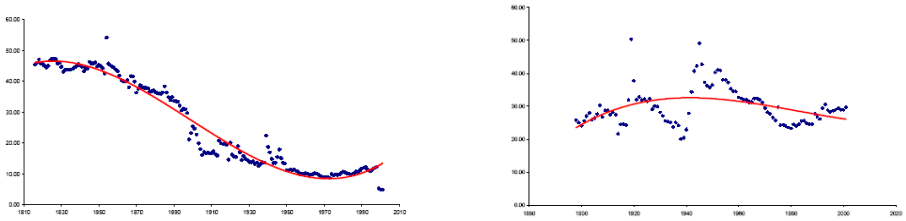

Figure 9: Reformulation Curves, Great Britain (L) and the United States (R)[69]

Of the mildly similar curves, the best examples in the major power system are Germany and Russia. In both cases (see Figures 10 and 11, below and overleaf) the major elements of curves remain, with the rises and falls of the curves in similar places. However, as can be seen in the German curve, the rise in the middle of the curve is less dramatic and has been significantly smoothed in the reformulated curve. Similarly, in the Russian curve, and probably as a result of the post-Cold War period assessed by the reformulation, there is a significant decline in the latter part of the curve that is not evidence in the Doran and Parsons power cycle.

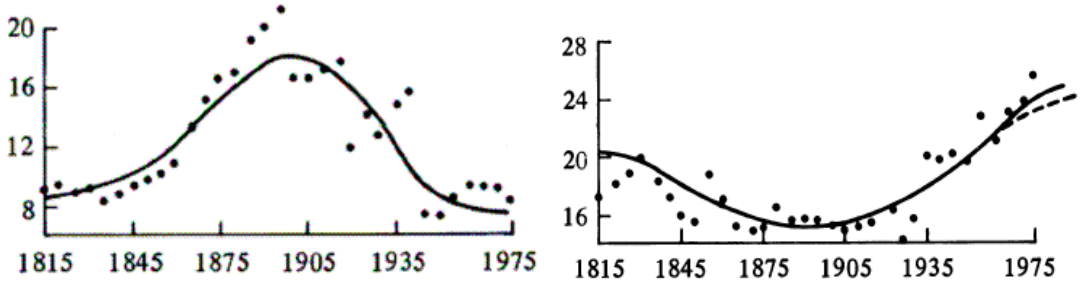

Figure 10: Doran and Parsons Curves, Germany (L) and Russia (R)[70]

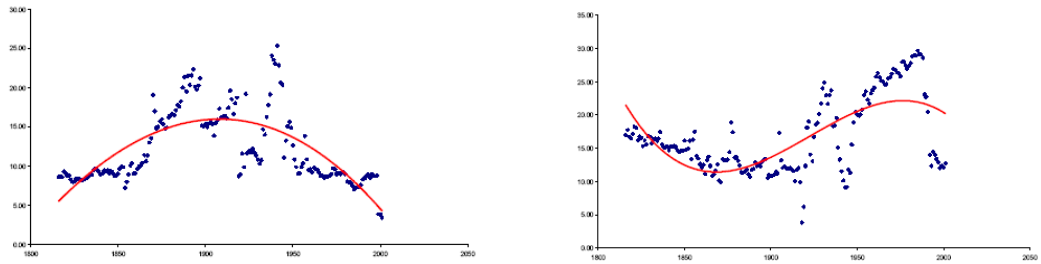

Figure 11: Reformulation Curves, Germany (L) and Russia (R)[71]

[68] Doran and Parsons 1980, p.956.
[69] Kissane 2005a, p.137; p.140.
[70] Doran and Parsons 1980, p.956.
[71] Kissane 2005a, p.138.

Of the third type of curve, Japan and Italy are prototypical candidates. While in the case of Italy the difference is clear, a point must be made about the Japanese example. In their 1980 paper, Doran and Parsons differentiated between pre-WW2 and post-WW2 Japan, splitting the power cycle into two.[72] This meant that the rise of Japan before the war and after the reconstruction was represented clearly, but it was an ad-hoc methodological move that was not made with respects to Germany, which would have been another obvious candidate. The reformulation rejects the pre- and post-WW2 distinction and, as a result, the curve for Japan bears little resemblance to the Doran and Parsons curves (see Figures 12 and 13, below).

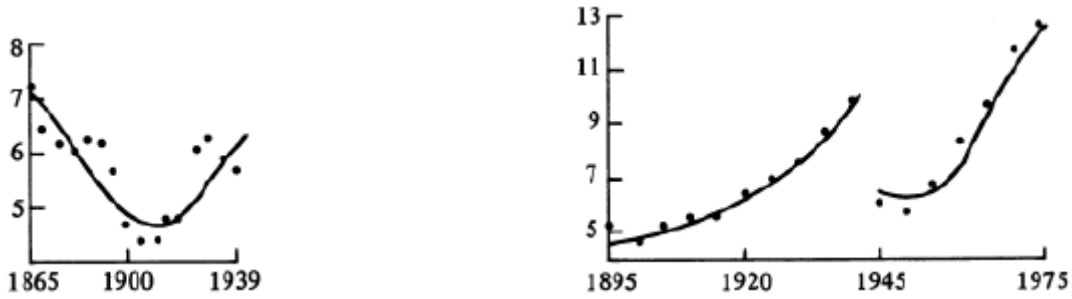

Figure 12: Doran and Parsons Curves, Italy (L) and Japan (R)[73]

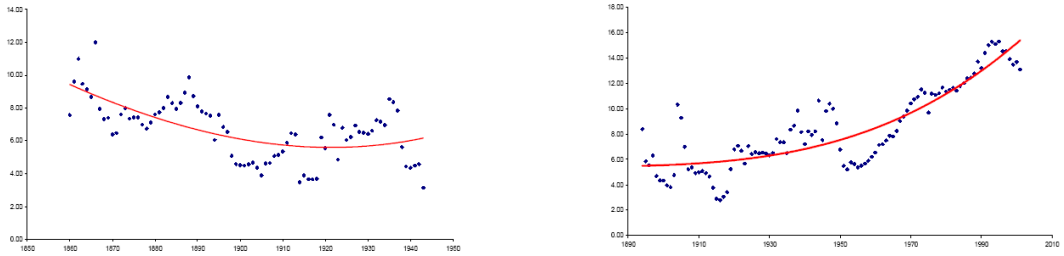

Figure 13: Reformulation Curves, Italy (L) and Japan (R)[74]

The test of the curves comes in the assessment of the correlation between the critical points and conflict in the system is assessed. To begin with, the number of critical points in the system varies between the two methodologies. The Doran and Parsons method produces 23 critical points for the period 1816 to 1975 and, of these, 18 correlate with conflict in the major power system for a correlation of approximately 0.78.[75] In contrast, the reformulated method produces 17 critical points and 14 of these correlate with conflict in the major power system for a correlation of approximately 0.82.[76] If the relatively minor Falklands Conflict is excluded, the correlation of the reformulated method drops to approximately 0.76.[77] Thus, in terms of the robustness of the reformulated method in maintaining the correlation between conflict and critical points, it can be seen that – at the worst – the reformulated method reduces the utility by less than 2.5% and, at best, can be held to improve the correlation by around 5%. In either case, there is minimal change in the critical

[72] Doran and Parsons 1980, p.955.
[73] Ibid, p.956.
[74] Kissane 2005, pp.139-140.
[75] Ibid, p.92; p.96. Doran and Parsons (1980) also considered any high point on a curve an H-point and the lowest point an L-point. This meant that a curve that declined consistently from 1816 to the present such as, for example, Great Britain, was considered to have an H-point in 1816 and an L-point in 1975. Had the assessment begun in 1817, 1817 would have been the H-point. Thus, the Doran and Parsons method is likely to produce significantly more critical points that the reformulated method.
[76] Ibid.
[77] Ibid, p.97.

point-conflict correlation and, thus, the utility of the power cycle methodology is maintained and, perhaps, even improved. When considering the twentieth century in isolation, however, the difference in correlation between the two methods' critical points and conflict becomes stark. Where the Doran and Parsons method finds a correlation of approximately 0.82, the reformulated method produces a correlation that is perfect, that is, a correlation of 1.0. In this way, the reformulated method is far superior, by a rate of more than 22%, than the original method and, it must be remembered, has also addressed all of the criticisms raised in this paper and by others of the original, Cold War-era method.

Thus, it seems clear that this reformulated power cycle theory method can assist in explaining the incidence of conflict in the past. However, like a weatherman predicting last week's rain this week, it has not yet been shown to be of much utility in allowing analysts to predict upcoming conflict. Thus, some sort of testable hypotheses must be determined in order to assess the predicative powers of the reformulated method and the claims of this author that it may be of some use in forecasting the future conflictual storms of the international political sphere. This paper will construct two hypotheses through the extrapolation of the reformulated curves and predicting the likely impacts for political issues in which the nominated actors might be involved, the first in East Asia and the second in Europe.

Consider, for example, the rising powers in the Asia-Pacific region – China and Japan – against the likely track of a declining superpower in the shape of the United States (Figure 14, below).[78]

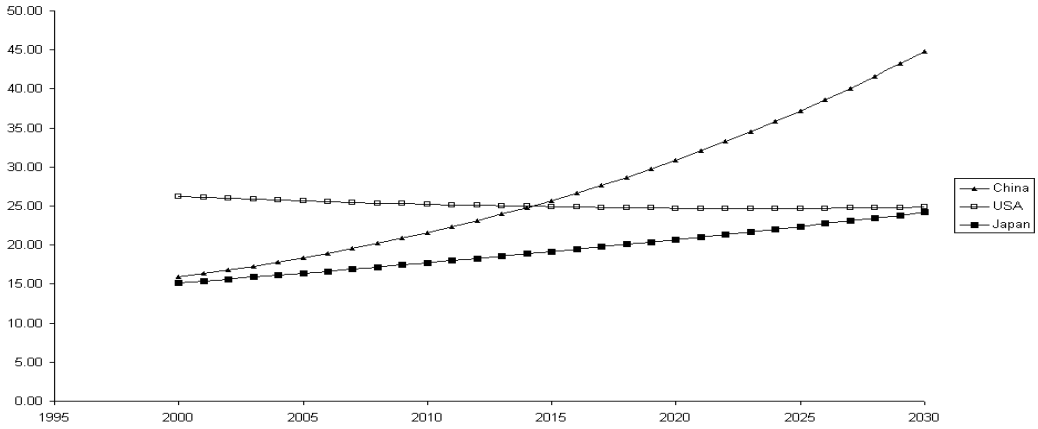

Figure 14: Reformulation's Extrapolated Power Cycles (China, USA and Japan)[79]

As is clearly seen, China is expected to exhibit a logarithmic rise during the first three decades of the twenty-first century, outstripping a slow but steady advance by Japan. Both will experience their relative rise in power at the expense of the United States which – in a continuation of a trend of nearly 50 years – will find itself more and more challenged by its eastern rivals. Chinese-American power parity is expected in the year 2014 and China is expected to overtake the United States as the premier power on the planet by

[78] This discussion emerged from Kissane 2005b.
[79] Diagram extracted from Kissane 2005b.

the year 2015.[80] By 2030 China will not only dominate the region but also the major power system, maintaining just less than 45% of the relative share of total system power of the modern major power system. The US and Japan will be outclassed by the rising Chinese superpower.

Considering the potential for a China-Taiwan-US conflict in the light of this power cycle extrapolation, a US response against an aggressive China appears less likely or, at least, less likely to be successful the longer that the Taiwan situation is left without address. Whilst in 2005 the United States maintains a significantly positive power disparity over China (25.6% to 18.3%), that disparity is reduced over the next decade until, by 2020, the disparity is almost reversed (24.7% to 30.8%). Thus, it would seem that Beijing would be wise to adopt a strategy that prolongs the period before any conflict over Taiwan takes place while, conversely, the US would be advised to act sooner rather than later to secure the island against Chinese aggression.[81] While the extrapolation does not suggest that conflict will definitely take place, a hypothesis can be formed which states broadly that any Chinese action on Taiwan with a greater chance of success against a US-Taiwan coalition would be more likely to succeed after 2015, while any US action to secure Taiwan will be more effective against China before 2015. Indeed, the second decade of the twenty-first century will see the baton passed from the Atlantic-Pacific power of the United States to the East-Asian powers of Japan and China and the world's eyes will become focussed on Beijing, Tokyo and Taipei where, previously, they have always looked to Washington, Moscow and London.[82]

A second set of hypotheses can be drawn with reference to Europe. In 2001, the European Union was established in the major power system as the second most powerful (behind the US) of all of the most significant powers in the world.[83] This position is based solely on the economic power of the 25 member state EU as, due to an inability to determine a common foreign and defence\security policy with a common armed force and defence spending program, the EU was not assessed by the reformulated method in these areas.[84] Should the EU develop an integrated armed defence force – as has been mooted many times by EU supporters – it is likely that the EU will emerge as a second node of power in the twenty-first century, alongside East Asia.[85] Though the reformulated method suggests that the EU's economic performance is contributing to a very minor decline in its relative share of total system power over recent years (see Figure15, overleaf), it must also be recognised that the softening of the EU economy is slight and – should a military capability emerge soon – the EU will be among the most powerful international actors on the planet. Essentially then, the EU's fate is in its own hands. Should the leadership of the member states

[80] This argument and hypothesis forms the basis of the author's forthcoming paper, Kissane 2005b.
[81] Such calls for an early resolution via US military intervention in Taiwan already exist within the wider disciplinary literature. For example Richard Bernstein. 1997. 'The Coming Conflict With America.' *Foreign Affairs* 76(2): 18-32; David Shambaugh. 2000. 'A Matter of Time: Taiwan's Eroding Military Advantage.' *The Washington Quarterly* 23(2): 119-133.
[82] Kissane 2005b.
[83] Kissane 2005a, p.134.
[84] Ibid, pp.70-73; p.134.
[85] See discussion in Charlotte Bretherton and John Vogler. 1999. *The European Union as a Global Actor*. London: Routledge, pp.3-4; Anne Deighton. 2002. 'The European Security and Defence Policy.' *Journal of Common Market Studies* 40(4): 719-741.

negotiate the Common Foreign and Security Policy (CFSP) in the coming years, it seems clear that the EU too will outstrip the United States in relative power terms.[86] Thus, a hypothesis can be put that suggests that the sooner the EU develops a workable and effective CFSP arrangement, the sooner the EU will be able to take its place on the world stage as a truly powerful actor. If it fails to construct a credible and effective CFSP arrangement, however, the EU will be quickly overrun by its rivals in the Pacific and it will not overtake the US as the predominant Western power in the major power system.

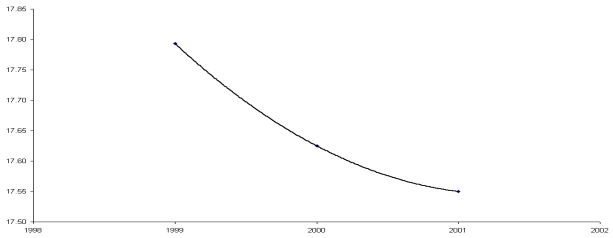

Figure 15: Reformulation Curve, European Union 1999-2001[87]

Thus, in both the East Asian and the European theatres the reformulated power cycle method implies the following predictions and time frames:

1. Conflict between China and Taiwan\US will favour the two democracies at the present and before 2015 and China post-2015.

2. The EU will not emerge as a challenger in the major power system to its Western rival, the United States, unless it develops a Union-wide military capability – economic potential is not enough to push them ahead of the US.

While it may remain a matter of 'wait and see' in order to prove or disprove these predictions, they stand as the result of a research method that involves assessment of nearly 200 years of major power system activity and a method that becomes more and more accurate in accounting for conflict as it moves from the nineteenth century, through the twentieth century and into the twenty-first century. Though new criticisms of the reformulated method may emerge, it is these predictions of the 'storms' and 'weather patterns' ahead that will see it truly tested.

This paper set out to answer a seemingly simple question: can international relations theory forecast conflict in the international system in the same manner that weather forecasters predict storms? In power cycle theory a method for understanding and explaining the conflict in the international system was found, but the method of the power cycle theorists was found to be subject to numerous damaging criticisms. It failed to account at all for the influence of non-state actors; it failed to

[86] According to Kissane 2005a, pp.72-73, if the current EU-wide spending on military matters and the current standing strength of the EU armed forces were combined, the EU would command approximately 24.05% of the major power system's military expenditure and 24.54% of the major power system's military personnel. Though lagging in spending in comparison to the United States, the EU would be in control of the planet's largest standing army.
[87] Kissane 2005a, p.141.

account for technological development by actors; it failed to respond to changes in the international system by quantifying capabilities only twice per decade; it failed to account for or balance the three elements of modern power – military, economic and soft; and it was difficult to operationalise, requiring special software and training as well as extensive mathematical skills. Thus, this paper introduced a reformulated method, developed by the author, which addressed these criticisms in 'rethinking' the power cycle method. The reformulated method was extended to assess relevant non-state actors; it included an indicator to account for technological change; it measured capabilities annually; it balanced its assessment between the three elements of power, including a soft power proxy; and it greatly simplified the method for fitting the curves, potentially opening the theory up to a new generation of students, scholars and analysts.

The reformulated method was shown to be just as robust as the original method in accounting for conflict in the international system, with the parsimonious new method maintaining a correlation between critical points on the power cycle curves and conflict almost exactly the same and the Doran and Parsons method. Significantly, the reformulated method outstripped the correlation of the original method for the period of the twentieth-century, with a perfect positive correlation (i.e.-1.0) emerging for post-1900 critical points compared to an original method correlation of only 0.82. Thus, it was concluded that this reformulated method, which answered all of the criticisms raised with regards to the original but which maintained or improved the correlation between critical points and conflict, is a superior analytical tool in considering international systems and the conflict within them. From this reformulated method, hypothesis were drawn, essentially predictions of the 'storms' and systemic 'weather' in the years ahead. First, in East Asia it was suggested that any conflict over Taiwan between the US and China is likely to favour the former before 2015 and the latter, a rising superpower of amazing potential, in the years post-2015. Secondly, with regards to the EU's role in the international system, it was predicted that the significant economic capacity and potential of the Union will not be enough for it to replace the US as the predominant western power in the international realm. It is only by incorporating an independent EU military capability that the EU will begin to challenge the US for Western supremacy and, this, the CFSP process should be a major concern for an institution searching for international relevance.

Like any forecast, time will tell if the reformulated method maintains utility in the prediction of conflict and international role alongside its demonstrated success in the explanation of conflict in the international system. Many a picnic has been ruined by unpredicted rain; one hopes that the application of the reformulated power cycle theory method will save the international community – from institutions to individuals – from suffering from the impacts of future devastating storms.

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