

## Forecasting the Storm: Power Cycle Theory and Conflict in the Major Power System

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### Abstract:

Unpredicted and unpredictable storms have cut a disastrous swathe through coastal communities in recent years. If the international relations system can be imagined as a peaceful coast, then conflict is the storm that wrecks havoc upon those in its path. One 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 re-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 research. A 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 offer new insights for explaining and predicting conflict.

### Introduction

According to reports in March 2006, the Category 5 storm that formed above the Pacific Ocean and crossed the Australian coast near Innisfail came almost out of nowhere.<sup>1</sup> Though all in the tropical region of the Australia live daily with the knowledge of the *possibility* of a tropical cyclone forming off the coast, locals are consistently dumfounded by the speed and ferocity of storms which – despite their size and force – are often entirely unpredicted by meteorologists even a week before they strike. In response, the meteorologists 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

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<sup>1</sup> NASA reported that the storm formed off the coast on 18 March 2006 and crossed the Australian coast less than two days later. See NASA. 2006. *Tropical Cyclone Larry*. <[http://earthobservatory.nasa.gov/NaturalHazards/shownh.php3?img\\_id=13423](http://earthobservatory.nasa.gov/NaturalHazards/shownh.php3?img_id=13423)>. 2006, 29 March.

conditions, local weather remains almost impossible to predict in the 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 likely be completely wrong. So complex are weather systems that, in the final analysis, an amateur's prediction sometimes proves to be more accurate than that of a professional.

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 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 (for example, Milner 1991, 82-85). 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 (Doran 1999).

If the international system can be compared to complex weather systems, then the conflicts within the system are the storms so despised by the coastal locals. 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 (Hobbes 1985; Machiavelli 1977; Carr 1946; Morgenthau 1948; Waltz 1979). 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 (Mearsheimer 1994; Mandelbaum 1998; Keohane 1986). 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 best quality of most forecasts: when (see Mearsheimer 1988; 1990; 2001a; 2001b).

Another explanation for international conflict is offered by power cycle theory. 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 (Doran and Parsons 1980, 963). 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 relative material capability and foreign policy roles have some sort of important affect on the incidence of conflict in international systems (*ibid*). 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 many as nine) (for example: Parasiliti 2003; Kumar 2003; Tessman 2005). 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 lesser extent, economic capabilities of states (Doran and Parsons 1980). Similarly, the result of the relative lack of access to relevant capability information for states is that classic power cycle theory only records capabilities and their shifts every five years (*ibid*). 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 (Geller 2003); some have added indicators drawn from other conflict programs such as the Correlates of War (CoW) project (Tessman 2005); 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 (Kozintseva 2005).

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.

### **Classic Power Cycle Theory Method**

Before the reformulation is introduced it is necessary to outline the original methodology. Thus, it is necessary to return to the decisive 1980 paper of Charles Doran and Wes Parsons which has laid the foundation for all power cycle work that has followed (Doran and Parsons 1980). This section of the paper will present the methodology and a worked example (in the form 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. This section will demonstrate that power cycle theory is not a dead theory but certainly one that 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 (for example: Geller 2003;

Kumar 2003). 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 (Kissane 2005a, 33; Levy 1983, 29-43). For Doran and Parsons, the states that compose the system, and their respective entry and exit dates, are represented in Figure 1 (Doran and Parsons 1980, 953). 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.

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 development (*ibid*). 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) (*ibid*). 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 (*ibid*). Once all the results are known, the relative share of each indicator for the system is determined for every state (Doran and Parsons 1980, 954). 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.

The selection of these specific indicators is open to critique. For example, the notion that the development of a state can be measured by only two indicators - energy consumption and urbanisation - ignores any number of other indicators that have emerged in the wider developmental economics literature. Similarly, by assessing the gross figures for indicators such as iron and steel production, size of armed forces and energy consumption, it is possible that states with large populations will distort comparisons with less populous states. Another criticism is the rejection of often used comparative indicators such as GDP, GDP per capita or military spending

in favour of indicators that seem to maintain a bias towards large, populous states.<sup>2</sup> In response to such criticisms, Doran and Parsons defend their choice of indicators by arguing that “theoretical relevance and practical availability” guided their selection of indicators (Doran and Parsons 1980, 953). In particular they explained that common comparative indicators such as GDP were unsuitable for the purposes of their analysis as “problems of exchange rate comparability, the incorporation of qualitative technological change, and the effect of uneven rates of inflation reduce the value of the concept when applied over long periods” (*ibid*). Furthermore, data for some of today’s more common indicators of national capability was either “nonexistent or of very poor quality for the nineteenth century” (*ibid*). Thus, while the indicators in classic power cycle theory might be considered somewhat weaker than some analysts would prefer, the indicators included by Doran and Parsons are the most complete, practical and relevant indicators for the period from 1816 to 1975.

For a practical demonstration of Doran and Parsons’ approach, consider the example of Great Britain in 1901. Figure 2 displays the indicator scores for Great Britain for the year 1901. 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, Great Britain’s 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 as Figures 3 and 4, respectively (extracted from Kissane 2005a, 35-36).

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

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<sup>2</sup> The author acknowledges the anonymous reviewers for their comments on these points.

when, as in this study, one is interested not in absolute capability levels but in the pattern of change in relative capability (Doran and Parsons 1980, 953-954).<sup>3</sup>

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 (extracted from Kissane 2005a, 37) indicates the final total relative shares for all states in the major power system for 1901.

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 (Doran and Parsons 1980, 956).<sup>4</sup>

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 (Doran and Parsons 1980, 948). This is easily determined by calculating the equation of the curve and deriving it ( $f'(x)$ ) – allowing maxima and minima

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<sup>3</sup> See also Howard Wainer. 1978. On the Sensitivity of Regression and Regressors. *Psychological Bulletin* 85: 267-273. Note: The original text refers to Wainer 1976 but the correct citation is Wainer 1978.

<sup>4</sup> Doran and Parsons (1980, 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."

to be identified – and then deriving the derivative ( $f''(x)$ ), allowing the points of inflection on the curve to emerge (*ibid*). 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) (*ibid*, Figure One). 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) (*ibid*, 956). 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 (see: Doran and Parsons 1980; Tessman and Chan 2004). While not predicative in and of themselves, the critical points on a power cycle curve correlate in a manner so statistically significant with conflict ( $>0.75$ ) that, at 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 (see: Tessman and Chan 2004; Parasiliti 2003; Doran 1989).

### **Five Criticisms of Classic Power Cycle Theory Method**

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 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 (for example: Robinson 1998; Kerr 2003;

Attaman 2003). 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 (Legro and Moravcsik 1999, 41). 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.<sup>5</sup> 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 (Kissane 2005a, 65-80). In particular, the European Union (EU) stands as a clear candidate for assessment within the major power system.

Where Doran and Parsons had difficulty quantifying all of the material capability indicators for all states in all years of 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 made obtaining information on indicators much easier.<sup>6</sup> 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 (see [www.corellatesofwar.org](http://www.corellatesofwar.org)). Indeed, the CoW datasets alone, very popular among academic analysts in the discipline, quantify all of Doran and Parsons material capability indicators.<sup>7</sup> 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

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<sup>5</sup> 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 Institutional Theory. *International Security* 20: 39-51; Barbara Koremenos, Charles Lipson and Duncan Snidal. 2001. The Rational Design of International Institutions. *International Organization* 55: 761-79.

<sup>6</sup> 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."

<sup>7</sup> The specific datasets are the *State System Membership List* (v2004.1) and the *National Material Capabilities* (v3.02) dataset.

available, there are 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) (Kissinger 2001, 22; Maull 1990). 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.<sup>8</sup> 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.<sup>9</sup>

While Doran and Parsons weigh 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 (Nye 2002, 39). 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

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<sup>8</sup> 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 19<sup>th</sup> and 20<sup>th</sup> century context within which the theory was developed.

<sup>9</sup> 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: 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: 21-30; Wesley Clark. 2000. How to fight an asymmetric war. *Time* 156: 40; Russell Watson and John Barry. 1997. Tomorrow's New Face of Battle. *Newsweek* 130: 66-67.

influences will be potentially flawed (Nye 2002, 39; Kissane 2005a, 55-59). Thus, the critique of power cycle analysis in relation to the elements of power is twofold: 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.<sup>10</sup> Requiring specialised computer software and training in order to both input the data and produce the cycles of relative power, power cycle theory is left on the edges of international relations theoretical discourse.<sup>11</sup> 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”.<sup>12</sup> 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 (Parasiliti 2003; Tessman 2005). 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 paradigm shift it implies (see Kuhn 1962). 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

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<sup>10</sup> The original equation was extracted by Doran and Parsons from Raymond Pearl. 1924. *Studies in Human Biology*. Baltimore: Johns Hopkins.

<sup>11</sup> 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.

<sup>12</sup> Lee Sigelman.2005. Personal Communication.

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 (further discussion of the justification for refinement of the power cycle method exists in Kissane 2005a).

### **Addressing the Criticisms and Reformulating the Power Cycle Method**

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 (Marshall 1996, 976; Breslin, Higgott and Rosamond 2002, 1-19; Kim 2004). 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 (Kissane 2005a, 79-80). 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, while the analysis in this paper only includes the EU as a non-state actor, 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 (Keohane and Martin 1995).

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 (Department of State 2003). 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.<sup>13</sup> 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 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.<sup>14</sup> 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 (Kissane 2005a, 93).

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 (Nye 2002, 39). The reformulation

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<sup>13</sup> 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.

<sup>14</sup> Indeed, some cyclic modelling of international relations predicted that the USSR would take over from the US as the dominant world power in the first 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.

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 shows, the capability indicators in the reformulated method recognise all factors involved in modern internationally powerful actors (see also Kissane 2005b).

Each of the three elements of power is represented by three capability indicators though, in the case of soft power, these are essentially proxies (*ibid*, 6; 86). 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 (*ibid*, 61-62; 86). 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 (see Treverton and Jones 2005).

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.<sup>15</sup>

### **A Reformulated Power Cycle Theory<sup>16</sup>**

With the above criticisms and suggested changes in mind, the following methodology is presented as a reformulated power cycle theory. As this section will demonstrate, all of the five changes suggested above can be incorporated into a new power cycle approach. There are six steps involved in determining the power cycle curve and associated critical points using the reformulated power cycle theory. Though the methodology is largely

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<sup>15</sup> Brock Tessman was among the first to initiate such parsimony into the power cycle method.

<sup>16</sup> The reformulated methodology is explained in greater detail in Chapter 5 and Appendix C of Kissane 2005a.

adapted from the work of Doran and Parsons (1980), it also owes some acknowledgement to the work of Brock Tesson (2005) and George Modelski and William Thompson (1988).

The six steps are as follows:

*Identify the system and the actors within the system*

Power cycle theory can – and has – been applied in global, regional and geographically local systems. Identification of the system is the significant first step owing to the relative power assessments that power cycle theory employs. Only when the system, the actors and the periods that the actors are active within the system are determined can power cycle analysis continue. In the case of this article’s assessment of the global international system, the relevant actors are Great Britain, France, Austria-Hungary, Italy, Russia, Japan, the United States, China and the European Union.

*Collect and input data for the six capability indicators*

Data is collected and input for six capability indicators across two elements of power. The two elements and their constitutive indicators are:

<b>Military Elements</b>	<b>Economic Elements</b>
Military Personnel	Iron and Steel Production
Military Expenditure	Energy Consumption
Military Expenditure per Military Personnel	Urbanisation

The inclusion of the ‘Military Expenditure per Military Personnel’ indicator does, to some extent, answer some of the criticisms of power cycle theory which target the significant weight Doran and Parsons give to populous states with large militaries.<sup>17</sup> As outlined in *Curves, Conflict and Critical Points*, this indicator has been employed by the US Department of State as a key comparative indicator in its annual World Military Expenditures and Arms Transfers (WMEAT) report as a tool by which to measure technological preparedness (Kissane 2005a, 84). In the reformulated power cycle theory:

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<sup>17</sup> cf. 2.

...this indicator serves a similar purpose, allowing for the military indicators to match, with some success, the technological improvements that have rendered large, poorly equipped standing armies ineffective in the face of smaller, technologically advanced forces. This capability indicator is therefore evolutionary in nature, recognising the impacts that technologies can have on the efficacy of military might (Kissane 2005b, 85).

*Calculate the percentage shares for each actor for each indicator*

This figure is determined by dividing an actor's share of the system's total for each indicator by the sum total for that indicator within the system. The resultant figure is multiplied by 100 to determine a percentage. For example, if actors A, B and C had indicator scores of 100, 200 and 300, respectively, for the Military Personnel indicator, then their respective percentage shares for that indicator are 16.67%, 33.33% and 50%.

*Calculate the annual percentage share of system power for each actor*

Having determined the indicator share for each indicator and for each actor, the various scores are summed and a mean determined for each actor. For example, if actor A has indicator shares of 16.67%, 22.34%, 15.00%, 32.21%, 21.09%, 12.02%, the following mathematical process is required:

$$(16.67 + 22.34 + 15.00 + 32.21 + 21.09 + 12.02) / 6$$

This produces an annual percentage system share for actor A of 19.89%.

*Plot annual percentage shares to graph and fit polynomial curve*

Having determined the annual percentage shares for all the years in which that actor was a member of the system under investigation, these results should be plotted against time on a graph. This is most easily done using a spreadsheet package, such as Microsoft Excel. Having plotted the points, a polynomial trending curve is determined by determining the cubic graph with the R<sup>2</sup> value, or coefficient, maximised. The equation for the cubic curve is then determined and noted.

*Deriving the critical points from the equation of the curve*

Having established the equation for the various curves, the first derivative ( $dy/dx$ ) is determined via rudimentary calculus. For example, if the equation of the cubic curve was:

$$y = 3.56x^3 - 2.34x^2 + 345x - 19254$$

The derivative of the curve is expressed as:

$$dy/dx = 10.68x^2 - 4.68x + 345$$

High (H) and Low (L) turning points can be established by solving  $dy/dx$  for 0. The inflection points (I1 and I2) are determined by solving the second-derivative of the original equation for 0. In the example above, the second derivative takes the form:

$$d^2y/dx^2 = 21.36x - 4.68$$

Having thus established the critical points, correlations between the timing of the critical points and international conflict can then be drawn.

### **Testing the Utility of the Reformulated Method**

While it is one thing to make changes to the theoretical approach but another 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 maintains the utility of the original method via a robust and positive critical point\conflict correlation. 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). 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.

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) 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, 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.

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 (Doran and Parsons 1980, 955). 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).<sup>18</sup>

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<sup>18</sup> Data for Japan in the immediate post-WW2 period is unavailable. Rather than re-start the power cycle as Doran and Parsons (1980) have done, the missing data was approximated. Missing or unavailable data has been replaced by estimates gathered by assessing the available data in years either side of the missing data. The estimates are made so that the gaps between available data are filled with mean annual increases. In cases where there is more than one consecutive year of data missing, the estimates reflect a linear upwards or downwards progression. Instances of missing data account for only around 1% of all data

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 (Kissane 2005a, 92; 96). 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 (*ibid.*). If the relatively minor Falklands Conflict is excluded, the correlation of the reformulated method drops to approximately 0.76 (*ibid.*, 97). 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 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 0.90. In this way, the reformulated method is far superior, by a rate of approximately 10%, 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.

### **Forecasting the Storms Ahead**

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

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required for the construction and testing of the reformulated theory. Given the mathematical processes used, and the robustness of the data set in general, the estimates do not affect the utility of the methodology. See Kissane 2005a, 103.

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, extracted from Kissane 2005b). 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 the year 2015 (see Kissane 2005b). 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 (Kissane 2005b).

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 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 (such calls already exist: Bernstein 1997; Shambaugh 2000). 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 (Kissane 2005b).

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 (Kissane 2005a, 134). 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 (*ibid*, 70-73; 134). 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 (see Bretherton and Vogler 1999, 3-4; Deighton 2002). 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), 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 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 (Kissane 2005a, 72-73). 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.

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.

## **Conclusion**

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 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 near perfect ( $\sim 0.90$ ) positive correlation 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 towns have been destroyed by the unpredictable course of a hurricane; 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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## Figures and Tables

Figure 1: States of the Major Power System (Doran and Parsons 1980, 953)

<b>Nation</b>	<b>Period of Membership</b>	<b>No. of Years</b>
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 2: Material Capability Indicators, Great Britain 1901

<b>Iron-Steel</b>	<b>Armed Forces</b>	<b>Energy</b>	<b>Population</b>	<b>Urbanisation</b>
4983	521	181916	41538	13769

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

<b>State</b>	<b>Iron-Steel</b>	<b>Armed Forces</b>	<b>Energy</b>	<b>Population</b>	<b>Urbanisation</b>
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
<b>Total</b>	<b>29697</b>	<b>3785</b>	<b>702819</b>	<b>473992</b>	<b>60469</b>

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

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
<b>Total</b>	<b>29697</b>	<b>100.00</b>	<b>3785</b>	<b>100.00</b>	<b>702819</b>	<b>100.00</b>	<b>473992</b>	<b>100.00</b>	<b>60469</b>	<b>100.00</b>

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

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
<b>Total</b>	<b>100.00</b>

Figure 6: Great Britain Power Cycle, 1816-1975

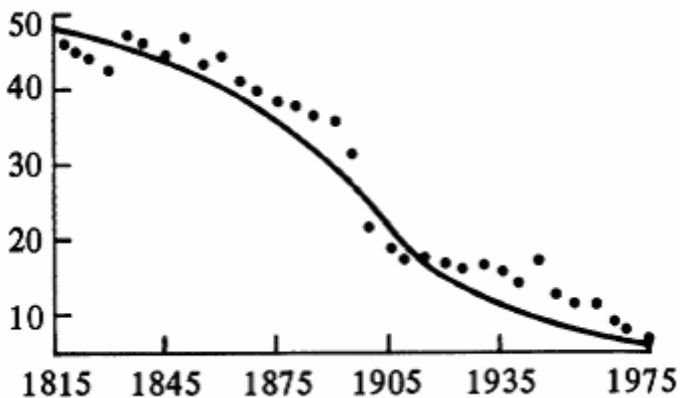
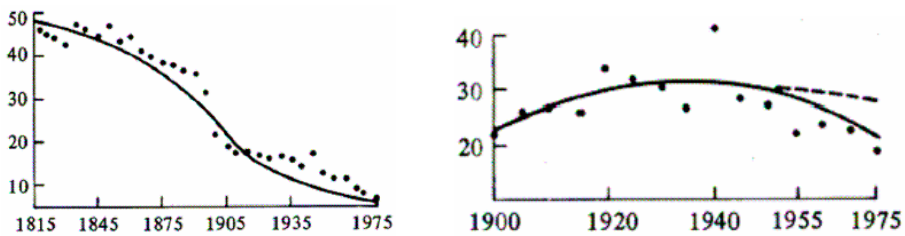


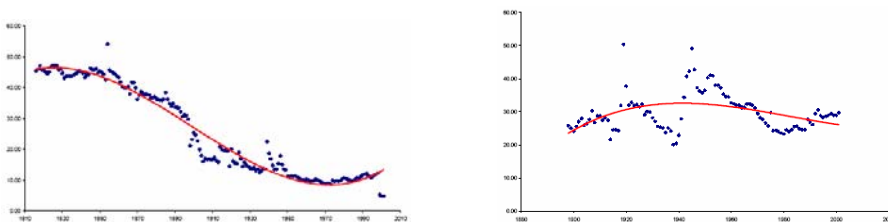
Figure 7: Elements of Power in the Reformulated Power Cycle Theory (Kissane 2005a, 84)

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 8: Doran and Parsons' Curves, Great Britain (L) and the United States (R)**  
(Doran and Parsons 1980, 956)



**Figure 9: Reformulation Curves, Great Britain (L) and the United States (R)**  
(Kissane 2005a, 937; 940)



**Figure 10: Doran and Parsons Curves, Germany (L) and Russia (R)**  
(Doran and Parsons 1980, 956)

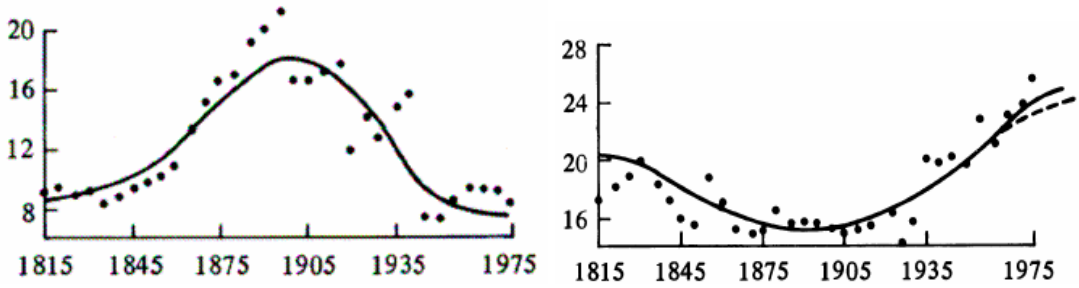


Figure 11: Reformulation Curves, Germany (L) and Russia (R)  
(Kissane 2005a, 138)

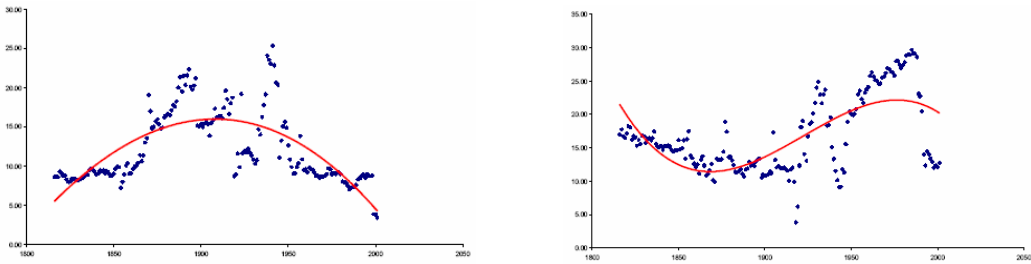
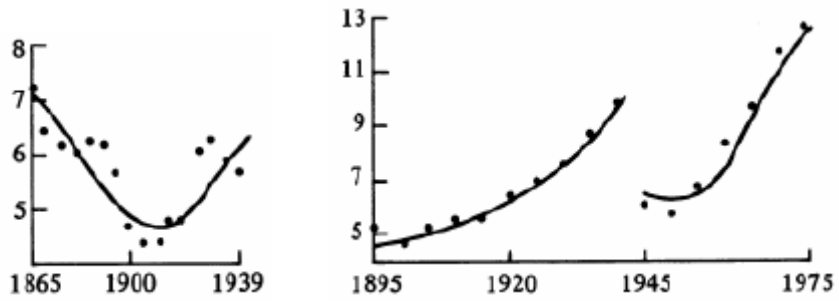
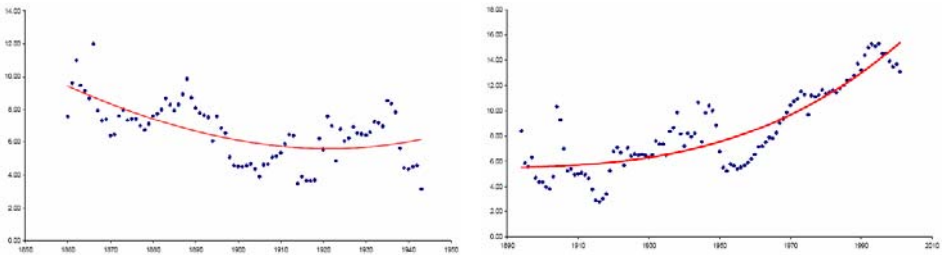


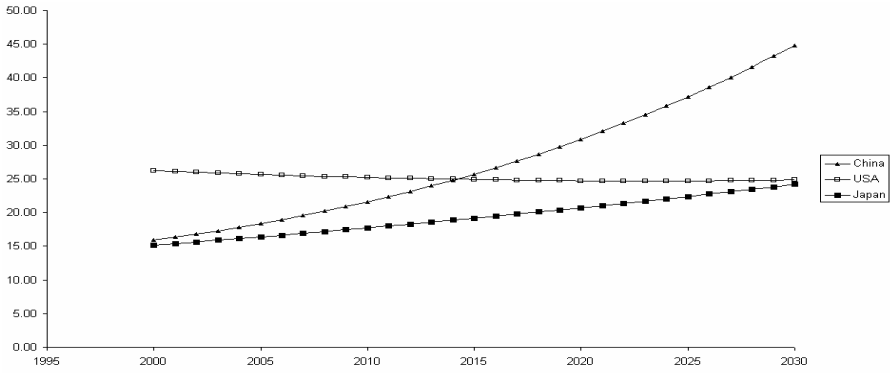
Figure 12: Doran and Parsons Curves, Italy (L) and Japan (R)  
(Doran and Parsons 1980, 956)



**Figure 13: Reformulation Curves, Italy (L) and Japan (R)**  
(Kissane 2005a, 139-140)



**Figure 14: Reformulation's Extrapolated Power Cycles**  
(China, USA and Japan)  
(Kissane 2005b)



**Figure 15: Reformulation Curve, European Union 1999-2001  
(Kissane 2005a, 141)**

