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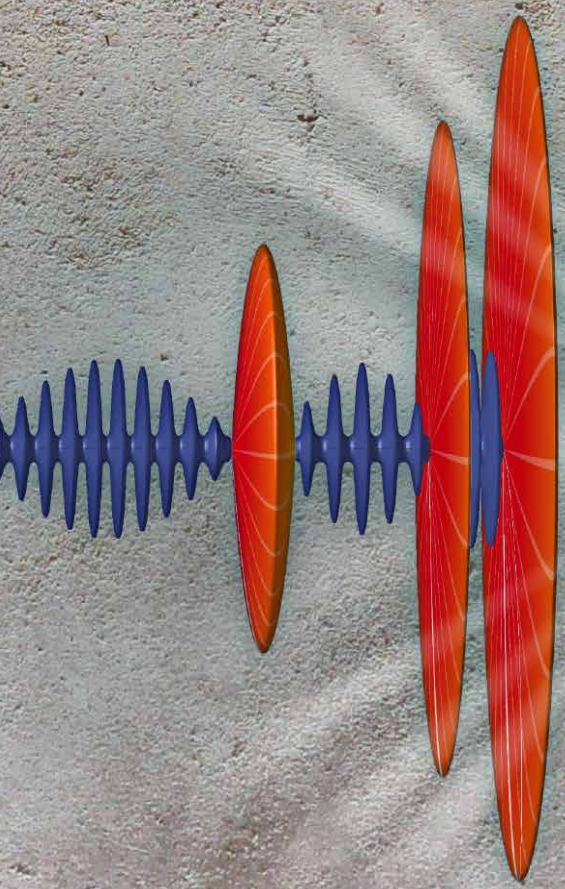
2020 WARNING

PART IV
ASSESSMENT AND PREDICTION



Patterns in war dynamics reveal disturbing developments

Ingo Piepers

2020 WARNING

SOCIAL INTEGRATION AND EXPANSION IN ANARCHISTIC SYSTEMS: *HOW CONNECTIVITY AND OUR URGE TO SURVIVE DETERMINE AND SHAPE THE WAR DYNAMICS AND DEVELOPMENT OF THE SYSTEM*

PART IIV **ASSESSMENT AND PREDICTION**

This study consists of seven parts:

The illustration on the first page of this book depicts the first finite-time singularity dynamic (1495-1945) as a 'turbine' consisting of four accelerating cycles that propels the System to the next level of social integration and expansion. Increasingly severe systemic wars, and non-systemic wars during relatively stable periods, are respectively shown as red and blue discs.

About the Author

Ingo Piepers studied 'International Relations and Security' at the Royal Netherlands Naval College (1980-1985). In 1997 he obtained a Master's Degree in Business Administration. In 2006 he obtained his Ph.D. from the University of Amsterdam with a doctoral thesis on the war dynamics and development of the International System.
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PART IV

ASSESSMENT AND PREDICTION

So foul a sky clears not without a storm

Shakespeare, The Life and Death of King John

Contents PART IV

Introduction

Assuming that the conditions of the current (first global order (starting in 1945) are more or less similar to the conditions that prevailed during the unfolding of the first finite-time singularity dynamic accompanied by four accelerating cycles (1495-1945), this dynamic and the theoretical model I discussed in part II could serve as references for assessing and predicting the dynamics and development of the current order. The deterministic nature of the System and its regularities during the 1495-1945 period provide numerous clues for setting up a framework for assessment of the current order's dynamics and development. Such a framework and its application are the subjects of this chapter.

The structure of part IV 'Assessment and prediction' differs from the structure of the other parts: First I make a 'quick' assessment of the first global order (1945-...), next I discuss a number of concepts concerning early warning signals in complex systems, to determine their utility for the System and its dynamics; then I will complement Levy's dataset (that only concerns the period 1495-1975) to the present (2016); next, I construct a framework consisting of a number of deterministic and contingent indicators to assess the current condition of the System in more detail, followed by an assessment of the current System, and its dynamics. Following the assessment of the current global order, I construct a (speculative) model of the second finite-time singularity dynamic. Finally, I discuss a number of statements related to 'assessment and prediction'.

1 Initial assessment of the relatively stable period of the first cycle of the second finite-time singularity dynamic

In this chapter I discuss a number of observations regarding the present relatively stable period of the first global order (1945-...), that was established following the dual-phase transition (the fourth systemic war, the Second World War, 1939-1945).

1 ***Wars are an integral part of the first global order***
The first global order produced 20 non-systemic wars involving at least one Great Power in the period 1945-2016. Wars are energy releases and are not disruptions of the System. Wars are integral components of anarchistic systems and fulfill vital functions to ensure the performance and timely evolvability of the System. 'Performance' refers to the ability of the System to fulfill basic requirements of uneven states in an anarchistic System; 'evolvability' refers to the System's ability to adjust itself to changed circumstances to ensure sustained performance. Physical laws, including the second law of thermodynamics and related principles, and a number of deterministic mechanisms apply to the dynamics and development of the System.

2 ***The current System is a global system***
Through the fourth systemic war (the Second World War, 1939-1945) the System produced a dual phase transition: at the same time as dedicated hierarchies were implemented in the core of the System (Europe) resulting in the neutralization of anarchy within the hierarchies, the first global order was established. Consistent with the demands of the second law of thermodynamics, these two regional orders and the first global order are closely related and integrated. The 'European order' is an integral part of the global international order.

3 ***The System experienced a second exceptional period (1953-1989)***
As a consequence of the intense rivalry between the United States and the Soviet Union and the respective hierarchies they controlled, the System produced abnormal non-systemic war dynamics during the period 1953-1989. When the Eastern hierarchy collapsed in 1989, the number of degrees of freedom in the System became > 2, allowing for the resumption of chaotic war dynamics.

4 ***The second exceptional period distorted the development of the System***
Based on the analysis of the first exceptional period (1657-1763), I assume the second exceptional period also caused inefficiencies and probably a delay in the System's development. Contrary to non-systemic war dynamics during the first exceptional period, non-systemic war dynamics during the second exceptional period were suppressed by the high connectivity of the System. The condition of the System during the second exceptional period is in fact

comparable to the System's condition shortly before the outbreak of previous systemic wars; 'subcritical but almost critical'. At those points, states and the System were highly stable as a consequence of their high connectivity in the network of issues and states. This extended stable condition did not lead to the outbreak of a systemic war because the System could not become critical, and systemic war would ensure mutual assured destruction (MAD in nuclear strategy terminology) of rival states and hierarchies in the System. Instead this extended stable (almost critical) period led to the collapse of the Eastern hierarchy and Soviet Union, because of the impact 'external' pressure had on the balanced fulfillment of its basic requirements.

Whereas the System produced extreme non-systemic war dynamics during the first exceptional period, during the second exceptional period war dynamics were very subdued. Until the properties of the first and second cycle of the second finite-time singularity dynamic become evident, it is impossible to determine the delay this caused in the development of the System towards criticality.

5 ***The current global order has not become critical yet***

At this time (2016), the first global order of the System has not yet become critical and has not yet experienced a systemic war. The organizational arrangements that were designed and implemented through the Second World War (the dual phase transition, 1939-1945) are still in place. However, given the dynamics and condition of the current System, it is a question of when, not if, the System will become critical and produce a necessary systemic war to ensure continued compliance with the demands of the second law of thermodynamics.

6 ***The current System meets all requirements to produce a finite-time singularity dynamic***

The current global anarchistic System meets all requirements to produce critical periods and a finite-time singularity dynamic:

a *The current System produces free energy.* Populations of states still grow and demands for basic requirements continuously increase; as a consequence, the connectivity of the System and the interdependence between states is also increasing. The current global System is anarchistic in nature. The intrinsic incompatibility between increasing connectivity and security ensures the production of free energy that will eventually be put to work to upgrade the current order and ensure a lower energy state.

b War decisions of states in the current anarchistic System also qualify as *'binary decisions with externalities and thresholds.'* States in the global System form a network of binary switches regarding war decisions ('war' or 'no war').

c Chaotic non-systemic war dynamics ensure the System will reach a high-connectivity regime that enables the formation of underlying vulnerable issue clusters that will eventually percolate, resulting in criticality and systemic war.

7 ***It is unlikely that the unfolding of the second finite-time singularity dynamic can be sustained***

The undisturbed unfolding of the second finite-time singularity dynamic is unlikely, if decreasing population (growth) in the early 22nd century is not compensated by (for example) demands for (ever) higher standards of living and/or extended average life expectancies of the world population. Other factors that could hinder the unfolding of the second finite-time singularity dynamic include self-destruction of populations (and the System) by unrestrained nuclear war (for example causing irreparable damage to our climate system), and other finite-size effects, for example a lack of resources to produce sufficient destructive energy, that has to be deployed during systemic wars.

2 Early warning signals in complex systems

2.1 Introduction

Quite extensive research has been done related to early warning signals (EWS) that precede critical transitions in complex systems, in particular concerning ecosystems, climate change, earthquakes, and financial markets (14), (21), (37), (53), (54), (55), (63). Critical transitions can be considered phase-transitions. In this chapter I use these terms interchangeably.

It is suggested that generic EWS can be identified that point to the existence of tipping points and related catastrophic shifts in behavior of systems; some researchers are, however, more skeptical about these claims. In this chapter I discuss research related to the existence of EWS in various systems and I show that these EWS cannot be identified in the dynamics of the System. It seems that the dual phase transition the System experienced in 1939, belongs to a fundamentally different class of critical transitions, than discussed in above mentioned research. The critical transition the System experienced in its core and at a global level, qualifies as a dual phase transition that marked a specific growth phase in a long-term process of social integration and expansion (SIE) of populations and their organizational support systems.

2.2 Research

2.2.1 "Early-warning signals for critical transitions"

Research. "This paragraph is based on the article, "*Early-warning signals for critical transitions*", by Scheffer et al. (53). Scheffer et al. observe that "it is becoming increasingly clear that many complex systems have critical thresholds [tipping points] at which the system shifts abruptly from one state to another." "It is notably hard to predict such critical transitions, because the state of the system may show little change before the tipping point is reached. Also, models of complex systems are usually not accurate enough to predict reliably where critical thresholds may occur. Interestingly, though, it now appears that certain generic symptoms may occur in a wide class of systems as they approach a critical point."

"The dynamics of systems near a critical point have generic properties, regardless of differences in the details of each system. Therefore, sharp transitions in a range of complex systems are in fact related. In models, critical thresholds for such transitions correspond to bifurcations. Particularly relevant are 'catastrophic bifurcations', where, once a threshold is exceeded, a positive feedback propels the system through a phase of directional change towards a contrasting state. Another important class of bifurcations is those that mark the transition from a stable equilibrium to a cyclic or chaotic attractor. Fundamental shifts that occur in systems when they pass bifurcations are collectively referred to as critical transitions."

"The most important clues that have been suggested as indicators of

whether a system is getting close to a critical threshold are related to a phenomenon known in dynamical systems theory as 'critical slowing down'. Although critical slowing down occurs for a range of bifurcations, we will focus on the fold catastrophe as a starting point."

"At fold bifurcation points the dominant eigenvalue characterizing the rates of change around the equilibrium becomes zero. This implies that as the system approaches such critical points, it becomes increasingly slow in recovering from small perturbations." Moreover, analysis of various models shows that such slowing down typically starts far from the bifurcation point, and that recovery rates decrease smoothly to zero as the critical point is approached." "It can be shown that as a bifurcation is approached in such a system, certain characteristic changes in the pattern of fluctuations are expected to occur. One important prediction is that the slowing down should lead to an increase in autocorrelation in the resulting pattern of fluctuations. This can be shown mathematically, but it is also intuitively simple to understand. Because slowing down causes the intrinsic rates of change in the system to decrease, the state of the system at any given moment becomes more and more like its past state. The resulting increase in 'memory' of the system can be measured in a variety of ways from the frequency spectrum of the system. The simplest approach is to look at lag-1 autocorrelation, which can be directly interpreted as slowness of recovery in such natural perturbation regimes. Analyses of simulation models exposed to stochastic forcing confirm that if the system is driven gradually closer to a catastrophic bifurcation, there is a marked increase in autocorrelation that builds up long before the critical transition occurs."

"Increased variance in the pattern of fluctuations is another possible consequence of critical slowing down as a critical transition is approached. Again, this can be formally shown, as well as intuitively understood: as the eigenvalue approaches zero, the impacts of shocks do not decay, and their accumulating effect increases the variance of the state variable. In principle, critical slowing down could reduce the ability of the system to track the fluctuations, and thereby produce an opposite effect on the variance. However, analyses of models show that an increase in the variance usually arises and may be detected well before a critical transition occurs."

"In summary, the phenomenon of critical slowing down leads to three possible early-warning signals in the dynamics of a system approaching a bifurcation: slower recovery from perturbations, increased autocorrelation and increased variance."

"In addition to autocorrelation and variance, the asymmetry of fluctuations may increase before a catastrophic bifurcation. This does not result from critical slowing down." "In the vicinity of this unstable point, rates of change are lower. As a result, the system will tend to stay in the vicinity of the unstable point relatively longer than it would on the opposite side of the stable equilibrium. The skewness of the distribution of states is expected to increase not only if the system approaches a catastrophic bifurcation, but

also if the system is driven closer to the basin boundary by an increasing amplitude of perturbation."

"Another phenomenon that can be seen in the vicinity of a catastrophic bifurcation point is flickering. This happens if stochastic forcing is strong enough to move the system back and forth between the basins of attraction of two alternative attractors as the system enters the bi-stable region before the bifurcation. Such behavior is also considered an early warning, because the system may shift permanently to the alternative state if the underlying slow change in conditions persists, moving it eventually to a situation with only one stable state."

Evaluation. From Scheffer's et al. perspective, the bifurcations the System experienced in 1657 and 1763, when the nature of non-systemic wars changed, respectively, from chaotic to periodic and vice versa, qualify as critical transitions. These particular transitions are, however, not the focus of my research related to EWS in the System; I focus instead on the behavior of the System during the dual phase transition it experienced through the fourth systemic war (the Second World War, 1939-1945).

Critical slowing down, a phenomenon Scheffer et al. argue typically seems to precede critical transitions, cannot be observed in the war dynamics of the System. Autocorrelation increased only during the exceptional period (1657-1763) and concerned non-systemic war dynamics during the second relatively stable period (the second international order, 1648-1792). On the contrary, the unfolding of the finite-time singularity dynamic towards the critical connectivity threshold in 1939 shows that there was no slowing down, but instead acceleration toward infinity.

Flickering also cannot be observed in relation to the dual phase transition. However, as I explained in a number of statements in part III, there is a possible scenario in which the order in Europe, presently consisting of a single dedicated hierarchy (the European Union), is temporarily forced back to an anarchistic attractor before finally settling in a non-anarchistic stability domain.

2.2.2 "Anticipating Critical Transitions"

This section discusses the article "*Anticipating Critical Transitions*" by Scheffer et al. (55).

Scheffer et al. combine "emerging insights from two unconnected fields of research. One line of work is revealing fundamental architectural features that may cause ecological networks, financial markets, and other complex systems to have tipping points. Another field of research is uncovering generic empirical indicators of the proximity to such critical thresholds."

Research. "Sharp regime shifts that punctuate the usual fluctuations around trends in ecosystems or societies may often be simply the result of an unpredictable external shock. However, another possibility is that such a shift

represents a so-called critical transition. The likelihood of such transitions may gradually increase as a system approaches a "tipping point" (i.e., a catastrophic bifurcation), where a minor trigger can invoke a self-propagating shift to a contrasting state. One of the big questions in complex systems science is what causes some systems to have such tipping points. The basic ingredient for a tipping point is a positive feedback that, once a critical point is passed, propels change toward an alternative state."

"A broad range of studies suggests that two major features are crucial for the overall response of such systems: the heterogeneity of the components and their connectivity," as can also be observed in the model by Watts. "How these properties affect the stability depends on the nature of the interactions in the network."

"One broad class of networks includes those where units (or 'nodes') can flip between alternative stable states and where the probability of being in one state is promoted by having neighbors in that state. One may think, for instance, of networks of populations (extinct or not), or ecosystems (with alternative stable states), or banks (solvent or not). In such networks, heterogeneity in the response of individual nodes and a low level of connectivity may cause the network as a whole to change gradually - rather than abruptly- in response to environmental change. This is because the relatively isolated and different nodes will each shift at another level of an environmental driver. By contrast, homogeneity (nodes being more similar) and a highly connected network may provide resistance to change until a threshold for a systemic critical transition is reached where all nodes shift in synchrony."

"This situation implies a trade-off between local and systemic resilience. Strong connectivity promotes local resilience, because effects of local perturbations are eliminated quickly through subsidiary inputs from the broader system". "However, as conditions change, highly connected systems may reach a tipping point where a local perturbation can cause a domino effect cascading into a systemic transition. Notably, in such connected systems, the repeated recovery from small-scale perturbations can give a false impression of resilience, masking the fact that the system may actually be approaching a tipping point for a systemic shift."

It is important to note that wars do not qualify as perturbations, as defined by Scheffer et al. Wars are energy releases the System produces in response to triggers.

Apart from structural properties that point to the possibility of sharp transitions, other research described by Scheffer et al. focuses on features of systems that can be used to measure how close a particular system is to a critical transition. "One line of work is based on the generic phenomenon that in the vicinity of many kinds of tipping points, the rate at which a system recovers from small perturbations becomes very slow, a phenomenon known as 'critical slowing down.' This happens, for instance, at the classical fold bifurcation, often associated with the term 'tipping point', as well as

more broadly in situations where a system becomes sensitive so that a tiny nudge can cause a large change."

"The increasing sluggishness of a system can be detected as a reduced rate of recovery from experimental perturbations. However, the slowness can also be inferred indirectly from rising 'memory' in small fluctuations in the state of a system, as reflected, for instance, in a higher lag-1 autocorrelation, increased variance, or other indicators. Slowing down will precede not all abrupt transitions. For instance, sharp change may simply result from a sudden big external impact. Also, slowing down of rates can have causes other than approaching a tipping point (e.g., a drop in temperature). Therefore, slowing down is neither a universal warning signal for shifts nor specific to an approaching tipping point. Instead, slowing down should be seen as a 'broad spectrum' indicator of potential fundamental change in the current regime."

"Slowing down suggests an increased probability of a sudden transition to a new unknown state. By contrast, the information extracted from more wildly fluctuating systems suggests a contrasting regime to which a system may shift if conditions change."

Evaluation. Once the System reached the percolation threshold in 1495, it developed a 'self-propagating shift' to the eventual implementation of dedicated hierarchies in its core (Europe). Scheffer et al. define the tipping point as the moment such a self-reinforcing dynamic is set in motion (to avoid confusion: in this study, the term 'tipping point' is used in a different context and denotes the separation between low- and high-connectivity regimes of relatively stable periods).

Despite some superficial similarities between the anarchistic System and the category of systems Scheffer et al. studied, their differences are more significant. As discussed in the previous subsection, the dynamics of the anarchistic System do not show symptoms of critical slowing down; to the contrary, the System experienced an acceleration that led to its collapse when the critical connectivity threshold was reached in 1939.

2.2.3 "A state shift in Earth's biosphere"

This section is based on the article "*Approaching a state shift in Earth's biosphere*" by Barnosky et al. (8).

Research. Barnosky et al. observe: "Localized ecological systems are known to shift abruptly and irreversibly from one state to another when they are forced across critical thresholds."

In the article Barnosky et al. "review evidence that the global ecosystem as a whole can react in the same way and is approaching a planetary-scale critical transition as a result of human influence. The plausibility of a planetary-scale 'tipping point' highlights the need to improve biological forecasting by detecting early warning signs of critical transitions on global

as well as local scales, and by detecting feedbacks that promote such transitions. It is also necessary to address root causes of how humans are forcing biological changes."

Barnosky et al. argue that complex interactions, feedback loops, and their hard-to-predict effects must be taken into account to forecast a system's behavior. "Particularly important are recent demonstrations that 'critical transitions' caused by threshold effects are likely. Critical transitions lead to state shifts, which abruptly override trends and produce unanticipated biotic effects. Although most previous work on threshold-induced state shifts has been theoretical or concerned with critical transitions in localized ecological systems over short time spans, planetary-scale critical transitions that operate over centuries or millennia have also been postulated." Barnosky et al. present evidence that "such planetary-scale critical transitions have occurred previously in the biosphere, albeit rarely, and that humans are now forcing another such transition, with the potential to transform Earth rapidly and irreversibly into a state unknown in human experience."

"It is now well documented that biological systems on many scales can shift rapidly from an existing state to a radically different state. Biological 'states' are neither steady nor in equilibrium; rather, they are characterized by a defined range of deviations from a mean condition over a prescribed period of time. The shift from one state to another can be caused by either a 'threshold' or 'sledgehammer' effect. State shifts resulting from threshold effects can be difficult to anticipate, because the critical threshold is reached as incremental changes accumulate and the threshold value generally is not known in advance. By contrast, a state shift caused by a sledgehammer effect – for example the clearing of a forest using a bulldozer – comes as no surprise. In both cases, the state shift is relatively abrupt and leads to new mean conditions outside the range of fluctuation evident in the previous state. Threshold-induced state shifts, or critical transitions, can result from 'fold bifurcations' and can show hysteresis. The net effect is that once a critical transition occurs, it is extremely difficult or even impossible for the system to return to its previous state."

"Recent theoretical work suggests that state shifts due to fold bifurcations are probably preceded by general phenomena that can be characterized mathematically: a deceleration in recovery from perturbations [critical slowing down], an increase in variance in the pattern of within-state fluctuations, an increase in autocorrelation between fluctuations, an increase in asymmetry of fluctuations and rapid back-and-forth shifts [flickering] between states."

"One key question is how to recognize a global-scale state shift. Another is whether global-scale state shifts are the cumulative result of many smaller-scale events that originate in local systems or instead require global-level forcings that emerge on the planetary scale and then percolate downwards to cause changes in local systems. Examining past global-scale state shifts provides useful insights into both of these issues."

Barnosky et al. observe that past global-scale state shifts coincided "with

global-scale forcings that modified the atmosphere, oceans and climate. These examples suggest that past global-scale state shifts required global-scale forcings, which in turn initiated lower-level state changes that local controls did not override. Thus, critical aspects of biological forecasting are understanding whether present global-scale forcings are of a magnitude sufficient to trigger a global-scale critical transition and ascertaining the extent of lower-level state changes that these forcings have already caused or are likely to cause."

"Global-scale forcing mechanisms today are human population growth with attendant resource consumption, habitat transformation and fragmentation, energy production and consumption, and climate change. All of these far exceed, in both rate and magnitude, the forcings evident at the most recent global-scale state shift, the last glacial–interglacial transition, which is a particularly relevant benchmark for comparison given that the two global-scale forcings at that time – climate change and human population growth – are also primary forcings today." "The magnitudes of both local-scale direct forcing and emergent global-scale forcing are much greater than those that characterized the last global-scale state shift, and are not expected to decline any time soon."

Barnosky et al. propose, "Three approaches should prove helpful in defining useful benchmarks and tracking progression towards them". These can be summarized as (1) tracking global-scale changes, (2) tracking local-scale changes caused by global forcings, and (3) synergy and feedbacks.

Evaluation. Contrary to the "state shifts" to which Barnosky et al. refer, the timing of the critical connectivity threshold of the finite-time singularity dynamic can be predicted accurately. As I explained in the previous sections, the state shift the System experienced is of a fundamentally different nature than the critical transitions and state shifts Scheffer et al. and Barnosky et al. discuss.

Despite the fundamentally different characteristics of critical transitions from the dual phase transition the System experienced, the two transitions share some similarities. As is the case with state shifts discussed by Barnosky, in the System there is also global-scale forcing in the form of global population growth. The System was forced because of increasing demands for basic requirements, increasing connectivity, and the resulting increasing rivalries between states.

2.2.4 "Slowing down as an early warning signal for abrupt climate change"

In the article "*Slowing down as an early warning signal for abrupt climate change*", Dakos et al. (21) discuss the phenomenon that "in the Earth's history, periods of relatively stable climate have often been interrupted by sharp transitions to a contrasting state. One explanation for such events of abrupt change is that they happened when the earth system reached a critical tipping point. However, this remains hard to prove for events in the remote past, and it is even more difficult to predict if and when we might reach a

tipping point for abrupt climate change in the future." In the article, Dakos et al. "analyze eight ancient abrupt climate shifts and show that they were all preceded by a characteristic slowing down of the fluctuations starting well before the actual shift."

Research. "Such slowing down, measured as increased autocorrelation, can be mathematically shown to be a hallmark of tipping points. Therefore, our results imply independent empirical evidence for the idea that past abrupt shifts were associated with the passing of critical thresholds. Because the mechanism causing slowing down is fundamentally inherent to tipping points, it follows that our way to detect slowing down might be used as a universal early warning signal for upcoming catastrophic change. Because tipping points in ecosystems and other complex systems are notoriously hard to predict in other ways, this is a promising perspective." "In models such tipping points correspond to bifurcations where, at a critical value of a control parameter, an attractor becomes unstable, leading to a shift to an alternative attractor. The underlying mechanism causing such extreme sensitivity at particular thresholds is typically a positive feedback."

Dakos et al. explain that the theoretical finding that, "as a rule, dynamical systems become "slow" when a critical point is approached as conditions are gradually changing." "This slowing can be used as a clue to predict upcoming critical transitions. In technical terms, the maximum real part of the eigenvalues of the Jacobian matrix tends to zero as a bifurcation point is approached. As a result, the dynamical system becomes increasingly slow in recovering from small perturbations. Although an ideal way to test whether a system is slowing down is to study its response to small experimental perturbations, this is obviously of little use for analyzing past climate change. An alternative is to interpret fluctuations in the state of a system as it responds to natural perturbations. Slowing down should then simply be reflected as a decrease in the rates of change in the system, and therefore, as an increase in the short-term autocorrelation in the time series."

As I already explained, despite some similarities in certain properties, the System developed a fundamentally different dynamic. The rate of change in the System did not slow down, but, to the contrary, accelerated.

Furthermore, Dakos et al. observe: "In all examples of abrupt climate change we analyzed, autocorrelation showed an increase in the period before the shift, suggesting that these climate systems did indeed slow down before the abrupt change, as expected theoretically for systems approaching a tipping point." "It may seem rather surprising that all cases of sharp climate shifts we analyzed were announced well before they happened by changes in the pattern of fluctuations."

"It is simply very difficult to prove what had been the mechanism behind such events in the far past. The slowing down that our analysis suggests does not point to any specific mechanism. Rather, it is a universal property of systems approaching a tipping point. Therefore, it represents an

independent line of evidence, complementing model-based approaches, suggesting that tipping points exist in the climate system. Clearly, this is an important insight because it implies that, in principle, internal feedback can propel the climate system through an episode of rapid change once a critical threshold is reached." An important fundamental limitation we should keep in mind is that slowing down will only occur if the system is moving gradually toward a threshold. Therefore, transitions caused by a sudden large disturbance without a preceding gradual loss of resilience will not be announced by slowing down." "Putting our results in an even wider perspective, it is important that slowing down is a universal property of systems approaching a tipping point. This implies that our techniques might in principle be used to construct operational early warning systems for critical transitions in a wider range of complex systems where tipping points are suspected to exist, ranging from disease dynamics and physiology to social and ecological systems."

Evaluation. See previous subsections.

2.2.5 "From patterns to predictions"

As I explained, although the System experienced a phase transition (1939-1945), it did not show the typical slowing down behavior that Scheffer et al., Barnosky et al., and Dakos et al. observed in ecosystems and the biosphere when these systems reached a critical transition or state shift. Obviously the System belongs to a fundamentally different category of systems.

Carl Boetigger and Alan Hastings, in the article "*From patterns to predictions*", argue that truly generic warning signals of tipping points are unlikely to exist, and advise researchers to study transitions specific to real systems (14). My study confirms this advice.

As Boettigger et al. observe, "no 'one-size-fits-all' property" can be found "that signals the imminent collapse of a complex system... Much effort is being dedicated to finding 'generic' warning signals that apply across diverse systems. But because the phenomena identified so far are not universally associated with tipping points, nor even sure indicators of a major shift, their predictive power is uncertain. We believe that in most cases, models designed to predict when critical transitions will happen, and in what circumstances, will need to be guided by — and perhaps even generated from — data on the specific system of interest."

Although the dynamics of the System – the unfolding of the finite-time singularity dynamic accompanied by four accelerating cycles (1495-1945) - did not have the typical features discussed in this section, the deterministic properties of the System and the resulting regularities in its dynamics and direction of development provide numerous clues that make it possible to quite accurately forecast the future behavior of the current anarchistic System.

3 Complementing Levy's dataset

Before further discussing a framework for the assessment and prediction of the war dynamics of the current (global) System, I present in this paragraph the dataset I will use to make this assessment; this dataset complements Levy's dataset that only covers the period 1495-1975 (38). The supplemented dataset covers the period 1945-2016 and, for consistency, I use Levy's terminology and criteria.

The first step is to determine what states qualify as Great Powers during the period 1945-2016. After establishing which states qualify as Great Powers, I determine what wars during the period 1945-2016 should be included in the dataset.

3.1 Identifying Great Powers

I quote Levy (38): "A Great Power is defined here as a state that plays a major role in international politics with respect to security-related issues. The Great Powers can be differentiated from other states by their military power, their interests, their behavior in general and interactions with other powers' perception of them, and some formal criteria."

"Most important, a Great Power possesses a high level of military capabilities relative to other states. At a minimum, it has relative self-sufficiency with respect to military security. Great Powers are basically invulnerable to military threats by non-Powers and need only fear other Great Powers. In addition, Great Powers have the capability to project military power beyond their borders to conduct offensive as well as defensive military operations. They can actively come to the defense of allies, wage an aggressive war against other states (including most of the Powers), and generally use force or the threat of force to help shape their external environment."

"Second, the interests and objectives of Great Powers are different from those of other states. They think of their interests as continental or global rather than local or regional. Their conception of security goes beyond territorial defense or even extended defense to include maintenance of a continental or global balance of power. Great Powers generally define their national interests to include systemic interests and are therefore concerned with order maintenance in the international system. Symbolic interests of national honor and prestige are also given high priority by the Great Powers, for these are perceived as being essential components of national power and necessary for Great Power status."

"Third, the Great Powers are distinguished from other states by their general behavior. They defend their interests more aggressively and with a wider range of instrumentalities, including the frequent threat or use of military force. They also interact frequently with other Powers... Great Powers are further differentiated from other states by others' images and perceptions of them."

"Finally, Great Powers are differentiated from others by formal criteria,

including identification as a Great Power by an international conference, congress, organization, or treaty, or the granting of such privileges as permanent membership or veto power by an international organization or treaty."

Applying these criteria, I argue that only Iran (in 2011) acquired Great Power status during the period 1945-2016; no Great Powers that established their positions in 1945 lost Great Power status. I assume that Iran achieved Great Power status through its involvement in the Iraq War (2003-2011) and its sustained nuclear ambitions that were, after a series of negotiations and conferences involving the other Great Powers, settled by mutual agreement in 2015.

Other states, including India and Brazil but also Japan, lack the capabilities and typical behaviors of Great Powers as defined by Levy. Only the United States, the Soviet Union/Russia, China, Great Britain, France, and Germany qualify as Great Powers during the period 1945-2016; starting in 2011 Iran can be added to this group.

3.2 Identifying wars in the Great Power System, 1945-2016

To determine what wars qualify as "wars in the Great Power System" during the period 1945-2016, Levy's method must also be applied. In his study "*War in the Modern Great Power System, 1495-1975*", Levy identified Great Power wars until 1975.

Levy (38) defines war conceptually as "a substantial armed conflict between the organized military forces of independent political units." Levy distinguishes between two subsets of wars: (1) wars involving the Great Powers and (2) interstate wars involving the Great Powers that "consists of wars with at least one Great Power on each side of the conflict. These wars are labeled Great Power wars." Levy operationalizes the criterion "substantial" by requiring a minimum of 1000 battle-deaths, defined as the number of deaths of military personnel.This number is not restricted to the Great Powers but includes all states, "even though these other states are not included in the actual measurements of the parameters of the war".

I used a number of sources to supplement Levy's dataset: the data presented in the study "*Resort to war 1816-2007*", by Sarkees et al. for wars 120-128 and other sources (see below in table) for Wars 129-134 (52). The table below shows the complemented dataset that I will apply to the framework discussed in this chapter.

War data, 1945 - August 2016 ased on Levy (115-119), Sarkees et al. (120-128), and other resources (125-134)							
No.	War	Dates	Duration (Years)	Extent (No of GP's)	Severity (in BCD)	Size (Fraction)	GP's
115	Korean War	1950-1953	3.1	4	954,960	0.67	US, China, Fr, GB
116	Russo-Hungarian War	1956-1956	0.1	1	7,000	0.17	SU
117	Sinai War	1966-1956	0.1	2	30	0.33	GB, Fr
118	Sino-Indian War	1962-1962	0.1	1	500	0.17	China
119	Vietnam War	1965-1973	8.0	1	56,000	0.17	US
120	Sino-Vietnamese Punitive War	1979-1979	0.1	1	13,000	0.17	China
121	The Soviet Quagmire	1980-1989	9.0	1	40,000	0.17	USSR
122	Falklands War	1982-1982	0.3	1	255	0.17	GB
123	Sino-Vietnamese Border War	1987-1987	0.1	1	1,800	0.17	China
124	Gulf War	1990-1991	0.7	3	402	0.5	US, GB, Fr
125	The First Chechnya War of 1994-1996	1994-1996	2.8	1	4,000	0.17	Russia
126	Intervention in Bosnia	1995	0.1	3	27	0.5	US, GB, Fr
127	War for Kosovo	1999-1999	0.2	3	2	0.5	US, GB, Fr
128	The Second Chechnya War of 1999-2003	1999-2003	4.2	1	5,000	0.17	Russia
129	War of Afghanistan	2001-2014	13.2	4	2,955	0.67	US, GB, Fr, Germany
130	Iraq War	2003-2011	8.7	2	4,676	0.33	US, GB
131	Intervention in Libya	2011-2011	0.6	3	0	0.43	US, GB, Fr
132	War for Syria	2011-ongoing	5.5	5	20	0.71	US, GB, Fr, Iran, Russia
133	Russian-Ukraine War	2014-ongoing	2.5	1	450	0.14	Russia
134	Iranian Intervention in Iraq	2014-ongoing	2.1	1	11	0.14	Iran

Table 108 *Updated war data, 1945 - August 2016. This is an extension of the war data of Levy (38). To ensure consistency and avoid bias, I have used Levy's definitions of Great Powers, wars, and battle-deaths in my interpretation of the dataset presented by Sarkees et al. (52) and data from numerous sources; however, further validation of the dataset is required. Sarkees qualifies the Intervention in Bosnia in 1995 by the United States and NATO, including Great Britain and France, (War 125) as a phase in an intra-state war (The Bosnian-Serb Rebellion of 1992-1995). This intervention, also referred to as*

'Operation Deliberate Force,' qualifies – I assume – as a war involving Great Powers. Sarkees classifies the 'Soviet Quagmire of 1980-1989' as an 'extra-state war.' Because this war meets Levy's requirements, I assume, I added it to the data set.
*Wars 116-123 constitute the second exceptional period (1953-1989) and are shaded in grey. If the First and Second Chechnya War (respectively 1994-1996 and 1991-2003) qualify as interstate wars needs validation: These wars cause distortions in the circular trajectories in phase state. However, if excluded, this does not impact on the outcome of the assessment and predictions. The 'War of Afghanistan' (129) is arguably still ongoing, although France's involvement ended in 2012 and Great Britain's involvement ended in 2014. The Russian-Ukraine War (133) includes the annexation of Crimea by the Russian Federation (20 February - 20 March 2014) and the Russian military intervention in Ukraine (ongoing since 20 February 2014). GP: Great Powers, Fr: France, GB: Great Britain, SU: Soviet Union. The data in this table is based on Levy (38) for Wars 115-119. The data for Wars 120-128 is based on the dataset in "Resort to War 1816-2007" (52). The data for the remaining wars (127-134) were collected from: War nr. 129: "Afghanistan: Fatalities by year", icasualties.org 9 September, retrieved 14 September 2013; www.defense.gov/casualty.pdf, retrieved 29 June 2016 (through Wikipedia, retrieved 21 August 2016). War nr. 130: "Fact Sheets/Operations Factsheets/Operations in Iraq: British Fatalities", Ministry of Defence of the United Kingdom, archived from the original on 11 October 2009, retrieved 17 October 2009 (through Wikipedia, retrieved 21 August 2016). War nr. 132: "*Глава Кабардино-Балкарии подтвердил гибель двадцатого российского военного в Сирии*". Retrieved 12 August 2016 (through Wikipedia, retrieved 21 August 2016). War nr. 133: "Nuland Claims 400-500 Russian Soldiers Killed in Eastern Ukraine". Sputnik News. 10 March*

4 Identification of deterministic and contingent indicators

With the help of regularities in the dynamics and development of the anarchistic System during the 1495-1945 period – the period when the first finite-time singularity dynamic accompanied by four accelerating cycles unfolded – a number of deterministic and contingent indicators can be identified that could provide clues for the assessment and prediction of the dynamics and developments of the current order.

4.1 Deterministic indicators

The following deterministic indicators can be identified:

Deterministic indicators for assessment and prediction		
	Indicator	Clarification
1	Rate of population growth	Determines the free energy that will be produced in the System and its connectivity.
2	The number of degrees of freedom of the System	Determines whether non-systemic war dynamics are chaotic or non-chaotic. Chaos is a precondition for the System to form underlying vulnerable issue clusters and to become critical.
3	Average size of non-systemic energy-releasing wars	Determines if the System is in a low- or high-connectivity regime.
4	Development of the frequency of non-systemic energy releases	Determines if the System is in a low- or high-connectivity regime.
5	Changes in centrality of nodes (development of Great Power status dynamics)	Indicator for the structural stability – organizational permanence – of the System.
6	Changes in the size and form of nodes (states)	Indicator for the structural stability – permanence of political control – in the System.
7	The nature of the size distribution of states in the System; the level of fractality of the System	Indicator for the performance of the System, and the efficiency of free energy production and (re-)distribution in the System.
8	Robustness of the System	Determines the System's sensitivity to perturbations and its ability to release free energy through non-systemic release events. This property is closely related to the System's fragility.
9	Fragility of the System	Determines the life span of relatively stable periods. This property is closely related to the System's robustness.
10	The durations of relatively stable periods and of critical periods (respectively the life span of international orders and systemic wars)	Indicator for the connectivity and pace of life of the System. Decreasing durations mean the System is approaching the critical connectivity threshold.

	Deterministic indicators for assessment and prediction	
11	Amount of destructive energy that is deployed during critical periods, for which severities of systemic wars is an indicator	Indicator for the connectivity and pace of life of the System. Increasingly higher – and ultimately infinite – amounts of destructive energy means the System is approaching the critical connectivity threshold.
12	The rate of acceleration of the System	Indicator for the connectivity and pace of life of the System. Increasing and ultimately infinite acceleration means the System is approaching the critical connectivity threshold.

Table 109 *This table shows deterministic indicators.*

4.2 Contingent indicators

The following contingent indicators can be identified:

	Contingent indicators for assessment and prediction	
	Indicator	Clarification
1	Development of the power flux (CINC-index).	The development of the CINC-indices indicates whether states produce destructive energy.
2	Development of alliance dynamics.	The development of alliance dynamics indicates whether states are concerned with their security and try to hedge risks.
3	Development of tensions in the System.	Tensions are manifestations of free energy, and are transformed into destructive energy.
4	The number of issues in the System and their interconnectedness.	The number of issues is indicative of the war potential of the System.
5	The number and nature of unresolved issues and their interconnectedness.	The number and nature of unresolved issues are indicative of the buildup of underlying vulnerable issue clusters.
6	Ideological reach, outspokenness, and radicalization.	Ideological developments are indicative of the mobilization potential and ultimately war preparedness of states.
7	Perceived unpredictability of wars and their properties.	The perceived unpredictability of wars, including unexpected escalation and unexpected de-escalation and containment, are indicative of the chaotic nature of these dynamics.
8	The willingness of states to get involved in non-systemic wars.	The willingness of states to engage in wars is indicative whether the System is in a low- or high-connectivity regime, and of the chaotic or non-chaotic nature of war dynamics. Chaotic war dynamics cause restraint because of the intrinsic unpredictability of these types of wars.
9	The level of representativeness of the current order.	To what degree the actual centrality of states is reflected in its order determines the level of functionality and legitimacy of the global order. The degree to which the order's rules and institutions are undermined by states with special privileges is indicative of its ability to maintain the status quo.

Table 110 *This table shows contingent indicators.*

5 Assessment of the current condition of the System

5.1 Introduction

In this chapter I make an initial assessment of the current condition of the System through the framework of deterministic and contingent indicators.

5.2 Assessment of the deterministic dynamics and properties of the System

1 ***Rate of population growth***

Population growth powered the finite-time singularity dynamic during the 1495-1945 period, determined its connectivity, and contributed to rivalries between states.

The question is whether the rate of population growth during the unfolding of the finite-time singularity dynamic in Europe (1495-1945), the core of the System, fundamentally differed from the rate of population growth at a global level starting in 1945.

The global population growth rate peaked in 1962-1963 at 2.1% (per year) and decreased to 1.2% in 2010. The global population is still growing exponentially, but its growth rate is declining. In 2100, the population growth rate is expected to be 0.06%. Around 2045 the growth rate will have decreased to the rate of 1750 (around 0.4%). During the unfolding of the finite-time singularity dynamic (1495-1945), the population growth rate increased steadily.

In order to answer above mentioned question, I calculated population growth rates during the unfolding of the finite-time singularity dynamic in Europe, and at a global scale starting in 1945. Growth rates were calculated based on change during increments of 50 years from 1500 until 2150, as follows: (population size t(2) - population size t(1)) / population size t(1).

These calculations show that global population growth rates, at least until the year 2100, are in the same range as population growth rates during the unfolding of the finite-time singularity dynamic (1495-1945), suggesting that in the coming 100 years the current global System could produce enough free energy to develop a critical condition and to initiate a second finite-time singularity. The average population growth rate in Europe during the period 1500-1950 was 23.9% and at a global scale during the period 1900-2150 will be 47.5%.

Comparison of population growth rates				
Period	Europe	Growth rate Europe	World	Growth rate world
1500	84		458	
1550	96	14.3 %	500	
1600	111	15.6 %	580	
1650	118	6.3 %	630	
1700	125	5.9 %	682	
1750	163	30.4 %	791	
1800	203	24.5 %	978	
1850	276	36.0 %	1,262	
1900	408	47.8 %	1,650	30.7 %
1950	547	34.1 %	2,521	52.8 %
2000	729		5,978	137.1 %
2050	734		9,725	62.7 %
2100	639		1,0854	11.6 %
2150	517		9,746	–10.2 %

Table 111 *This table shows the growth rate during successive periods of 50 years in Europe (1500-1950) and at a global scale (1900-2150) (data from United Nations Population Division and related sources).*

2 ***Degrees of freedom of the System***
The first global order (beginning in 1945) experienced an exceptional period following the phase transition in the System brought on by the fourth systemic war (the Second World War, 1939-1945). This exceptional period (1953-1989) lasted until the collapse of the Eastern hierarchy in 1989. The intense rivalry between the United States and the Soviet Union temporarily decreased the number of degrees of freedom in the System to two and resulted in its ossification. In 1989 the System resumed chaotic war dynamics, a prerequisite for (eventually) becoming critical and producing a systemic war.

3 ***Average sizes of non-systemic wars***
To be discussed in paragraphs.

4 ***Frequency of non-systemic wars***
To be discussed in paragraphs.

5 ***Changes in centrality of nodes (in the deterministic domain) and associated development of Great Power status dynamics (in the contingent domain)***
The centrality of nodes in the System is not stable. Great Power status dynamics changes are manifestations of changes in the ('underlying') centrality of

nodes. Since 1945, the centrality of Great Britain and France has decreased despite their privileged positions in the current order (i.e. permanent seats in the Security Council of the United Nations, 'legal' possession of nuclear weapons, etc.), while Iran's centrality increased despite not being reflected in the formal status hierarchy of the System. I argue that Iran achieved Great Power Status in 2011.

The fact that changes in centrality still occur implies that the organizational stability of the System is not yet absolute (as was the case shortly before the dual phase transition (1939-1945)), and that a next critical period in the form of systemic war will not constitute a phase transition.

6 ***Changes in the sizes and forms of nodes***

In the current System, changes in the sizes and forms of nodes (territories of states), or efforts to achieve such changes, can be observed in the Middle East where a number of states (Iraq, Syria, Libya, Yemen) collapsed, in Eastern Europe involving Russia and Ukraine, and in Asia concerning territorial claims regarding the South China Sea (involving China, Vietnam, and the Philippines, but also the United States).

Changing sizes and forms of nodes means that the System is not structurally optimized and stable, and has not yet achieved optimal fractal structures at a global scale that reflect the actual power positions of states in the System. The fact that these dynamics take place also means that the current international order is not infinitely stable and that the System is not yet poised for a phase transition. This indicator and indicator (5) (concerning changes in the centrality of nodes) are related, and dynamics during the unfolding of the finite-time singularity dynamic (1495-1945) suggest that both dynamics (changes in the centrality of nodes, and in the sizes and forms of nodes) are indicative for the structural stability of the System, and will eventually become absolute/infinite at the same time.

7 ***The nature of the size-distribution of states and the level of fractality of the System***

The fact that Great Power status dynamics have resumed following the dual phase transition (1939-1945) and that sizes and forms of nodes (territories of states) both have lost their permanency implies that the current global does not reflect the actual power positions of states in the System. Power positions of states (see indicator (5)) and the territories they control (see indicator (6)) are presently in flux again.

The development of the anarchistic System during the 1495-1945 period (during the unfolding of the finite-time singularity) shows that it can be expected, that the System will through a number of successive systemic wars carve out fractal structures that will reflect the ultimate power positions of states in the (now global) System. These fractal structures will crystallize during the unfolding of the second finite-time singularity dynamic that begun in 1945. Fractal structures are – as explained in this study - instrumental in

achieving a lower energy state in the anarchistic System, and in the efficient distribution of destructive energy during systemic wars (critical periods); the emergence of fractal structures is directly related to the application of the second law of thermodynamics.

8 ***Robustness of the System***
The current order periodically produces non-systemic energy releases (non-systemic wars). This implies that the System is not yet absolutely robust, and that the critical connectivity threshold will not be reached during this order: This means that the next systemic war will not (yet) constitute a (next) phase transition to a next (global) level of SIE. Consistent with indicators (5), (6), and (7), current dynamics and their properties suggest that the System requires more than one critical period (systemic war) to produce a phase transition and establish dedicated hierarchies at a global or regional level(s) of the System.

9 ***Fragility of the System***
Fragility and robustness are related properties of the System: they go hand-in-hand and are two sides of the same coin. When the robustness of the System becomes absolute and the System can no longer produce non-systemic release events because of its high connectivity, its fragility at the same time has become infinite and the System collapses. Collapse results in phase transitions to ensure the survival of populations in the System. The fact that the current global order still produces non-systemic release events means that its robustness and fragility are not yet absolute/infinite, and that the next systemic war will not precipitate the System's collapse and a phase transition.

The development of this indicator is consistent with indicators (5) through (8). All of these indicators suggest that the current global System requires more than one critical period to implement a next level of SIE.

10 ***The durations of relatively stable and critical periods represented by the life spans of international orders and systemic wars***
The current order is still unfolding, and, as this study shows, will eventually become critical and produce a systemic war. The systemic war will be instrumental in the implementation of an upgraded order that enables a lower energy state in the System, consistent with the demands of the second law of thermodynamics. Indicators (3) and (4) provide some clues to determine the expected life span of the current order; as will be discussed in next paragraphs.

11 ***The amount of destructive energy that is deployed during critical periods (systemic wars)***
Cannot (yet) be determined.

12 ***The rate of acceleration of the System***
Cannot (yet) be determined.

5.3 Assessment of contingent dynamics and properties of the System

1 ***Development of the power flux (CINC-index)***

CINC-index stands for the 'Composite Index of National Capability', and is based on six variables: (1) total population, (2) urban population, (3) iron and steel production, (4) energy consumption, (5) military personnel, and (6) military expenditure. CINC is s statistical measure of national power; its components represent demographic, economic and military strength. Each component (out of six) is a percentage of the word's total: Component ratio = state / global; the CINC (by state) = the sum of the six ratios / 6 (59).

Developments of the power flux (CINC-index) can be tracked until 2007 (59); subsequent data is not yet available. This study shows that the power flux does not signal upcoming systemic wars very far in advance. Significant increases in the power flux of the System preceding the third and fourth systemic wars (respectively, the First (1914-1918) and Second (1939-1945) World Wars) occurred, respectively, 2-3 years (1911-1912) and 1-2 years (1937-1938) before these wars started. Furthermore, as the analysis shows, increases in the power flux do not necessarily announce systemic wars, but can also announce non-systemic wars, or can be just random fluctuations.

There were no significant changes in the power flux during the period 1945-2007 other than a steady increase that started with the resumption of chaotic non-systemic war dynamics around 1989, when non-systemic wars stopped being 'subdued' as a consequence of the intense rivalry between the United States and the Soviet Union, and the hierarchies they controlled.

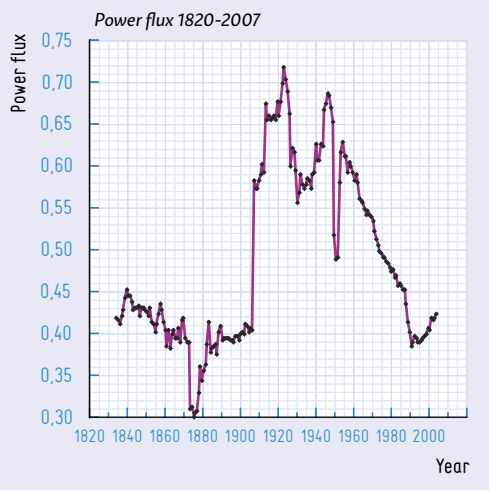

Figure 138

This figure depicts the total power flux measured by the sum of the CINC-indices of Great Powers in the System (multiplied by 10). Sudden changes in the power flux cannot be attributed to the war dynamics of the System, but rather to states that acquired or lost their Great Power status. This is for example the case in 1898, when the United States acquired Great Power status. Because of the short 'lead-time' of significant changes in the power flux before systemic wars, the power flux is not a useful indicator for the upcoming war dynamics of the System.

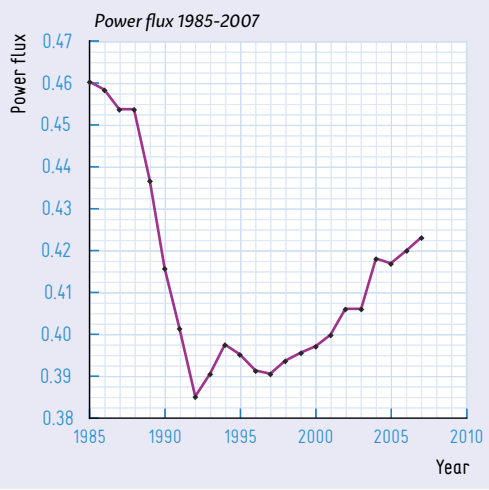

Figure 139
This figure provides a more detailed look at the development of the power flux during the period 1985-2007. The resumption of chaotic war dynamics led to a steady increase in the power flux that, I assume, still continues.

2 ***Development of alliance dynamics***

I define 'alliance dynamics' as the number of alliances that were started or ended by Great Powers in the System each year during the period 1816-2013. As is the case with the power flux, alliance dynamics are of limited practical value as reliable EWS. Furthermore, as this analysis also shows, alliance dynamics are not necessarily related to systemic wars, but also indicate the formal establishment of new states (decolonization), rivalries during the Cold War (1945-1989), and the collapse of the Eastern hierarchy (1989).

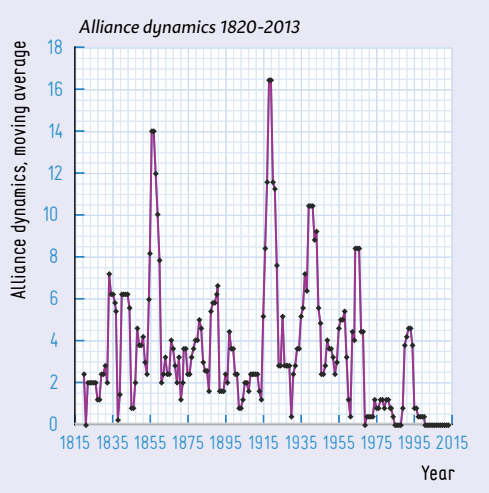

Figure 140
This figure shows the alliance dynamics of the System as the moving average (five observations) of the sum of alliances started or ended by Great Powers in the System in increments of five years during the period 1820-2013 (25).

3 ***Development of tensions in the System***

This indicator cannot be quantified. Current developments in the System suggest tension levels are rising. Great Power rivalries appear to be increasing within Europe, between the United States and Russia regarding the Ukraine and Syria, and between the United States and China regarding the South

China Sea for example, in addition to increasing tension levels in the Middle and Far East and regionally in Africa.

4 ***The number of issues in the System, and their interconnectedness***
See also indicator (3). Because of the simultaneous involvement of Great Powers in a number of issues, for example involvement of the United States and Russia in Syria and the Ukraine, issues can become connected. A relevant question is if the current order is in a low- or high-connectivity regime, and if increased connectivity of the network of states and issues will result in an increase in the average sizes of non-systemic wars (in case the order is in a low-connectivity regime), or in increased local stability of states and as a consequence in a decrease in the average sizes of non-systemic wars (in case the order is in a high-connectivity regime).

The current, more restraint behavior of the United States and of Russia suggest that the current order is in its high connectivity regime. This would imply that issues and tensions are not being 'released' through non-systemic wars, but instead contribute to further growth and crystallization of underlying vulnerable issue clusters.

As this study shows, through growth and crystallization of underlying vulnerable issue clusters, that eventually percolate the System, the System 'charges' itself, becomes critical and produces a systemic war.

5 ***The number and nature of unresolved issues, and their interconnectedness***
See indicators (3) and (4).

6 ***Development and reach of ideologies, and level of radicalization***
This indicator cannot be quantified; however, ideologies are apparently becoming more radical, including religious ideologies in the Middle and 'nationalism' and political positions in Europe, Russia, China, and the United States.

7 ***Perceived predictability of wars and their properties***
Since 1989, wars are perceived as increasingly unpredictable, consistent with the chaotic nature of non-systemic war dynamics.

8 ***The willingness of states to get involved in non-systemic wars***
States seem to have become more reluctant to get involved in wars. This effect can be attributed to a high-connectivity regime of the current order (see also point (4)) or the chaotic and intrinsically unpredictable nature of non-systemic wars.

9 ***The level of representativeness of the current order***
The current global order is the outcome of the fourth systemic war (the Second World War, 1939-1945) that constituted a dual phase transition.

International orders are a reflection of power positions of states in the System during the systemic wars that produced them. Following the Second World War (1939-1945), the United States, the Soviet Union (later Russia), China, Great Britain, and France assigned privileges to themselves to ensure that their interests – and the status quo of the international order they established - would be served. These privileges include permanent membership and veto-right in the Security Council of the United Nations, and a legal monopoly on the possession of nuclear weapons, formally laid down in the Treaty on the Non-Proliferation of Nuclear Weapons in 1970. This 'nuclear' privilege serves the power positions of the five states, and of the status quo (of the current order): by forbidding nuclear weapon possession for potential rival states, those states are unable to pose a serious threat to the structural stability of the international order.

The current order is, however, obsolete, and does not represent current power positions and the current hierarchy of influence in the System. Great Britain and France derive their positions from their privileges in the current System, not from their actual power and influence; on the other hand, other more powerful and influential states are not sufficiently represented in the current order. As a consequence, the current order is becoming increasingly dysfunctional and will be increasingly challenged by rising powers.

The obsolescence and dysfunctionality of the current order is also evident in the behavior of privileged Great Powers. For example, in 2003 the United States manipulated the United Nations and the Security Council to legalize its attack on Iraq, in 2014 Russia infringed on sovereign rights of the Ukraine, and China is challenging sovereign rights of other states in the South China Sea. These actions undermine the current order from which these actors have most to gain - and lose.

The (temporary) structural stability, but also (the seed of) the collapse of international orders in anarchistic systems, both lie in the rules and institutions these orders are based on; it is as a consequence of the increasing connectivity of the System and rivalries between Great Powers, however just a matter of time before international orders collapse under their own contradictions.

6 Further quantitative analysis of the first global order (1945-...)

6.1 Introduction

In this chapter I discuss four observations concerning the properties and development of the first global order (1945-...).

6.2 The System produced fundamentally different non-systemic war dynamics before and after 1989.

The war dynamics during the period 1945-1989, denoted as the 'second exceptional period,' and during the period that followed differ fundamentally.

Properties of non-systemic war dynamics (1945-2016): Two distinct periods (Based on the assumption that two periods can be identified)				
		1945-1989 (Exceptional period)	1989-2016 (Chaotic)	1945-2016
1	Number of wars (n)	9	11	20
2	Duration of period	46	27	71
3	War frequency	0.20	0.41	0.28
4	Average war size	0.24	0.39	0.32

Table 112 *This table shows some quantitative properties of the second exceptional period (1945-1989), the period that followed (1989-2016), and of the full period (1945-2016).*

This analysis confirms the fundamental differences in the nature of the war dynamics during the second exceptional period and the period that followed. During the exceptional period, the war frequency was significant lower as was average war size.

Contrary to the periodic war dynamics during the first exceptional period (1657-1763) the abnormal non-systemic war dynamics during the second exceptional period were much more subdued, for fear of escalation and self-destruction. The only exception was the Korean War (War 115, 1950-1953) the first non-systemic war following the fourth systemic war (the Second World War, 1939-1945). Some historians argue that the year 1953 marks a significant escalation in the rivalries between the superpowers of the United States and the Soviet Union.

If 1953 is the start year of the second exceptional period, the conclusion that the first global order experienced two fundamentally different types of non-systemic war dynamics is even more convincing. This implies that the nature of non-systemic war dynamics during the first global order were as shown in the table below.

The nature of non-systemic war dynamics during the first global order (after 1945.)				
	Period	Nature of war dynamics	Degrees of freedom (n)	Remarks
1	1945-1953	Chaotic	$n > 2$	Cannot be proven. The only non-systemic war during this period was the Korean War; its ending marked the start of the intensification of the US-SU rivalry.
2	1953-1989	Non-chaotic	$n = 2$	The System produced seven wars during this subdued and ossified period.
3	After 1989	Chaotic	$n > 2$	The System produced nine wars of varying sizes and intensities/severities.

Table 113 *The nature of non-systemic war dynamics during three distict periods during the first global order (1945-...).*

It is now possible to make adjustments to table 111 (*Properties of fundamentally different war dynamics (1945-2016), based on the assumption that **two** periods can be identified*), assuming the first global order can be divided in three different periods.

Properties of non-systemic war dynamics (1945-2016): Three distinct periods (Based on the assumption that three periods can be identified)					
		1945-1953 (Chaotic)	1953-1989 (Exceptional period)	1989-2016 (Chaotic)	1945-2016
1	Number of wars (n)	1	8	11	20
2	Duration of period	8	36	27	71
3	War frequency	0.125	0.22	0.41	0.28
4	Average war size	0.67	0.19	0.39	0.32

Table 114 *This table shows the division of the first global order into three distinctive periods, and their respective properties.*

In the figures below, I show the trajectory in phase state (sizes and intensities) of non-systemic wars. During the second exceptional period (1953-1989) it is not possible to identify orbits in the trajectories. The fact that, since 1495, the System never otherwise experienced such an extended series of non-systemic wars only involving one Great Power (also) confirms that the period 1953-1989 indeed was exceptional.

From 1989 onwards, it is possible to identify circular-like trajectories in phase state; I attribute these orbits to the chaotic nature of non-systemic war dynamics. Obviously Great Powers became less constrained in engaging in war, because the risk of self-destruction was significantly reduced.

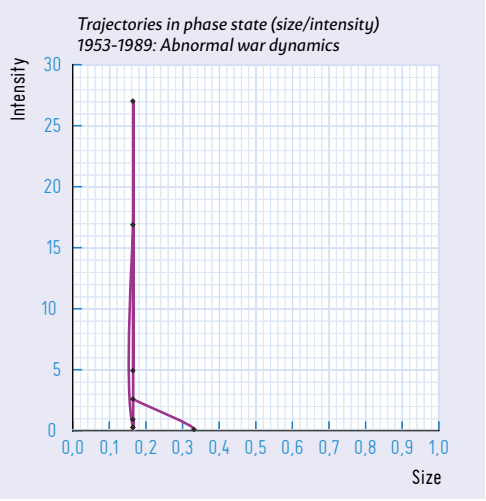

Figure 141

This figure depicts the trajectories in phase state of non-systemic Wars 116-123 during the second exceptional period (1953-1989): x-axis: size, y-axis: intensity. The sizes of these wars are very subdued (except for war 117 (Sinai War, 1956), only one Great Power was involved), and typically occurred outside of Europe (except for war nr. 116 the Russo-Hungarian War, 1956-1956).

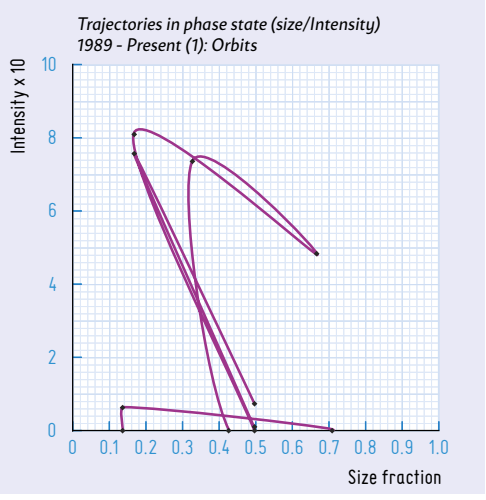

Figure 142

This figure depicts the trajectories in phase state of non-systemic Wars 124-134 from 1989 to the present (2016). The size of these wars is now more variable: the trajectories in phase state point to the chaotic nature of these war dynamics.

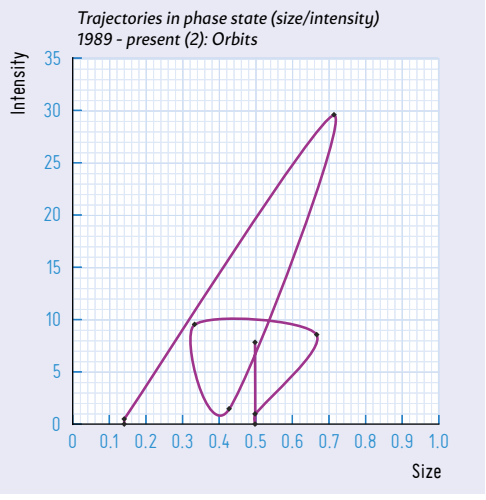

Figure 143

This figure depicts the trajectories in phase state of non-systemic Wars 124-134 from 1989 to the present (2016), however in this figure the First and Second Chechnya War respectively during 1994-1996 and 1999-2003 are excluded and the orbits (circular trajectories) are more pronounced. The question is if these two wars qualify as interstate wars. Exclusion of these two wars from the analysis does not impact on the assessment and predictions.

6.3 The non-systemic war frequency of the current order suggests that the System is in its first relatively stable period of a second finite-time singularity.

I observed that Great Power status dynamics have resumed during the first global order (begun in 1945) after coming to a halt during the fourth international order (1918-1939) that preceded the dual phase transition caused by the fourth systemic war (the Second World War, 1939-1945). Consistent with the previous observation, I also found that not only is the organizational stability of the System's status hierarchy no longer absolute/infinite, but also its physical organization, since state borders again are contested in certain regions in the cyrrent order.

These properties, and the fact that the current order's robustness is not absolute, suggest that the System will not produce a phase transition during the next critical period to meet the demands of the second law of thermodynamics. These indicators suggest that the global System can still produce upgraded orders within the current anarchistic system, without implementing dedicated hierarchies; there still are opportunities for upgrading orders in an anarchistic context.

The war frequency during successive international orders of the first finite-time singularity dynamic (1495-1945) decreased linearly; the war frequency of the current chaotic period (1989-present) is 0,41 and approximates the war frequency – 0,37 - of the first international order (1495-1618) of the first finite-time singularity dynamic (1495-1945). This similarity suggests that the current global order is part of the first cycle of a second finite-time singularity that is now unfolding on a global scale.

Further analysis (concerning the (expected) life span of the first global order (1945-2020) shows that the second finite-time singularity dynamic will also be accompanied by four accelerating cycles (1945-2187).

Properties of international orders (1495-...)			
International order	Period	War frequency	Average size
1	1495-1618	**0.37**	0.39
2	1648-1792	0.24	0.39
3	1815-1914	0.17	0.31
4	1918-1939	0.05	0.71
5 (First global order)	1945-2016	0.28	0.32
Suborder 5a	1945-1953	0.13	0.67
Suborder 5b	1953-1989	0.22	0.19
Suborder 5c	1989-2016	**0.41**	0.39

Table 115 *This table shows the war frequencies and average sizes of non-systemic wars during the five international orders. I have subdivided the first global order into three suborders:*

a chaotic order from 1945-1953 (suborder 5a), a non-chaotic order from 1953-1989 (the second exceptional period, suborder 5b), and a chaotic order that started in 1989 after the collapse of the Eastern hierarchy (suborder 5c).

6.4 Analysis of war data suggests that the current order reached the tipping point in 2011, and now is in its high-connectivity regime

With the help of the complemented war data it is possible to determine if a tipping point can be identified in the non-systemic war dynamics of the current global order; to determine if a tipping point exists I used the size of non-systemic wars and how the size developed over time, as an indicator.

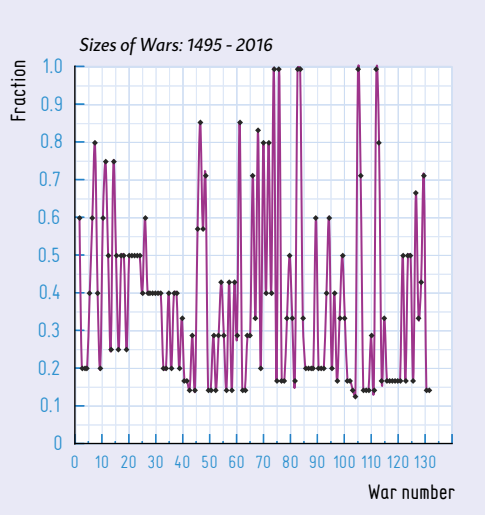

Figure 144
This figure shows the size of successive wars the System produced during the period 1495-present (2016); size is defined as the number of Great Powers involved in wars divided by the total number of Great Powers in the System. The x-axis numbers refer to war numbers. Data from Levy (38) and extended data set.

In the figure below, I show the moving average of five successive wars for the same data. This gives a clearer picture of the size development of non-systemic wars in the System.

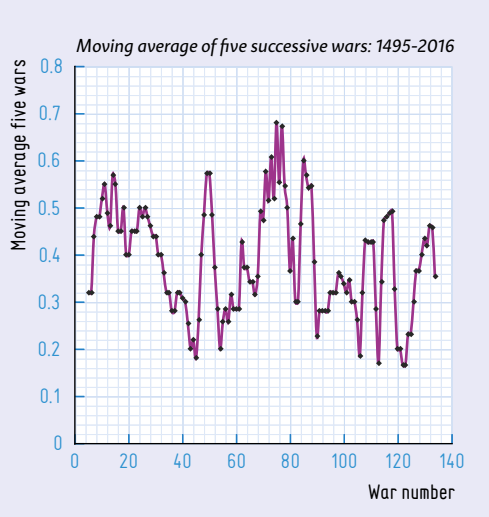

Figure 145
This figure shows the moving average sizes (in terms of fraction) of groups of five successive wars in the System (1495-2016). Data from Levy (38) and extended data set.

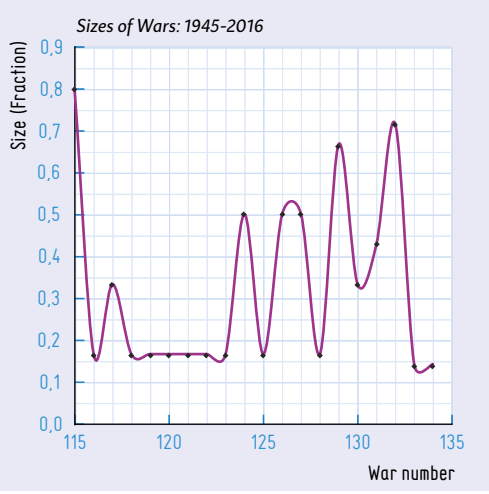

Figure 146
This figure shows the sizes (in terms of fraction) of successive non-systemic wars (nr's 115-134) during the period 1945-2016. Data from Levy (38) and extended data set.

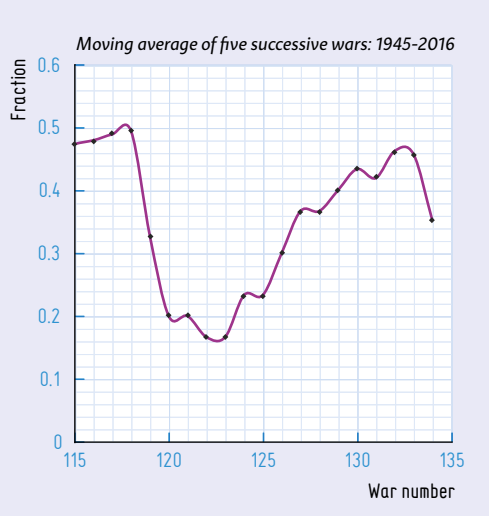

Figure 147
This figure depicts the moving average size (based on five wars, in terms of fraction) during the first global order (1945-present, war nr's. 115-134). The maximum found in numbers 1-4 is related to the sizes of the Second World War and the Korean War, a lag effect typical for moving averages. Data from Levy (38) and extended data set.

This analysis suggests that the year 2011 – 'The War for Syria' – constitutes the tipping point of the current order, an assumption that must be confirmed by the size of the next non-systemic war(s). If this is the case, it implies that the System indeed is (since 2011) in the high-connectivity regime of the current order; consistent with a number of indicators (EWS) in the contingent domain, as discussed. However, this could turn out to be a premature conclusion: Validation of the dataset is required.

Typically, during high-connectivity regimes states become increasingly stable because of their high and increasing connectivity within the network of states and issues. In the contingent domain, this means that Great Powers become increasingly reluctant to engage in new wars. As explained in this study, during high connectivity regimes the buildup of free energy accelerates, but instead of being released, it crystallizes into underlying, and eventually percolating, vulnerable issue clusters.

6.5 The System will become critical around 2020 and produce a systemic war to ensure that it meets the demands of the second law of thermodynamics

Assuming that 2011 indeed is the tipping point of the current relatively stable period, and assuming that the moving average will further decrease, it is possible to estimate when the current order will become critical.

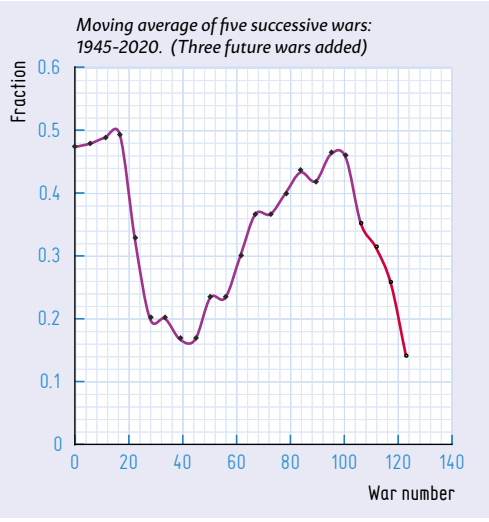

Figure 148
This figure shows the moving average size (in terms of fraction) of non-systemic wars (based on five wars) if three future wars occur involving one Great Power. Data from Levy (38) and extended data set (nr's 115-134).

The figure above shows the moving average of war size when three hypothetical future non-systemic wars in which only one Great Power participates are added to the data set. This simulation is based on the assumption that the current order is in its high-connectivity regime, and is unable to produce non-systemic wars of a significant size.

This 'experiment' suggests that the System needs one to three non-systemic wars involving one (or two analysis shows) Great Powers to push the moving average to the same level as when the System became critical during the first finite-time singularity dynamic (1495-1945).

In the case of *one* additional non-systemic war involving one or two Great Powers, the moving average will (about) reach the critical fraction (of the moving average of the System) before the outbreak of the second systemic war (the French Revolutionary and Napoleonic Wars, 1792-1815). In the case of *two to three* additional non-systemic wars, the System will reach the critical fractions of the moving average before the outbreak of the first, third, and fourth systemic wars.

In the figure below I have added three still fictional systemic wars (135-137) involving only one Great Power.

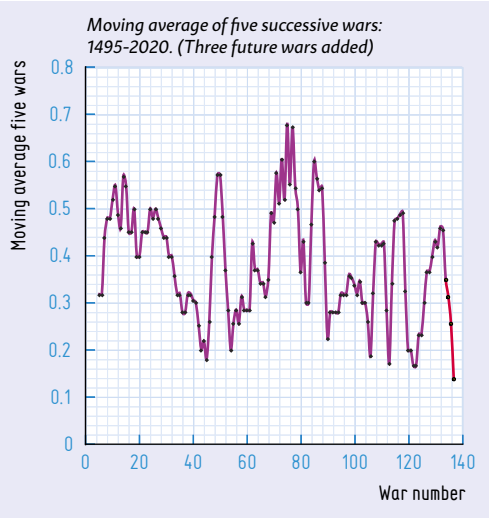

Figure 149
In this figure, three (still hypothetical) wars involving only a single Great Power are added to the dataset. The addition of these 'fictional' wars makes it possible to identify what number of wars is necessary to reach the critical fraction of the first global order of the second finite-time singularity dynamic. Data from Levy (38) and extended data set (nr's 115-134).

If these assumptions are correct, the next question is how long it would take the System to produce one to three non-systemic wars to reach the critical fraction of the first global order. This study shows that, although non-systemic wars are normally chaotic in nature, during successive relatively stable periods they developed (in some respects) very regularly.

With the help of the calculated war frequencies during the current order (see above table), and by ignoring the chaotic nature of the System, it is possible to speculate on how long it will take for the System to develop one to three non-systemic wars, and thus to become critical and produce a systemic war.

I distinguish between two scenarios; a scenario with a war frequency of 0.28 (the average of the first global order 1945-2016), including the second exceptional period (1953-1989), and a scenario with a war frequency of 0.41, concerning the chaotic period 1989-2016.

'Criticality analysis' of the first global (1945-...)			
War frequency	One additional war	Two additional wars	Three additional wars
0.28 (average 1945-2016)	3.6 years (2018)	7.2 years (2021)	10.8 years (2025)
0.41 (average 1989-2016)	2.4 years (2016)	4.8 years (2019)	7.2 years (2021)

Table 116 *In this table I show how many years it could take, depending on the war frequency of the current order, to produce one, two, or three additional wars. This is a speculative calculation. The years (in the table) refer to the year the war would be produced with a baseline at 2014, the last year the System produced a non-systemic war (number 134).*

I assume that the System requires 2-3 non-systemic wars to become critical and that probably the higher war frequency (0,41) of the period 1989-2016 is applicable to these three additional (still fictional) non-systemic wars. This implies that the System will become critical around 2020 (2019-2021) and will produce a systemic war to implement an upgraded order that will allow for a lower energy state of the System and ensure compliance with the second law of thermodynamics.

The size of the next non-systemic war will be indicative of the likelihood of this scenario. If it turns out that 2011 is not the tipping point, that implies that a systemic war will be produced at a later stage than suggested in this scenario.

7 Evaluation

7.1 Introduction

In this section, I evaluate the usability of the framework for assessing the current condition of the System and predicting its dynamics and development, as just applied and discussed. The following subjects will be discussed: (1) a number of factors and conditions that complicate assessment and prediction and (2) similarities and differences between the first (1495-1945) and second (beginning in 1945) finite-time singularities.

7.2 Complicating factors

A number of factors complicate the analysis of the war data and prediction of the next systemic war. These factors include:

1 ***The unknown impact of abnormal war dynamics during the second exceptional period (1953-1989)***

During the second relatively stable period (1648-1792) of the first finite-time singularity, the System temporarily produced abnormal non-systemic war dynamics from 1657 to 1763. I denoted this period as the first exceptional period.

During this period, the number of degrees of freedom of the System was reduced to two as a consequence of the intense rivalry between Great Britain and France. This led to the 'downgrading' of non-systemic war dynamics from chaotic and more constrained to period and more extreme war dynamics. I argue that these periodic war dynamics were suboptimal and caused a time-delay in the development of the second relatively stable period toward criticality (systemic war) and inefficiencies in the energy production and releases of the System.

During the first global order (beginning in 1945), an intense rivalry between the United States and the Soviet Union again produced an exceptional period from 1953 until 1989. Contrary to the abnormal war dynamics during the first exceptional period, these abnormal war dynamics were not more extreme or more regular than chaotic war dynamics, but were very small in size. The difference in types of abnormal war dynamics, both defined by two degrees of freedom, can be explained by the connectivity of issues that were at stake during the exceptional periods. In the case of the second exceptional period, issues were very tightly connected and destructive energy that was preventively deployed could cause self-destruction. During this exceptional period, the intense rivalry between two Great Powers led to the System's ossification. The energy state of the System was very high, but energy could not be released other than by a series of wars only involving one Great Power outside of the erstwhile core of the System (Europe). When the Eastern hierarchy collapsed in 1989, the System resumed its default chaotic war dynamics.

I calculate that the first exceptional period caused a delay of about 13 years in the development of the second cycle and in the unfolding of the first finite-

time singularity dynamic. A thirteen-year delay on a theoretical life span of the second cycle of 154 years is about eight percent, and arguably qualifies as relatively insignificant; above all, it shows how the System was able to recover very quickly from abnormal war dynamics: The System produced a percolating underlying vulnerable issue cluster necessary to achieve criticality only within 29 years (in 1792). The abnormal war dynamics during the first exceptional period probably also contributed to the formation of this underlying cluster.

The question now is if, and to what extent, the second exceptional period (1953-1989) also caused a delay in the development of the current global order toward criticality.

Because of the different response of the System to intense rivalries during the first and during the second exceptional periods, it is not clear if the delay caused by the first exceptional period predicts a delay caused by the second exceptional period. Did the ossification of the System have the same impact as hyper-excited dynamics during the period 1657-1763? Did the abnormal war dynamics during the second exceptional period have an impact at all?

Because I use the moving average as an indicator for whether – and when - the current order will become critical and produce a systemic war, this complication does not impact the prediction for the timing of the next systemic war. However, it means that the life span of the first global order must be used with reservations to calculate the life spans of the next cycles, assuming a second finite-time singularity consisting of more than one cycle unfolds, as I argued in previous paragraph.

2 ***The timing of a tipping point in the war dynamics of the first global order***

Based on the moving average of sizes of five successive non-systemic wars, it is possible to identify a tipping point, when an order changes from a low- to a high connectivity regime. At the tipping point, the increased local stability of states results in a decrease in the size of non-systemic wars and also in the buildup of underlying vulnerable issue clusters that will lead to criticality of the System. I identify 2011 as the tipping point of the current global order. Assuming the System will only produce small wars involving one or two Great Powers, the System will become critical and produce a systemic war around 2020. These conclusions could be premature: the moving average of the sizes of non-systemic wars during relatively stable periods does not always develop regularly; moreover, the supplementary dataset I made for 1975-present requires validation.

3 ***The duration of low- and high-connectivity regimes***

If 2011 is the tipping point of the current (first global) order, and the System becomes critical around 2020, this means that the current global order is able to produce percolating vulnerable issue clusters – to 'charge' iteslef – that will cause a global systemic war in about ten years. That seems to be relatively fast. However, issues related to the intense rivalry between the United States and the Soviet Union (and between states that formed the respective hierrachies

these two states controlled) that seemed to be settled through a number of 'agreements' following the second exceptional period (1953-1989, the Cold War), could re-emerge – as current developments suggest - and cause underlying vulnerable issue clusters to grow and percolate relatively fast(er). Probably renewed rivalries between Britain and France during the period 1763-1792, were 'reinforced' by 'unresolved' tensions during the first exceptional period (1657-1763), and also contributed to the 'fast' emergence of the second systemic war (the French Revolutionary and Napoleonic Wars, 1792-1815).

Life spans of low- and high-connectivity regimes of international orders of the first finite-time singularity (1495-1945) do not show any regularities, and do not provide any clues that are useful to estimate the life spans of the low- and high-connectivity regimes of the current global order.

4 ***The impact of fundamental transformations: From hierarchies to networks as optimal solutions to meet the demands of the second law of thermodynamics***

Although the System is still a state-system, a number of developments point to some fundamental changes that could be underway. These changes include: (1) the transformation of the System from a state-system with hierarchical organizational structures to a system consisting of a network of border-crossing communities. If such a transformation is actually taking place, the System can achieve lower energy states demanded by the second law of thermodynamics by crystallizing in network structures rather than by settling in hierarchical structures. (2) Fundamental changes in the nature of warfare from wars between states to wars between populations and communities. These two changes are closely related, interact, and are self-reinforcing. I assume change (1) and (2) are closely related.

The development of organizational structures in Europe shows, on one hand, that state-structures become obsolete when states reach a certain level of interdependence, and on the other hand, that top-down hierarchical structures are insufficient and ineffective in integrating the former European states, utilizing economies of scale and scope, and ensuring the balanced fulfillment of the basic requirements of all Europe's populations.

If such a fundamental change takes place, implying the dissolution of state structures and regional hierrachies at a global scale, and replacement of these structures by networks of communities, this could – I assume – (eventually) impact on the dynamics of the second finite-time singularity dynamic (1945-...) during its unfolding. The impact (also on predictions) – if there is any - cannot be determined at this stage.

5 ***The non-availability of a model to run scenarios and test relationships between variables and parameters***

Models of the System and its dynamics are not yet available. Models and simulations with these models (as has become common practice in climate change research), will be helpful in further analyzing and understanding the System's dynamics, and predict its behavior.

8 Constructing a (speculative) model of the second finite-time singularity dynamic

8.1 Introduction

Based on this study and the assessment discussed in this chapter, I assume that the current global System that emerged through a dual phase transition in 1945, meets the basic conditions to produce a second finite-time singularity dynamic. Population growth ensures an increase in connectivity and the production of free energy (tensions in the anarchistic System), and the demands of the second law of thermodynamics and other laws and deterministic principles of course still apply.

If a second finite-time singularity unfolds, it leads to the implementation of a number of upgraded orders and eventually to the implementation of a dedicated hierarchy or other organizational solution for the System to meet the demands of the second law of thermodynamics, but now at a global scale. This is the next and probably the final step in the long-term process of social integration and expansion (SIE), towards global integration.

It is possible to construct a hypothetical second finite-time singularity dynamic, based on the insights the dynamics and development of the System, the first finite-time singularity (1495-1945), provide us. I assume (regarding this theoretical model) that the second exceptional period (1953-1989) did not have a significant impact on the development of the first cycle, and the unfolding of the second finite-time singularity dynamic.

Further factors that are not taken into consideration, but probably impact on the dynamics and unfolding of the second finite-time singularity dynamic, are related to the initial conditions of both singularity dynamics, that differ fundamentally. These differences include differences between: (1) the structure of the System in 1495 consisting of a collection of loosely connected diverse units without any significant collective organization versus the structure of the System in 1945 consisting of states that are organized in a clearly defined anarchistic order, (2) the level of interdependence between units/states of the first international order of the first and second finite-time singularity dynamics, (3) the level of empowerment of individuals and communities in the System, and (4) the pace of life of the System during the first cycle) of the first (start 1495 and second (start 1945) finite-time singularity dynamics. Further research is required to determine if and how these differences impact on the unfolding of the second finite-time singularity dynamic. Each developmental stage of the unfolding second finite-time singularity dynamic – but also simulations with models of finite-time singularities – makes it possible to further fini-tune and gauge the second -finite-time singularity dynamic.

8.2 Determining the life spans of cycles

If the first global order indeed becomes critical around 2020, its lifespan is 75 years.

A crucial condition for this scenario to unfold is that population growth of states in the System continues to 'power' the development and unfolding of the second finite-time singularity dynamic). This seems not to be the case until 2185 (see table 119), or a decrease in population (growth) is compensated by an increase in life expectancies and demands for higher standards of living. population growth starts stagnating in the beginning of the 22nd century.

Assuming (1) the second finite-time singularity dynamic accelerates consistently with the same rate as the first, (2) systemic wars the System produces do not lead to collective self-destruction, and (3) finite-size effects do not impact the unfolding of the second finite-time singularity dynamic, the second finite-time singularity dynamic will reach its critical connectivity threshold (anarchistic end state) around 2185.

To make these speculative calculations, I made use of the theoretical model of the first finite-time singularity dynamic.

Ratio's and acceleration factors of the theoretical model of the first singularity dynamic

	Lifespan cycle	Acceleration factor of cycles
1	168	NA
2	153	0.91
3	102	0.67
4	22.5	0.22

Table 117 *This table shows the acceleration factors of successive cycles of the theoretical model of the first finite-time singularity dynamic, accompanied by four accelerating cycles.*

Timing of a (still) hypothetical second finite-time singularity dynamic (Based on certain properties of the 'theoretical' first finite-time singularity dynamic)

	Start	End	Life span (years)
First global order (rel.st. per.)	1945	2020	75
Fifth systemic war	2020	2036	17
Second global order (rel.st. per.)	2036	2104	68 (factor 0.91 applied)
Sixth systemic war	2104	2119	15 (factor 0.91 applied)
Third global order (rel.st. per.)	2119	2165	46 (factor 0.67 applied)
Seventh systemic war	2165	2175	10 (factor 0.67 applied)
Fourth global order (rel.st. per.)	2175	2185	10 (factor 0.22 applied)
Eighth systemic war	2185	2187	2 (factor 0.22 applied)

Table 118 *In this table I show the timing of successive global orders and critical periods of a (still) hypothetical second finite-time singularity dynamic (1945-2187). The life spans of successive global orders and systemic wars are calculated by applying the same acceleration factor to the second, third, and fourth cycle as I determined for the undisturbed theoretical version of the first finite-time singularity dynamic. The lifespan of the first systemic war produced by the second finite-time singularity dynamic (the fifth systemic war), I calculated by applying the same ratio as applies to lifespan of the first relatively stable period (138) and lifespan of the first systemic war (30) of the first cycle of the theoretical model of the first finite-time singularity dynamic (0.22).*

This model suggest that it will take 17 years (2020-2036) to design and implement the second global order. The model also suggests that the global anarchistic System will reach its critical connectivity threshold – the anarchistic end state – around 2185. I assume that at that point (through the eighth systemic war (2185-2187)), the System will produce a phase transition and implement a global non-anarchistic system: the second finite-time singularity is instrumental in implementing the next 'level' of social integration and expansion (SIE).

8.3 Determining the severities of cycles

It is also possible to speculate about the severity of the next systemic war. Analysis of the first finite-time singularity dynamic shows that there exists a consistent ratio between the total severity of non-systemic wars during relatively stable periods and the severity of the systemic wars that follow. I assume that the severity of a war is a measure for the destructive free energy that is deployed. This ratio is related to the robustness, or connectivity, of international orders. See the table below. However, as I explain in point (7) of this chapter, another 'start point' (other that the just mentioned ratio) could also be used to construct (and test) a model of the second finite-time singularity dynamic, leading to higher severities of systemic wars.

The total severity of non-systemic wars the first global order produced in the period 1945-present (Wars 115-134) is 1.091.088 battle-connected deaths of military personnel (Great Powers only). If the System must still produce three more systemic wars to become critical, and if these wars have the same average severities as the 20 preceding wars, the total severity of the first global order (the first relatively stable period of the first cycle of the second finite-time singularity dynamic) will be 1.254.751 battle-connected deaths of military personnel (Great Powers only).

Because both finite time singularity dynamics are accompanied by four accelerating cycles, (and the predicted war frequency of the relatively stable period of the first cycle of the second finite-time singularity dynamic, is 'close' to the actual war frequency of the relatively stable period of the first cycle of the first finite-time singularity dynamic), I assume the (more or less the same) release ratios will apply to the second finite-time singularity dynamic.

The ratio that applies to the first cycle is 0,65 (65% of the total energy will

be released during the systemic war); than 1.254.751 BCD (Great Powers only) is equivalent with 35%; 65 % (that is the energy released through the fifth systemic war (2020-2036)) is equivalent with 2.330.252 BCD (Great Powers only).

The severities of the severities of the 6-8 systemic wars, I calculated by applying the acceleration rate for severities of systemic wars (based on the first finite-time singularity dynamic (1495-1945).

Speculative calculation of the severity of systemic wars of the second finite-time singularity dynamic accompanied by four accelerating cycles (1945-2187)
(Severity = number of battle-connected deaths of military personnel, Great Powers only)

	Severity systemic war	Acceleration factor	Release ratio	War frequency
Cycle 1	1,971,000		0.65	0.37
Cycle 2	4,900,000	2.49	0.85	0.26
Cycle 3	8,100,000	1.65	0.93	0.17
Cycle 4	11,100,000	1.37	0.97	0.05
Cycle 5	2,330,252		0.65	0.33
Cycle 6	5,802,327	2.49	0.85	
Cycle 7	9,573,840	1.65	0.93	
Cycle 8	13,116,161	1.37	0.97	

Table 119 *This table shows the estimated severity of the systemic wars that will – the speculative model suggests – be produced by the second finite-time singularity dynamic accompanied by four accelerating cycles during the period 1945-2187. I have used the severity of successive systemic wars of the theoretical ('corrected') first finite-time singularity dynamic as a reference. I have calculated the severity of the fifth systemic war (2020-2036), by applying the release ratio to the estimated total severities of non-systemic wars during the relatively stable period of the first cycle (1945-2020). The severity of the sixth, seventh and eighth systemic war I have calculated by applying the acceleration rate (based on the theoretical model of the first finite-time singularity dynamic).*

8.4 Determining properties of cycles

In previous paragraphs I 'calculated' the life spans of the cycles of the second finite-time singularity dynamic, and the severities of systemic wars this singularity dynamic produces.

The regularities I identified in the dynamics and properties of the first finite-time singularity dynamic accompanied by four accelerating cycles (1495-1945), and the theoretical 'undistorted' - model I constructed, can also be used to determine the properties of the cycles of the second finite-time singularity dynamic.

In this paragraph I determine the properties of successive cycles, again based on a number of speculative assumptions. I assume:

1 The System produces 23 non-systemic wars during the first relatively stable period of the second finite-time singularity dynamic; this number is based on the assumption that the System reaches with 23 non-systemic wars the critical fraction of the first cycle and then becomes critical; this study suggests (assuming the data base is accurate) around this will happen around 2020.

2 I assume that the absolute number of non-systemic wars the second finite-time singularity dynamic produces during four cycles, decreases linearly from 23 during the relatively stable period (1945-2020) of the first cycle, to 1 non-systemic war during the relatively stable period (2175-2185) of the fourth cycle. The number is based on the assumption that the (global) anarchistic System reaches absolute robustness and its anarchistic end state at the end of the fourth relatively stable period (2175-2185).

3 I assume the decrease in the number of orbits also is linear (as is the case during the first finite-time singularity dynamic); I also assume the same ratio applies to the number of non-systemic wars and the number of orbits, as during the first finite-time singularity dynamic (1495-1945, respectively 0.20 - 0.18 - 0.19 average 0.19). This implies that the second relatively stable period would produce ≈ 4.4 - 2.0 - 1.5 - 0.2 orbits during respective relatively stable periods of the second finite-time singularity dynamic.

Properties of cycles of the second finite-time singularity dynamic (1945-2187)

	Life span Relatively stable periods	Non-systemic wars	War frequency	Orbits
1	75	23	0.31	4.4
2	68	15	0.22	2.0
3	46	8	0.17	1.5
4	10	1	0.10	0.2

Table 120 *This table shows the 'estimated' properties of cycles of the second finite-time singularity dynamic that will also be accompanied by four accelerating cycles (1945-2187).*

8.5 Identifying contingent dynamics that point to the condition and development of the current order

Dynamics of the deterministic domain are – must be – synchronized with - dynamics in the contingent domain; this is achieved through the security dilemma and interacting self-fulfilling prophecies.

In this section I discuss a number of contingent events that could occur leading up to or during the next systemic war (2020-2036). Whether these exact events will play out cannot be predicted; however, deterministic requirements must be met to ensure the compliance of these events with demands of the second law of thermodynamics.

In above paragraphs I made calculations to predict deterministic dynamics and properties of the System's dynamics from a top-down deterministic perspective. These calculations predict that the System will become critical and produce a systemic war around 2020. The deployment of destructive energy during this systemic war will cause about 2.3 million battle-connected deaths of military personnel (Great Powers only); the war will last about 16 years. To become critical, the System still must produce one to three non-systemic wars involving one or two Great Powers during the period 2016-2022. These deterministic properties define the latitude – the playing field - for contingent dynamics.

Based on a preliminary and superficial analysis of current dynamics, which are chaotic and unpredictable in nature, a number of the following contingent developments could play out during the next systemic war. These events can be derived from vulnerable issue clusters that are now crystallizing in the System through interacting self-fulfilling prophecies of states, populations, and communities:

1 ***In the Middle East***
Escalation of conflicts; further collapse and fragmentation; direct confrontation (as opposed to confrontation through proxies) between Iran and Saudi Arabia; establishment of an enlarged sphere of political influence by Turkey; direct confrontations between the United States and Russia; direct involvement of Israel.

2 ***In Eastern Europe***
Re-establishment of a sphere of influence in Eastern Europe by Russia, implying a pushback of Western influences and NATO; escalation of the war between Russia and Ukraine; direct confrontation between Russia and other European States; direct involvement of NATO and the United States; direct confrontation between Russia and the United States; exposure and enlargement of political divisions in Europe; fragmentation of the European Union; a new approach to the integration of Europe based on network structures.

3 ***Far East***
Enlargement of China's sphere of influence, including the South China Sea; China's goal to re-establish political control over Taiwan; escalation of resentments and rivalries between China and Japan; confrontation between North and South Korea; direct confrontation between China and the United States.

4 ***Central Asia***
Direct confrontation between Pakistan and India.

5 ***Africa***
Further escalation of various rivalries in Africa leading to further fragmentation.

6 ***Global communities***
Radical groups making use of the lack of order in the System in efforts to promote their radical ideas and enhance control over populations; reduced coverage and functionality of the Internet, and reduced global mobility hampering radical groups' abilities to mobilize and direct terrorists in other states.

7 ***Europe and the United States***
Manifestation of terrorist threats 'from within' that are inspired by radical global communities; imposition of strict controls over populations by states in response to threats that undermine the legitimacy of governments.

8 ***Use of nuclear weapons***
Reluctance of established Great Powers in possession of nuclear weapons (the United States, Russia, China, Great Britain, and France) to use these weapons directly against each other to avoid further escalation (and retaliation); escalation of regional rivalries between Pakistan and India, North and South Korea, and Israel and Middle Eastern states, result in the employment of nuclear weapons.

9 ***Hybrid warfare***
Wars will be hybrid, involving not only armies that represent states, but also populations and ad hoc coalitions of empowered individuals and communities. The totality of war will reach a new level.

These and other events could occur. However, 'whatever happens', the contingent dynamics during the next systemic war must meet the demands of the second law of thermodynamics; this also is the case for the upgraded second global order that will be designed and implemented through the fifth systemic war.

8.6 Identifying properties and the direction of development of next global orders

Based on the deterministic nature of the dynamics and certain properties of the System, it is possible to determine some key properties of the next orders that will be implemented through systemic wars. These successive orders each allow for a lower energy state of the System than their predecessors, as is demanded by the second law of thermodynamics.

Ultimately, assuming the second finite-time singularity dynamic can unfold until its critical connectivity threshold is reached, the System will be forced by the second law of thermodynamics to make a transition to a non-anarchistic global order, according to speculative calculations made in the previous paragraph this would be around the year 2185.

The System still awaits a long-term process of development involving a series of systemic wars at an accelerating pace. Furthermore, the integrative structures that will ultimately emerge will not resemble a government, as

we define it now. The non-anarchistic global order that ultimately will be implemented will resemble a network of communities and facilities at different scales of the System, will function on the basis of shared values and norms, and will be optimized to utilize parallel decentralized processing capabilities, similar to immune systems, and other aspects of life forms.

The second global order (potentially beginning around 2025) will have the following properties, I assume:

1 The second global order will be more stable and robust, but also more fragile than the preceding first global order (1945-2020). Its life span will be shorter than the life span of the first order (75 years (2020- 1945)). Its war frequency will be lower.

2 The second global order will include a number of regional orders that are integral parts of the global order, to meet the demands of the second law of thermodynamics and allow a lower energy state of the System. Regional dedicated hierarchies could, for example, be imposed in the Middle and Far East; it can also be expected that the order in Europe (the current European Union) will be upgraded.

3 The second global order will also include networks of global and regional communities that transcend the more formal orders referred to in (1) and (2), and that contribute to a lower energy state of the new order.

4 The second order is a next step in a longer-term SIE process. The System cannot establish a non-anarchistic order at a global level through a single systemic war; that is what calculations with deterministic properties of the System show. The fifth systemic war will be the first in a series that constitutes a second finite-time singularity dynamic that will also be accompanied by a number of accelerating cycles.

5 The second global order and global orders that follow, will increasingly reflect that (the concept of) national defense through states is becoming obsolete. This is the case for two reasons in particular: (1) the fact that states (given their function and organization) are to a high degree 'responsible' for the free energy they (unavoidably) produce in anarchistic systems, and – as this study shows – the second law of thermodynamics wants to reduce, and because of (2) the ('global') range of destructive energy that can be deployed by states (for example through aircraft, and missiles, see also Boulding (15) and the now global range of destructive energy that can be deployed by empowered individuals and communities that leverage the Internet, social media and global mobility. States and their governments derive their legitimacy from their ability to contribute to the fulfillment of basic requirements of their populations, including their security. States however have become increasingly vulnerable; this undermines their utility and legitimacy. This

vulnerability of states and their governments is purposefully targeted by radical communities, and will be further magnified by the inability of states to respond proportionally to these threats.

8.7 Comparison of both finite-time singularity dynamics

If this hypothetical scenario unfolds, it will mean that the (global) anarchistic System will reach the critical connectivity threshold in 2185 and produce a phase transition. This phase transition would result in the implementation of a global non-anarchistic structure, the ultimate level of social integration and expansion that can be achieved by the System.

Properties of the first and (hypothetical) second finite-time singularities		
	First finite-time singularity	Second finite-time singularity (hypothetical)
Life span	450 years (1945-1495)	242 years (2187-1945)
Number of cycles	4	4
Ultimate outcome	Simultaneous implementation of dedicated hierarchies in Europe and a first order with a global scale	Implementation of a non-anarchistic structure at a global scale

Table 121 *This table shows the basic properties of the first and (hypothetical) second finite-time singularities. Other scenarios*

The scenario I discuss in this chapter is based on the assumption that the ratio between the sum of severities of non-systemic wars during relatively stable periods (international orders) and severities of systemic wars, during the first finite-time singularity dynamic which was accompanied by four accelerating cycles 1495-1945, can be used to predict the severity of the next (fifth) systemic war. The ratios developed very regularly, during the first finite-time singularity dynamic, as shown and explained in this study.

Application of this ratio predicts a severity of the next systemic war (2020-2036) of 2,330,252 BCD (Great Powers only).

During the first finite-time singularity dynamic the severities of successive systemic wars exactly 'obeyed' above mentioned ratios. However, regarding the severities of the first four systemic wars, I also identified another regularity, that can be used as a start point to construct a model of the second finite-time singularity dynamic: In all four cases, the total severities of wars (non-systemic and systemic) during the four successive cycles the first singularity dynamic produced, were a more or less similar proportion - on average 2.43 percent - of the population size of the core of the System (Europe). In fact, an oscillating dynamic can be observed.

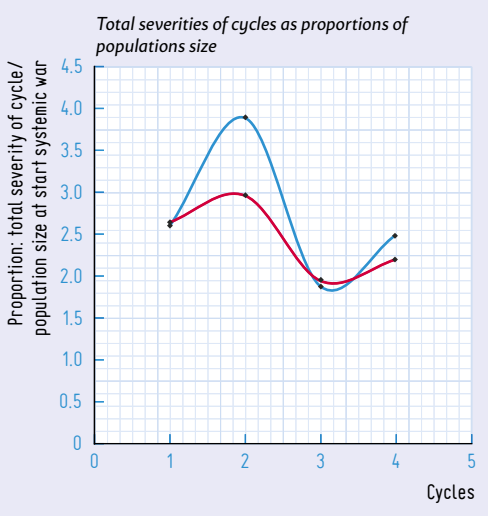

Figure 150
This figure shows the total severities of successive cycles of the first finite-time singularity dynamic (1495-1945) as a proportion of the population size of the System (Europe) at the start of the four systemic wars (that define the cycles. The average of the theoretical (corrected) model is 2.43 percent.
Actual finite-time singularity in blue, theoretical finite-time singularity in red.

If the proportion (percentage of the size of the global population) is used as a start point for the construction of the second finite-time singularity dynamic, the total severities of the four cycles the System will produce, will be significantly higher. For example, 2.43 percent of 7.7 billion (global population size in 2020) is 18.7 million BCD (great Powers only), during the first cycle.

Either way, this inconsistency (when the first finite-time singularity dynamic is used as a reference) suggests, that there (probably) was a 'reset' of parameters, the moment the System 'globalized' by means of the fourth systemic war (1939-1945, the Second World War).

The actual timing and severity of the next systemic war makes it possible to calibrate the model of the second finite-time singularity dynamic.

9 Related statements

In this chapter I discuss a number of statements that are closely related to the assessment and prediction of the dynamics and development of the System (1945-...).

350 A number of regularities in the dynamics of the System can be used as early warning signals (EWS); a distinction can be made between EWS in the deterministic and contingent domains of the System.

KEY WORDS *Singularity dynamic, EWS, Deterministic domain, Contingent domain, Contingent latitude.*

On the basis of the deterministic nature and properties of the finite-time singularity dynamic accompanied by four accelerating cycles (1495-1945), it is possible to identify a number of deterministic indicators that could be used as EWS for upcoming dynamics and developments. It is also possible to identify certain contingent indicators that are synchronized with, or are a contingent reflection of, deterministic properties of the System. The deterministic domain determines the latitude – playing field – of contingent dynamics in the System.

351 The size development of non-systemic chaotic wars since 1989 suggests that the first global order reached its tipping point in 2011 and is at present in its high-connectivity regime, when states become increasingly stable because of their increasing connectedness in the network of issues and states.

KEY WORDS *First global order, Fifth cycle, Tipping point, High-connectivity regime, Local stability, Second law of thermodynamics, 2020)*

During the period 1495-present, the System produced five relatively stable periods during which states and their populations could fulfill their basic requirements to ensure their survival; the first four relatively stable periods were each followed by a systemic war to ensure compliance with the second law of thermodynamics.

Cycles in the System, 1495-present				
Cycles of the first finite-time singularity dynamic (1495-1945)				
	Cycle	Life span order	Accompanying systemic war	Life span systemic war
1	1	1495-1618	First systemic war (Thirty Years' War)	1618-1648
2	2	1648-1792	Second systemic war (French Revolutionary and Napoleonic Wars)	1792-1815
3	3	1815-1914	Third systemic war (First World War)	1914-1918
4	4	1918-1939	Fourth systemic war (Second World War)	1939-1945
Cycles of the second finite-time singularity dynamic (1945-present)				
	Cycle	Life span order	Accompanying systemic war	Life span systemic war
5	1	1945-2022	Fifth systemic war (Third World War)	2020-2036

Table 122 *This table specifies the five cycles of the System; the timing of the fifth cycle is speculative.*

Analysis of war data since 1945 suggests that, during the relatively stable period that followed the fourth systemic war and dual phase transition (the Second World War, 1939-1945), three subperiods can be distinguished: (1) a chaotic period (1945-1953), (2) an exceptional period (1953-1989) when war dynamics were subdued because of the intense rivalry between the United States and the Soviet Union, and (3) a chaotic period (1989-present) that started when the Eastern hierarchy collapsed (1989) and chaotic war dynamics resumed.

The sizes of non-systemic wars the System produced during the first global order (beginning in 1945) suggest that the order reached its tipping point in 2011; from that moment in time the order has been in its high-connectivity regime with increased local stability of states. This can be attributed to the high connectivity of states to issues in the network and resulted in a decrease in the average size of non-systemic wars, despite tensions (free energy) being produced at an accelerating rate. Instead of being released, these tensions crystallize(d) in underlying vulnerable issue clusters that eventually percolate the System and cause it to become critical and produce a systemic war. This sequence of events is imposed on the System by the second law of thermodynamics, which determines when the System must adopt upgraded orders to allow for a lower energy state. Analysis suggest that the System becomes critical around 2020.

352 The timing, duration, and severity of the hypothetical fifth systemic war can be deduced from deterministic properties of the first finite-time singularity dynamic (1495-1945).

KEY WORDS *Criticality, Non-systemic wars, Fifth systemic war, Singularity dynamic, Properties.*

Typically, during high-connectivity regimes non-systemic wars come to a halt before producing a massive systemic energy release (systemic war). This study suggests that the moving average size of successive non-systemic wars is a reliable indicator for when the System will reach a critical fraction. The progression of the moving average of non-systemic wars during the current global order suggests that the System needs one to three more non-systemic wars involving one or two Great Powers to reach the critical point around 2020.

The war frequency of successive relatively stable periods during the first finite-time singularity dynamic decreased linearly to eventually reach a value near zero during the fourth relatively stable period (1918-1939) preceding its collapse (1939). If the war frequency of the current sub-period (1989-present, f = 0.41) and the start year (2014) of last non-systemic war (the Iranian Intervention in Iraq, number 134) are applied, the System should produce one to three non-systemic wars during the period 2016-2020. The System should become critical during this period and then produce a systemic war to ensure its compliance with the second law of thermodynamics.

If the predicted life span of the fifth relatively stable period (75 years, 1945-2022) is indicative of the life span of the systemic war that will follow, calculations based on the properties of the first finite-time singularity dynamic suggest that the duration of the next systemic war will be about 16 years. Similar assumptions and calculations suggest that the System will release destructive energy during the fifth systemic war causing about 2.3 million battle-connected deaths of military personnel of Great Powers.

353 A number of developments suggest that state-structures are no longer optimal solutions for populations to ensure fulfillment of their basic requirements.

KEY WORDS *Basic requirements, Populations, States, Optimal, Collapse, Empowerment, SIE.*

The following developments indicate that the state is challenged as the optimal solution for populations to ensure their collective survival:

1 ***Collapse of states***
States in the Middle East and Africa collapse because they lose legitimacy when they are not able to fulfill the basic requirements of their populations. It should be remembered that the 'state' is an European invention, and is the outcome of a long-term evolutionary process that interacted with specific European conditions.

2 ***Economies of scale and scope that can be leveraged in SIE***
When states in the System reach a certain level of interdependence they can no longer be maintained in an anarchistic System because of the tensions they produce; at that point, the second law of thermodynamics demands the imposition of dedicated hierarchies to achieve a lower energy state in the System. These hierarchies can be leveraged by former states and their populations to achieve economies of scale and scope that further enhance their abilities to fulfill basic requirements.

3 ***Empowerment enables more optimal forms of organization***
The empowerment of individuals and communities by the Internet, social media, and global mobility enables alternative structures organized into cross-border networks of communities. This alternative form of organization provides opportunities for the second law of thermodynamics to 'choose' networks instead of hierarchies to achieve lower energy states. Radical communities and individuals with global reach leverage networks to challenge the current order.

During the first finite-time singularity dynamic armies of states carved out state Fractal structures. The empowerment of individuals, communities and populations, the (as a consequence) more hybrid 'structure' of wars, will (increasingly) carve out a system consisting of these community-structures (a network of (nested) networks).

These and other forces influence the competition between SIE and fragmentation in the System.

354 The System has not experienced critical slowing down; its dynamics have accelerated instead.

KEY WORDS *Critical slowing down, Acceleration, Growth dynamic, Second law of thermodynamics.*

Research on the behavior of complex systems suggests that critical slowing down often precedes critical transitions, including phase transitions. Critical slowing down describes the phenomenon of systems becoming increasingly slow in recovering from small perturbations. Apart from the fact that wars are symptoms of the System's intrinsic dynamics and energy releases and are not perturbations of the System, the System has not shown critical slowing down; to the contrary, its dynamics accelerated towards a critical transition.

The anarchistic System does not belong to the category of systems that typically experience critical slowing down before producing a critical transition. I argue that there is a growth dynamic, and that the System must accelerate because of the increasing amounts of free energy produced by growing populations. The second law of thermodynamics does not tolerate high levels of free energy, and imposes upgraded orders on the System to allow for a lower energy state.

355 World population growth can power a second finite-time singularity dynamic at least until the first decennia of the 2[2n]d century.

KEY WORDS *Population growth, Second singularity dynamic, Critical connectivity threshold.*

Forecasts predict that the world population will continue growing until the early 22[nd] century. Population growth powered the first finite-time singularity dynamic (1495-1945), and also powers the second finite-time singularity that has been developing since 1945. Negative population growth could mean that the second finite-time singularity cannot sustain its development and unfolding until it reaches its critical connectivity threshold. However, the finite-time singularity dynamic is probably not only powered by population growth, but also by an increase in average life expectancy and by populations demanding higher standards of living. Further research is required to determine the contribution of these three components.

356 A number of conditions must be met for the System to produce a singularity dynamic. The current global System meets all requirements to produce the next finite-time singularity.

KEY WORDS *Second finite-time singularity dynamics, Conditions.*

The current global System meets all requirements to produce a second finite-time singularity dynamic accompanied by accelerating cycles. These conditions are: (1) population growth, (2) applicability of the second law of thermodynamics and other laws and deterministic mechanisms, (3) war decisions that qualify as binary decisions with externalities and thresholds, and (4) states that are connected in a network of binary switches.

357 The Western hierarchy that evolved in the European Union is now confronted with challenges similar to those that led to the collapse of the Eastern hierarchy (1989).

KEY WORDS *European Union, Challenges, Collapse, Fragmentation.*

The current first global international order (begun in 1945) and an upgraded order of two dedicated non-anarchistic hierarchies in Europe were established through a dual phase transition, in which the fourth systemic war (the Second World War, 1939-1945) was instrumental. The System produced the dual phase transition when in 1939 it reached the critical connectivity threshold (the singularity in finite time). These upgraded orders were required for the System to meet the demands of the second law of thermodynamics.

Initially, two dedicated non-anarchistic hierarchies were established in Europe: A Western hierarchy controlled by the United States and an Eastern hierarchy controlled by the Soviet Union. The two superpowers and their

respective hierarchies engaged in an intense rivalry that led to the second exceptional period (1953-1989); the second exceptional period was characterized by its subdued war dynamics.

The integrative structures of the Eastern hierarchy and the Soviet Union, however, struggled to fulfill the basic requirements of their populations and to maintain a viable internal balance. The threats to which the Eastern hierarchy and the Soviet Union had to respond led to ever-increasing demands on resources, and contributed to the Eastern hierarchy's eventual collapse and fragmentation (1989). External pressures and demands led to internal collapse and fragmentation; the Soviet Union's and Eastern hierarchy's integrative structures were – as explained – insufficient.

The fragmentation of the Eastern hierarchy and the Soviet Union led to a temporary disorientation in Russia (the core of both these collapsed structures), and to the absorption (integration) of a number of former members of the former Eastern hierarchy and the Soviet Union into what would crystallize as the European Union.

The roles now seem to be reversed. Whereas in the period 1945-1989 the Eastern hierarchy struggled and eventually collapsed because integrative requirements could not be met, the European Union is now confronted with similar challenges; its incomplete and unbalanced integrative structures are increasingly under pressure and must cope with (threats to) fragmentation of its structures.

358 The current international order has become increasingly dysfunctional and is no longer representative of actual power and influence positions.

KEY WORDS *Dysfunctionality, Fifth order, First global order, Inability to reorganize, Systemic war, Second law of thermodynamics.*

The current first global international order (begun in 1945) has become increasingly dysfunctional. The privileges that dominating Great Powers (the United States, the Soviet Union/Russia, China, Great Britain, and France) allocated to themselves do not reflect the actual power and influence positions of these states in the System anymore. Not only have Great Britain and France lost power and influence, and other non-privileged states (Iran and India for example) have gained power, but also the current arrangements of the first global order no longer seem to meet the requirements of the United States, Russia, and China. The three states that formally benefit the most from the current arrangements also increasingly challenge the current order and undermine its legitimacy: The United States purposefully misguided the United Nations to legitimize its attack on Iraq in 2003 by providing unsubstantiated proof of Iraq's imminent threat to international peace and stability; China willfully challenges legal arrangements that underpin the current international order to expand its influence in the South China Sea;

Russia infringed on the sovereignty of the Ukraine to expand its influence and to reestablish its position in the Great Power status hierarchy of the System.

As was the case for preceding orders, the current order lacks arrangements to reorganize itself and realign actual positions of power and influence with privileges that are allocated to states. This structural shortcoming is somewhat by design: International orders are designed to maintain the status quo to provide structural stability, and preserve the priviliges of dominant states that decided on the order's arrangements. As long as an order is established within an anarchistic System, states lack sufficient trust of other states to peacefully reorganize and upgrade the existing order with means other than war. The moment reorganization becomes necessary to avoid further buildup of tensions and the System becoming critical, the level of trust between states further deteriorates: negotiation (no longer) is an option.

These developments and mechanisms cause the System to become critical and produce a systemic war (in 2020 this study suggests) to implement an upgraded order that enables a lower energy state, consistent with the demands of the second law of thermodynamics. Interacting self-fulfilling prophecies ensure that the deterministic and contingent domains are synchronized.

359 Rules of international orders in the System are based on a 'snapshot' of the power and influence positions of states in the System and can only be optimal for a certain period of time.

KEY WORDS *States, International order, Rules, Dominant states, Privileges, dysfunctionality, Collapse.*

International orders become increasingly dysfunctional. Dysfunctional international orders in the contingent domain have equivalents in the underlying deterministic domain of the System. At a certain point, privileges that certain states enjoy do not reflect actual power and influence positions of states in the System any longer.

Dysfunctional orders – and accompanying dynamics – have their 'equivalents' in the deterministic domain. Dysfunctional orders are contingent representations of unbalanced networks in the deterministic domain.

In the deterministic domain, nodes in a network represent states in the System. Nodes (as well as states) differ from each other in some fundamental respects: nodes produce different amounts of free energy and make different contributions to the overall structural stability of the network. The free energy potential of nodes and their structural stability contribution are two sides of the same coin and are functions of their centrality and connectedness in the network.

The network of nodes performs a function. The network must ensure a balance between shared and conflicting requirements of nodes: nodes are dependent on each other for the input of energy (the fulfillment of their basic requirements), but dependencies also create security issues. During

the unfolding of the finite-time singularity dynamic (1495-1945), these contradictory dynamics intensified and led to the production of ever-increasing, and ultimately infinite, amounts of free energy.

Nodes in the network – states in the System – interact on the basis of a number of rules. These rules are embedded in international orders and are the outcome of preceding systemic wars in the contingent domain of the System. To ensure the optimal balanced functioning of international orders these rules must necessarily take into account the different centrality (power positions) of states, that is, their contributions to the overall network's functioning; this means that the rules of the System contain privileges for dominant states. Because of differentiated development of nodes (differentiated growth of states) and the continuously increasing connectivity of the network, rules that apply to the interactions between nodes of the network eventually do not reflect the actual centrality of nodes and undermine the System's functionality. Increasingly obsolete rules and unfounded privileges of certain states contribute to the production of free energy.

Rules that apply to interactions between nodes in the network are only based on a snapshot of the centrality of these nodes during a relatively short critical period (systemic war).

360 Effective conflict prevention and control require us to focus on the deterministic domain of the System.

KEY WORDS *Deterministic domain, Contingent domain, Contingent latitude, Control, Prevention, Top-down and bottom-up perspective, Synchronization.*

Deterministic dynamics determine the latitude and the playing field of contingent dynamics in the System; interacting self-fulfilling prophecies synchronize contingent and deterministic dynamics. Effective conflict prevention and control require us to focus on the development of deterministic dynamics and properties of the System, and to complement these insights with analysis of contingent dynamics. An effective control system requires combining and integrating a top-down deterministic perspective and a bottom-up contingent perspective. The contingent perspective must focus on the crystallization, connectivity, and growth of underlying vulnerable issue clusters and accompanying tensions, and on how interacting self-fulfilling prophecies synchronize the deterministic and contingent domains.

361 The next systemic war will not constitute a phase transition.

KEY WORDS *Systemic war, Phase transition, Robustness, Fragility.*

The properties of the current first global order (begun in 1945) show that the next systemic war will not constitute a phase transition. The current order is not infinite robust and the System can still release tensions through non-sys-

temic wars; the current order also is not infinite fragile. As explained, robustness and fragility are two sides of the same coin and infinite robustness and infinite fragility go hand in hand, and cause the anarchistic System to collapse.

These properties indicate that the System is not within reach of its critical connectivity threshold, and still can implement upgraded orders with improved robustness and structural stability, before eventually – at a later stage (in 2185, this study suggests) – collapsing

362 Empowerment of individuals and communities enables alternative organizational solutions to meet the demands of the second law of thermodynamics.

KEY WORDS *Empowerment, Communities, Second law of thermodynamics, Free energy.*

Empowerment of individuals and communities refers to the ability of individuals and communities to organize themselves in network structures that lack central control, but that coordinate and integrate their interactions and activities through shared values and norms. These networks are better able to adjust to local conditions and events and leverage 'local' economies of scale and scope (synergies). Effective networks strike an optimal balance between shared requirements and local initiatives. Empowerment is enabled through the Internet, social media, communication technology, and global mobility.

I assume that these networks have superior performance compared to traditional hierarchical organizations (where, hierarchy is defined as central authority and not as integrated clusters (see also: (58)), and can evolve more flexibly, avoiding the buildup of tensions and jerky energy releases. If these assumptions are correct, it can be expected that the second law of thermodynamics – demanding lower energy-states for upgraded orders – will force the System to adopt orders that increasingly resemble networks.

363 Sub-optimality of state-structures, increasingly hybrid forms of warfare and the blurring of differences between internal and external security of states, point to the development of the global System towards a networks of communities.

KEY WORDS *System, Second law of thermodynamics, States, Security, Suboptimal, Networks, Communities, Hybrid warfare.*

State organizations are the product of the first-finite-time singularity dynamic accompanied by four accelerating cycles (1495-1945). During the development and unfolding of the first finite-time singularity dynamic accompanied by four accelerating cycles, a multitude ('hundreds') of divers and loosely connected units in Europe (in 1495), developed into a highly integrated anarchistic System with fractal structures consisting of 25-30 highly standardized states (in 1939). I argue that (four) systemic wars during the 1495-1945 period – that

were integral parts of the first finite-time singularity dynamic – carved out this System with fractal (state) structures.

This process of integration (in Europe, the core of the anarchistic System), was accompanied by a simultaneous process of expansion of European states to non-core territories, that led to the implementation of state structures outside of the core. Over time (1495-1945) the state became the 'standard', and only 'legally' accepted structure in the System.

The state is a highly optimized structure, especially designed to meet the anarchistic and hostile conditions in Europe during the unfolding of the first finite-time singularity dynamic (1495-1945). States and anarchy are closely related, and coevolved.

However, following the dual phase transition (1939-1945, through the fourth systemic war, the Second World War), state-structures are increasingly challenged: In Europe, where state structures hinder the development and exploitation of economies of scope and scale (and efforts are underway to 'impose' a 'superstate'); but also in the Middle-East, Africa, and in Europe, where states 'collapse' (or regions seek autonomy), because the state is not (or less) effective in ensuring the fulfillment of basic requirements of their populations.

At the same time as the state becomes less effective, a trend towards increasing empowerment (also enabled by the Internet) of individuals and communities can be observed. Because of the empowerment of communities and individuals, warfare is increasingly 'hybrid' and involve not only states, but also 'populations', communities and individuals ('non-state-actors).

I assume, that the anarchistic System through the second finite-time singularity dynamic, which will also be accompanied by four accelerating cycles and will reach the critical connectivity threshold around 2185 (this study suggests), will step-by-step – 'systemic war by systemic war' – implement networks of communities, to ensure compliance of the global System with the demands of the second law of thermodynamics. States will become increasingly obsolete, and will increasingly hinder the (optimization of the) fulfillment of basic requirements by populations – and communities – in the anarchistic System. Networks of communities – networks of networks – can best balance 'local' (and community) requirements with (global) opportunities for economies of scale and scope.

I assume that the current struggles of the state to reach the next level of SIE, numerous state-collapses, the development of hybrid forms of warfare, and the blurring of differences between internal and external security of states/populations, are indicative for a trend towards (global) networks of communities. Hybrid wars, will carve out hybrid structures.

364 The ultimate phase transition of the second finite-time singularity dynamic will result in a non-anarchistic order at a global scale.

KEY WORDS *Second singularity dynamic, Critical connectivity threshold, Phase transition, Second law of thermodynamics, Non-anarchistic structures, Network of communities.*

The current conditions of the System (1945-...) will also allow the first global order to become critical, produce a systemic war, and implement an upgraded order to ensure compliance with the second law of thermodynamics. World population growth, in combination with extended life expectancy and higher standards of living, suggest that a second finite-time singularity dynamic (begun in 1945) can be sustained at least until the early 22nd century.

The direction of development of the second finite-time singularity is similar to the direction of development of the first singularity dynamic (1495-1945) towards 'higher' levels of order and integration.

The second law of thermodynamics will impose upgraded orders on the System through successive systemic wars that produce increasing amounts of tensions as a consequence of the intrinsic incompatibility between connectivity and security in the anarchistic System. When the second finite-time singularity eventually reaches its critical connectivity threshold, it will produce a systemic war that will constitute a phase transition that results in a non-anarchistic order at a global scale in 2185 this study suggests). The exact form of this 'final' non-anarchistic order is also dependent on various contingent factors and conditions; in fact, the exact form does not matter for the System, as long as the demands of the second law of thermodynamics are met.

As explained, various indicators – including the (increasingly) hybrid structures of wars – suggest that the final non-anarchistic order probably resembles a network of communities, that are able to optimize local requirements, as well as 'global' economies of scale and scope.

365 Because the initial conditions of the first (1495-1945) and second (beginning in 1945) finite-time singularity dynamics differ in some respects, certain quantitative properties of both singularity dynamics could differ.

KEY WORDS *First singularity dynamic, Second singularity dynamic, Properties, Different initial conditions.*

Although the basic conditions and workings of both finite-time singularity dynamics are similar, and the same laws and deterministic principles apply, (particular) conditions and properties of the System at the start of respective singularity dynamics, differ in some important respects.

Contrary to the first order of the first finite-time singularity dynamic, the first order of the second finite-time singularity dynamic already has a significant level of order. Further research must determine to what extent

the first finite-time singularity dynamic can be used as a reference for the second singularity, and if and to what degree similar war frequencies of orders of the first and second finite-time singularities imply similar levels of order. Further research must also determine if cycles of the first and second finite-time singularities accelerate with the same rates.

366 One to three non-systemic wars involving one or two Great Powers will bring the moving average of the sizes of five successive non-systemic wars of the first global order (begun in 1945) to the same level that typically produced systemic wars during the first finite-time singularity dynamic (1495-1945).

KEY WORDS *Critical fraction, Criticality, Moving average, War sizes, Prediction.*

The average sizes of non-systemic wars during high-connectivity regimes of international orders of the first finite-time singularity dynamic show that the System became critical and produced systemic wars when the moving average of the sizes of five non-systemic wars decreased to a value between 0.17 - 0.30, as shown in the table below.

'Critical fractions' of moving averages		
International order		Critical fractions of moving averages of five successive non-systemic wars
1	1495-1618	0.18
2	1648-1792	0.30
3	1815-1914	0.19
4	1918-1939	0.17

Table 123 *This table shows the (critical) fractions of the moving averages of sizes of five successive non-systemic wars immediately before the System became critical during the first finite-time singularity dynamic.*

For the System to become critical again, the moving average of five successive non-systemic wars must come within a range of 0.17 - 0.30. For the moving average of the current order to reach this critical range, the System must produce one to three non-systemic wars in which one or two Great Powers participate. The war frequency of the current phase of the first global order suggest that the System will become critical around 2020.

367 A number of conditions could impact the development of a second finite-time singularity dynamic that started in 1945.

KEY WORDS *New actors, Impact.*

Although the basic dynamics and mechanisms of the first and second finite-time singularities are identical, there also are a number of differences, including: (1) the emergence of a new type of non-state actors that organize in global border-crossing communities, and (2) the emergence of new forms of organizational networks that seem better able to optimize certain properties and dynamics. These two developments are related. These 'new' non-state actors develop their own dynamics in the System, that however also impact on rivalries between states in the System, and by doing so, reinforce the System's dynamics. Their impact still is unclear.

368 Based on the development of the first finite-time singularity dynamic (1495-1945), it is possible to predict the properties of the second global order that will follow the fifth systemic war.

KEY WORDS *Singularity dynamic, Prediction, Properties Second global order, Sixth international order.*

Deterministic properties can be predicted accurately. Contingent properties can vary, but must in all cases meet the demands of the deterministic domain and the second law of thermodynamics. The second global order will have the following properties:

1 ***No phase transition***
The fifth systemic war will not constitute a phase transition. The second order is a next step in a longer-term SIE process. The System cannot establish a non-anarchistic order at a global level through a single systemic war, based on calculations of deterministic properties in the System. The fifth systemic war will be the first in a series that constitutes the second finite-time singularity dynamic that started in 1945, and also is accompanied by a number of accelerating cycles.

2 ***Robustness, fragility and structural stability***
The second global order will be more structurally stable and robust, but also more fragile than the preceding first global order. Its life span will be shorter than the life span of the first order (1945-2020, 75 years). Its war frequency will be lower.

3 ***Regional orders***
The second global order will include a number of regional orders that are integral parts of the global order, to meet the demands of the second law of

thermodynamics; these regional orders also contribute to a lower energy state of the System. Regional dedicated hierarchies could, for example, be established in the Middle and Far East, the European Union could be upgraded.

4 ***More network (community) structures***
The second global order will also include networks of global and regional communities that transcend the more formal orders referred to in (1) and (2), and that also contribute to a lower energy state of the new order.

5 ***State become increasingly obsolete***
States and their governments derive their legitimacy from their ability to contribute to the fulfillment of basic requirements, including security, of their populations. States have become increasingly vulnerable; this undermines their utility and legitimacy. The next global order will reflect that national defense by states is becoming an increasingly obsolete concept. This is the case for two reasons in particular: (1) given their function and organization, states are largely responsible for the free energy they unavoidably produce in anarchistic systems, and (2) because of the global range of destructive energy that can be deployed by states with aircraft and missiles, and by empowered individuals and communities by leveraging the Internet, social media, and global mobility. The vulnerability of states and governments is purposefully targeted by radical communities, and will be further magnified by the inability of states to respond proportionally to these threats.

369 The totality of war will reach a new level during the next systemic war.

KEY WORDS *Totality of war, Systemic war, Fifth systemic war, Warfare.*

During the unfolding of the first finite-time singularity dynamic (1495-1945) and beyond, when chaotic war dynamics resumed in 1989, the totality of war continuously increased.

Developments suggest that the 'totality' of the next (fifth) systemic war, will show a further increase in the resources that are mobilized to produce and deploy destructive energy.

During the early stages of the unfolding of the first finite-time singularity dynamic, wars were fought by armies of mercenaries and did not involve populations and all domains of societies. By the time the System produced the fourth systemic war, this had changed fundamentally: All domains of society were mobilized by then to produce and deploy large amounts of destructive energy for states to destroy issues and acquire favorable bargaining positions regarding the design and implementation of the next upgraded order.

The increasing totalization of war went hand in hand with a process of empowerment: For states to mobilize their populations and societies in order to produce and deploy ever-increasing levels of destructive energy, populations' active involvement and support were required.

Since the collapse of the Eastern hierarchy (1989) and the resumption of chaotic war dynamics (1989), changes in the nature of warfare can be observed that are also related to the process of (further) empowerment of populations and societies. Technological developments (the Internet, social media, and global mobility) are enablers of these dynamics. Whereas during the unfolding of the finite-time singularity dynamic, wars mostly involved states, wars now increasingly involve non-state actors (e.g., in Afghanistan, Iraq, Syria, Libya, and Yemen). There are now wars against people, wars amongst people, and wars involving cross-border communities and individuals.

During the next systemic wars, states will also be confronted with an enemy 'from within'. Globally connected communities and individuals will deploy destructive energy from within states to fight their own wars. The threat from within is organized in networks, as is increasingly the case in above mentioned wars. These developments will force states to also organize their destructive capabilities (armies, etc.) into networks to optimize the deployment of destructive energy.

The mobilizations of communities and individuals, the employment of networks 'from within', and in inter-state wars will cause (systemic) wars to become more total.

370 Radical and terrorist groups aim to undermine democratic states by setting self-destructive and self-reinforcing dynamics in motion 'from within'; states are not equipped to counter these threats without playing into the hands of these radical groups.

KEY WORDS *Radicalization, Terrorism, Enemy "from within', Self-reinforcement.*

Because destructive power can be deployed from great distances but also from within, national defense has become increasingly problematic. States cannot under all conditions ensure the absolute security of their populations. These shortcomings undermine the concept of the state that is still considered the optimal solution for the fulfillment of basic requirements of populations of states.

The state as we know it is based on a social contract between the government and its population. In exchange for the security governments provide to their populations, states have a monopoly on the deployment of destructive energy against potential threats to their populations and to the states themselves. However, if states do not honor their side of the contract, this monopoly will be challenged from within, and individuals and communities will organize their own security. By doing so they will infringe on the violence monopoly of states.

Radical groups that employ terrorist tactics target this social contract to undermine the fabric of the state and its society. They hope to set in motion a self-reinforcing dynamic in which increasing disorder and responses to increasing disorder by governments feed on each other. An enemy from

within can lead to chaos from within, and ultimately, as developments in the Middle East show, to a state's collapse.

Democracies are especially vulnerable to radical groups and their terrorist tactics. The functioning of democracies is not only based on the social contract as such, but also on open societies that allow for unconstrained flows of information, people, and goods. These unconstrained flows ensure the democratic state's creativity, welfare, development, and adaptability. These unconstrained flows are based on trust and shared values and norms.

However, the unconstrained flows that provide democracies with their vitality can also be used by radical and terrorist groups to freely target populations and societies. In response to terrorist activity, states often feel forced to restrict flows, that – as explained – fulfill vital functions to democracies. By doing so, democratic states not only undermine their own functioning and legitimacy, but also their identities. These types of counter measures imposed by states play into the hands of radical and terrorist groups, and can set in motion a self-destructive dynamic.

The self-destructive dynamics that states and societies produce in response to threats from within resemble autoimmune diseases; the immune system that is supposed to protect an organism attacks healthy cells that pose no threat to the organism and, by doing so, undermine the system.

371 States are confronted with existential challenges.

KEY WORDS *States, State structures, SIE, Challenges, Collapse, Economies of scale and scope, Integration, Fragmentation.*

Typical properties of states, including exclusive control over well-defined territorial areas, centralized control, and a monopoly on the deployment of destructive energy against internal and external threats to security, are products of the finite-time singularity dynamic during the 1495-1945 period. During that period of time, the System developed from a loosely organized collection of diverse units into a highly optimized system of standardized states. The finite-time singularity dynamic produced these states, and states produced the singularity dynamic. States were optimal solutions for populations under the conditions that prevailed during the 1495-1945 period.

Because conditions have changed, states no longer are in all respects optimal solutions for the challenges populations presently have to confront.

As discussed, states are confronted with a number of existential challenges, including:

1 In Europe, the core of the System until 1939 and the 'birthplace' of the state, dedicated hierarchies have replaced anarchy (1945) and the state has – so to say – accomplished its task. As current struggles in the European Union also show, state-structures have become obstructions to the development and exploitation of the new synergies offered by a next level of SIE in Europe.

2 Outside of Europe, especially in the Middle East and Africa, state-structures were and are not always viable; that is, they are (for various reasons) not capable of ensuring the fulfillment of the basic requirements of their populations. This has resulted in the collapse of states and in efforts to replace states with alternative structures, often based on religious principles that are believed to produce better results.

3 States, especially in Europe, are confronted with threats from within, and states are not equipped to effectively confront these threats without causing 'collateral damage' that undermines their own legitimacy. States derive their legitimacy and existence from their abilities to ensure the security of their populations. Struggles of states with this primary responsibility suggest that state structures are no longer in all respects optimal.

These treats could cause fragmentation. Forces for fragmentation and integration continuously compete. This study shows that in the long term forces for integration (SIE) are stronger than forces for fragmentation: Integration has more to offer than fragmentation, assuming viable integrative structures can be found. The finite-time singularity dynamic accompanied by four accelerating cycles that unfolded during the 1495-1945 period, was in fact about 'finding' and perfecting the state as the optimal solution for challenges to populations in the core of the anarchistic System.

372 Accelerated integration as well as renationalization can relieve Europe from its current vulnerable 'stuck-in-the-middle' condition; in case of renationalization certain synergies cannot be developed and exploited, and the production of free energy (tensions) could resume. Increasing connectivity will push Europe (again) towards further integration.

KEY WORDS *Integration, Renationalization, European Union, Stuck in the middle, Re-activation, Security dilemma, Free energy, Systemic war.*

At the moment Europe is stuck in the middle; state-structures are partially dismantled, while integrative structures at a European level are not yet fully designed and implemented. As a consequence, individual states are constrained in their interactions, while Europe cannot adequately ensure an optimal internal balance or responses to external challenges and threats. Whereas Europe could and should be more than the sum of its parts, it now is less.

Europe's internal focus and political maneuvering further aggravate this condition.

In principle, two options are available to get out of this unsatisfactory 'worst-of-two-worlds' condition: accelerated integration or renationalization.

The question is what the effects of renationalization could be. Renationalization could result in the resumption of rivalries between European states, and even the re-activation of the security dilemma. I assume however that the current connectivity of European states is too high to produce non-systemic

wars (release events), as was the case during the fourth relatively stable period (1918-1939) of the first finite-time singularity dynamic (1495-1945). I assume that the current 'order' in Europe is and stays 'infinite' robust, also in case of renationalization of states and re-activation of the security-dilemma. This infinite robustness of Europe however, implies that the free energy that builds up in Europe (as a consequence of renationbalization and a possible re-activation of the security dilemma), can only be released through systemic war; this is what the second law of thermodynamics will enforce.

However, there also is another scenario that could play out if states in Europe renationalize, assuming that the demands of the second law of thermodynamics are met. In this scenario, the global System becomes critical (as I expect to happen) and produces a systemic war that results in the implementation of an upgraded second global order to ensure compliance with the second law of thermodynamics. This global systemic war is then be used by European states to implement an upgraded version of the European order that can ensure internal balance and adequate responses to external threats during the second global order.

373 The global non-anarchistic System that eventually will emerge will consist of a 'network of networks'.

KEY WORDS *Second Singularity dynamic, Second law of thermodynamics, Critical connectivity threshold, Network of networks.*

Assuming that the second finite-time singularity dynamic (begun in 1945) can sustain its development, it will ultimately reach the critical connectivity threshold and produce a phase transition through a systemic war. Before the threshold is reached, the System will have produced a number of accelerating cycles, as was the case for the first finite-time singularity dynamic (1495-1945).

When the second finite-time singularity dynamic reaches the critical connectivity threshold, the global anarchistic System will produce infinite amounts of free energy (tensions), and the relatively stable period (at that point in time) will have become infinitely robust and fragile. At that point the (global) anarchistic System can no longer implement yet another upgraded order that meets the demands of the second law of thermodynamics, and collapses; a response similar to the first finite-time singularity dynamic in 1939. Through a phase transition to a non-anarchistic configuration, the System will ensure that it meets the demands of the second law of thermodynamics.

The integrative structures that will be imposed will, I assume, not resemble a centralized government (like in the current state model), but will consist of a 'network of networks' that connect regional and global communities (including certain 'support facilities') in the System. These networks will function and operate on the basis of shared values and norms, and strike a balance between local requirements (like identities), and regional and global opportunities for economies of scale and scope.

The increasingly hybrid structure of wars, point to the network and community structures future wars will carve out in the System.

By utilizing parallel processing properties, networks can better develop and utilize synergies in the System, and can more effectively and efficiently distribute information, compared with centralized hierarchical organizations that are dependent on top-down control. The second law of thermodynamics will push the System in that direction, I assume, through a number of systemic wars that will be produced at an accelerating rate.

The global non-anarchistic System that will eventually emerge will resemble life forms, including in its security-arrangements that will have properties of immune systems at a conceptual level.

374 Wars are symptoms of the underlying deterministic dynamics of anarchistic systems; prevention and control of wars require measures that take into account the underlying deterministic properties and dynamics of the System.

KEY WORDS *Deterministic domain, Control, Prevention, War, Second law of thermodynamics.*

Wars are the outcome of a simple unavoidable logic: energy obeys the second law of thermodynamics, including the free energy that is produced by anarchistic systems. Deterministic laws and principles cannot be ignored. The second law of thermodynamics applies to the free energy (tensions) produced by the System. Conflict prevention requires that *free energy production* is stopped, and/or that the *mechanisms* by which this energy is put to use are changed.

Free energy production – the productions of tensions in the System – is a consequence of the intrinsic incompatibility between (increasing) connectivity and security in anarchistic systems. Free energy production can be reduced or prevented by: (1) avoiding a further increase in the connectivity (that is population growth) of the anarchistic System, (2) changing the notion of security that is inherent to anarchistic systems, or (3) replacing anarchy with a non-anarchistic system. This study shows that anarchy is replaced – and must be according to the second law of thermodynamics – when the anarchistic System reaches the critical connectivity threshold, and collapses as a consequence.

Changes in *mechanisms* that determine how free energy is put to work in anarchistic systems (typically by war) also provide clues to conflict prevention measures. Mechanisms that determine how free energy is put to work in anarchistic systems include the structure of decision-making processes and the connectivity of the System.

Decision-making dynamics in anarchistic systems are determined by (1) the nature of war decisions that qualify as 'binary decisions with externalities and thresholds,' implying that states constitute binary switches with two conditions: 'war' or 'no war'; and (2) the fact that these binary switches (states) form networks with their own typical dynamics, that depend on

the level of their connectivity (low or high), and thresholds states apply concerning war decisions.

Stopping the production of free energy and changing the mechanisms that determine how free energy is put to work address underlying causes of the war dynamics of the System and go further than just combating symptoms. However, this study also suggest that these fundamental changes cannot be achieved by other means than systemic wars.

Through systemic wars upgraded orders are implemented step-by-step; each upgraded order builds on the arrangements of its predecessor. But – despite these 'efforts' of the System, that only provide temporary respite – it is just a matter of time before the anarchistic System collapses. When the anarchistic System collapses (when the critical connectivity threshold is reached) the System must implement a non-anarchistic order to ensure compliance with the second law of thermodynamics.

It must be kept in mind, that the finite-time singularity dynamic accompanied by four accelerating cycles, was an optimal solution of the System to accommodate and allow for the population growth the System experienced during the 1495-1945 period.

375 A control system with the function to prevent and control wars requires an approach that combines a top-down deterministic perspective with a bottom-up contingent perspective, and that takes the interface between both domains into consideration.

KEY WORDS *Control system, Top-down approach, Bottom-up approach, Interface, Interacting self-fulfilling prophecies, Contingent latitude.*

Wars are symptoms of dynamics intrinsic to anarchistic systems. As far as it is possible, for a control system to prevent and control wars in an anarchistic system, such a control system must combine a top-down deterministic perspective with a bottom-up contingent perspective, and also take the interface between these two domains of the System into consideration.

Deterministic properties and dynamics of the System include the main features of the finite-time singularity dynamics, like the timing, duration, and amount of destructive energy that must be deployed during systemic wars, and the robustness of relatively stable periods. These deterministic properties determine the latitude for contingent dynamics. Interacting self-fulfilling prophecies between states synchronize the dynamics in both domains, and can be considered an interface. The interface consists of attractors around which tensions crystallize; vulnerable issue clusters are the product of this interactive crystallization process. Attractors are issues that rival states and populations interactively create and use to justify the production and deployment of destructive energy.

To be able to predict wars, a prerequisite for prevention and control, the deterministic domain governed by a number of deterministic laws,

the contingent domain in which change plays a dominant role within the latitude defined by the deterministic domain, and the interface between the two domains must be taken into account.

Given the nature of war dynamics in the System, the design and implementation of effective measures to prevent and control wars is problematic – 'impossible' – if the 'underlying' deterministic properties of the war dynamics are not incorporated in such a control system.