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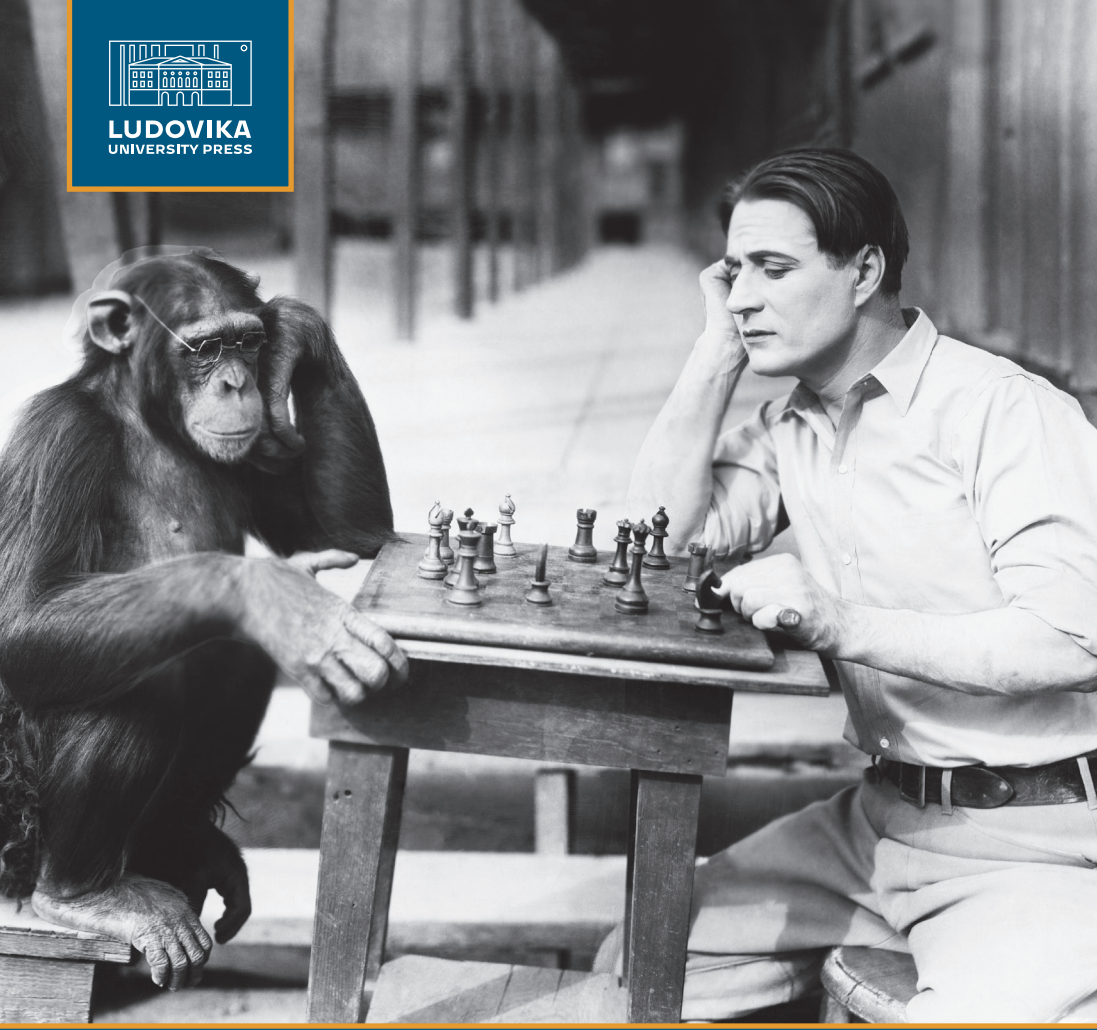

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Budapest, 2023

This work was created in the framework of the TKP2020-NKA-09 project supported by the National Research, Development and Innovation Fund, and financed by the Research Excellence Program 2020.


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Published by the University of Public Service
Ludovika University Press
Responsible for publishing: Gergely Deli, Rector

Address: HU-1083 Budapest, Ludovika tér 2.
Contact: kiadvanyok@uni-nke.hu

Managing editor: Katalin Pordány
Copy editor: Zsuzsánna Gergely
Layout editor: Angéla Fehér

ISBN 978-963-531-889-6 (ePDF)
ISBN 978-963-531-890-2 (ePub)

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# Introduction

This book is the continuation of a book entitled *The Effects of Joint Operations* published by the author in 2019.[1] This book takes forth and expands on the ideas written down three years ago. The basic assumptions of the author regarding the effectiveness of Allied and national forces in joint operations has not changed. The effectiveness of Allied forces in peace, crisis or in conflict depends on the ability to operate together coherently, effectively and efficiently. Joint operations, be Allied, coalition-based or national, should be prepared for, planned and conducted in a manner that makes the best use of the relative strengths and capabilities of the forces offered. Joint operations demand a way of thinking and specific processes that depart from causality and embraces the presence of correlation or even covariance for the effective use of military capability in achieving objectives and attaining desired end state. There is a fashionable tendency in military writings to use the vocabulary of complexity theory and to refer to complex adaptive systems. According to the author there are many good reasons to elaborate further on insights gained from a serious study of the theories of complexity and complex adaptive systems. First, joint operations display a wide array of multi-layered problems in which an approach that is less rigid and more flexible, less artificial and more organic, less mechanistic and more living appears to be most appropriate. Second, much of contemporary Western military thinking rests on natural science and its supporting paradigms. It often ignores human attributes such as apprehensions, sensations, perceptions, impulses and emotions that constitute a very important part of the activities carried out by forces during the conduct of joint operations. Third, comprehending joint operations as a complex adaptive system can help think outside the proverbial box to foster creativity. Novel metaphors and supporting methodologies can help make the shift for a better understanding and conceptualisation. Thus the aim of the book is twofold as it both attempts to conceptualise joint operations as a complex adaptive system and examines the practical utility of focusing on causality. The planned argumentation proceeds through eight interrelated chapters. Chapter 1 sets the scene by expanding on Clausewitz's Dynamic Law in War that can be seen as a sort of precursor to the rather recent complex

[1] Jobbágy 2019.

adaptive system approach. Chapter 2 briefly delineates the traditional top-down approach of the military to strategy development and names some of the obvious shortcomings. Chapter 3 details the basic characteristics of a bottom-up strategy development based on insights coming from complexity theory. Chapter 4 suggests three possible approaches that help exploit the combined power that comes from merging the various sorts of course of action development. Chapter 5 concludes on the findings and details to what extent a causality based approach is valid for joint operations when seen from a complex adaptive system point of view. Chapter 6 details to what extent learning and adaptation in joint operations can be used as a leverage. Chapter 7 details three organic approaches to command and control. Chapter 8 details the relationship between military effectiveness and efficiency. The book thus promotes a more organic, hence biological approach to joint operations as no one would doubt that joint operations are very complex undertakings. However, one can learn a lot from knowledge accumulated in other fields of science as complexity is not a unique feature of joint operations. Complex adaptive system theory offers a biological perspective that has much to contribute to a better understanding of joint operations. Biological evolution and joint operations feature perpetual novelty and conditions far from equilibrium featuring dynamics that demand continuous adaptation. Comprehending joint operations in an evolutionary framework requires a shift from statics to dynamics, from time-free to time-prone reality, from determinism to probability and chance, and from uniformity to variation and diversity. According to the author a biological approach has much to offer for a better understanding of joint operations. Regardless whether one sees joint operations through the eyes of Clausewitz, approach it as a complex adaptive system, or examine it along attributes that display similarities with biological evolution, there are timeless and innate characteristics. It is not difficult to conclude that both biological evolution and military operations are intrinsically complex, and primordial violence is at the heart of both.[2] Joint operations indeed can be understood as a complex adaptive system in which the system properties emerge from the interactions of the many components at lower levels. The abundance of dispersed interactions indicates a mechanism that often lacks global control, but feeds from cross-cutting hierarchical setup. Similar to biological evolution, joint operations feature perpetual novelty and far from equilibrium dynamics that demand continual

[2] Goldstein 1999: 49–72.

adaptation. Interaction with the enemy means that there is a multiplicity of feedback mechanisms that affect the further dynamics by constantly changing the attributes involved.[3] Both joint operations and biological evolution are as much about selection as about transformation with the consequence that adaptation appears to be a central feature. It stands for the importance of not only how to respond to perturbations properly, but also how to maintain the capacity to respond actively.[4] Biological evolution and joint operations are full of ramifications and divergences that come as a result of the constant interaction and changing environmental conditions with various and often unexpected events as a result.[5] Clausewitz, the great Prussian theorist of war knew about the interdependence of the elements involved and concluded that scientific analysis based on logic and mathematics is of little help. Waging war was for him an art and as such requires certain skills to discriminate among an infinite multitude of objects and relations to find out which is the most important and decisive. This is in sharp contrast to a strict logical deduction and requires intuitive comparison. Remote and unimportant things and indirect relations must be set aside in order to discover the more immediate and important ones.[6] Clausewitz was also aware of the fact that war has a non-quantitative and non-predictive character, which makes it impossible for fully fledged empirical or hard sciences to offer suitable descriptions, explanations or models. War features structural unpredictability in which the distribution or dispersal of information suggests definite limits to what can be known at any given point in time. Based on Clausewitz's insights, some argued that evolutionary biology may offer a better model for a theory of war than most quantitative sciences.[7] The book can be seen as a descriptive, reflective and explanatory study of joint operations seen as a complex adaptive system. It is descriptive in a sense that it describes joint operations as a search process on an imagery landscape called joint effects landscape. It is also reflective since by approaching joint operations as a complex optimisation process that comes from population genetics, consistency and coherence is provided by the use of the respective scientific literature and Clausewitz's epic volume *On War*.

[3] Levin 1998: 431–436.
[4] Ovington 1900: 411–420.
[5] Cole 1919: 247–257.
[6] Clausewitz 1989: 607–617, 623–626, 692–693, 702–708.
[7] Watts 2004: 49–56.

It is explanatory since inconsistencies are discovered and the author identifies and explains the contributory factors in detail. The book aims at developing a coherent framework that offers a novel approach to joint operations by detailing the underlying attributes from a biological point of view.

# Chapter 1
# Understanding Complexity

In the structural analysis in the previous book the author depicted joint operations in a two-dimensional setting as a continuum defined by ends-means relationships.[8] Examining joint operations in terms of interactions and couplings made it possible to see the way structures are produced and dissolved. As depicted in Figure 1 the four areas thus produced (linear, complicated, complex and chaotic) pointed towards increasing unpredictability.

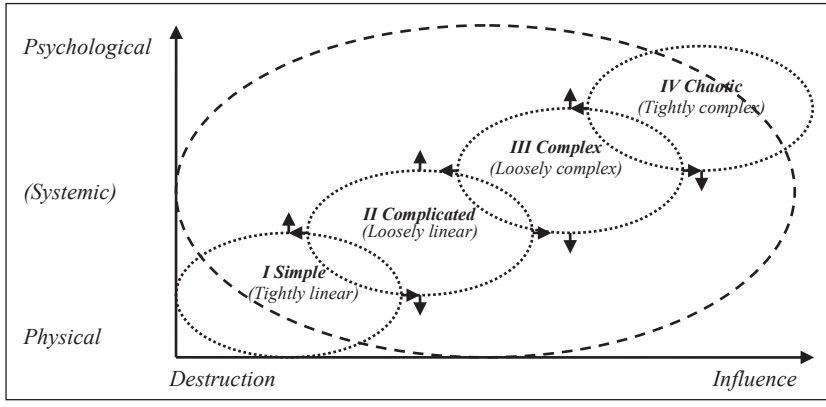


*Figure 1. Four areas projected*
*Source:* Compiled by the author

Moving towards the physical/destruction end-pole indicates direct causality and prediction, but the value of the effects achieved is normally seen as low. Although effects achieved around the psychological/influence end-pole have high values, they do not allow for predictions based on direct causality. The areas indicate that in joint operations all activities take place in an environment in which chaos constantly meets order in a disorderly way. Thus, the areas display joint operations as a phenomenon in which pre-order meets order in disorder, and occurrences move continuously back and forth in the continuum.

[8] Jobbágy 2019: 98.

Due to such attributes war can best be described by the term complexity. Similar to friction and chaos, complexity also denies the primacy of order and causality and the drive for efficiency and constant affirmation. In terms of unpredictability, complexity stands for freedom and openness that puts an emphasis on action and possibility. It is a whole in its own right in which actions complement each other when seen from the totality of the system.[9]

## Multitude of layers

The structural analysis made it clear that war displays complex forms of cause and effect relationships in which one must take the various interdependences better into account. Links between causes and effects often become distant in time and space or can even disappear. In case one proceeds as if simple linear links exist even if one does not know what they are, then one is likely to undertake actions that yield unintended and surprising results.[10] As indicated by friction and by the recent concept of chaos theory, complexity can best be described as the result of many constituents that are interdependent in a non-linear way. They display a bewildering array of effects that possess a hierarchical structure spanning over several scales. Complexity appears as an emergent property in the continuum of joint operations and comes from the constant interplay of chaotic and non-chaotic forces. Simply put, complexity arises from the sheer number of the constituents and their interdependencies. Complexity also stands for a continuous evolution and adaptation containing a network of various alternatives. It cannot be represented based on reasoning and causality since the interactions and couplings of the constituents often produce unforeseeable results.[11] In order to explore complexity properly, one must acquire a pluralistic world view that accommodates all the different kinds of phenomena coexisting side-by-side. Although the simplest way to think in terms of complexity is to assume a system that involves a huge number of interacting elements, the structural analysis introduced in the previous book made clear that complex systems cannot be defined only by the quantity of the interacting components. Complexity stands for a multitude of hierarchical layers in which any exclusive focus on individual

[9] Lefebvue–Letiche 1999: 7–15; Axelrod–Cohen 1999: 28–31; Lissack 1999: 110–125.
[10] Stacey 1996: 273–276; Tasaka 1999: 115–123.
[11] Levin 2003: 3–19; Baranger s. a.: 9–11; Cilliers 1998: 2–5; Swenson–Rigoni 1999: 576–577.

agents means that important properties can easily be lost. Nevertheless, the four areas make it possible to deliver an explanatory framework that helps us better understand the consequences of our actions, and the spatial and temporal effects they generate.[12] A very important attribute of complexity can be defined as a sort of structural stability/instability. Whereas structural stability allows for analytical examination, structural instability can only be explained in a non-analytical way.[13] The laminar flow of events ceases to be stable and spontaneously turns into a turbulent flow. Structural instability stands for bifurcation in which new solutions emerge. Every such point contains an element of randomness or chance that makes impossible to predict which path the system will take. Consequently, at bifurcation points the system is beyond the threshold of stability and is under the rule of a chaotic mechanism that expresses an extraordinary sensitivity to initial conditions. Links between causes and effects can be lost and it is not possible to identify the specific consequences of a specific action or the specific cause of a specific event.[14] Any complex system can display both deterministic outcomes and random fluctuations. Around bifurcation points deterministic descriptions break down and explanations based on causal relationships do not make sense. Fluctuations completely upset the equilibrium of a system and as a result, the number of possible effects can become very high. This constant shuffling between stability and instability explains why war can display growth and decay, capture and domination, in which periods of opportunity for alternative developments are followed by solidification of existing domination structures.[15]

## Emergence and environment

Joint operations stand for areas that feature different overlapping characteristics. These areas constantly influence each other, which makes attempts to identify direct causality very difficult. Linearity goes together with non-linearity and stability always coexists with complexity and chaos. Whereas stability stands

[12] Nicolis–Prigogine 1989: 5–8, 31–32; Moffat 2003: xi-xiv, 1–10; Prigogine–Stengers 1984: 131–137.

[13] Nicolis–Prigogine 1989: 93–98; Gove 1981: 213; Moffat 2003: 15; Briggs–Peat 1989: 53–65, 102; Lorenz 1993: 147.

[14] Prigogine–Stengers 1984: 140–141, 160–170, 177–179, 196–203.

[15] Stacey 1996: 324–329.

for simplicity and linearity reflecting a tight and linear relationship between causes and effects, non-linearity points towards chaos that can be described by extreme sensitivity to initial conditions indicating a tight, but complex relationship between causes and effects. The biggest area within the continuum of war can best be described as complexity proper, which stands for non-linearity, far-from-equilibrium conditions and emergence. Although joint operations display linear properties, the underlying mechanisms are mostly defined by non-linear attributes. Consequently, one must rethink regarding the basic mechanism and shift the reasoning away from prediction aimed at identifying desired effects.[16]

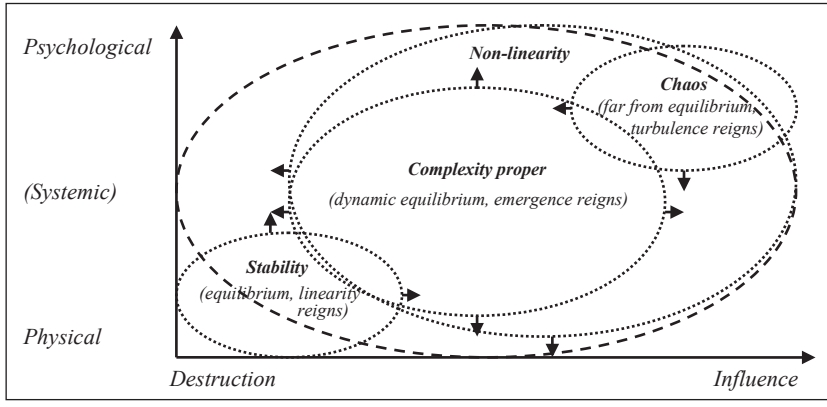


*Figure 2. Overlapping characteristics of war*
*Source:* Compiled by the author

Joint operations show emergent and interactive attributes that come as a result of structured, but non-additive interactions. Figure 2 indicates that whatever the result of joint operations it is always more than the sum of the constituents. In other words one always faces a general unpredictability in relation to the input. The various combinations in terms of interactions and couplings also mean that despite most assumptions complex systems can be surprisingly stable and resilient, too. They can continuously adjust and adapt, which ability provides them with multiple and often unexpected paths that make causal explanations

[16] Czerwinski 1998: 39–60; Briggs–Peat 1989: 174–180.

very difficult.[17] Instead of attempting to create idealised sets of problems that can be solved, joint operations require an everything-affects-everything-else mode to get a grip on the entire web of various connections. Thus conceptual elegance reflecting rational thinking, deductive logic and analytical categorisation is of little help. Novelty can come from simple properties producing emergent and unpredictable effects. Depending on the level chosen for examination, one always confronts with structures for which different laws, concepts and generalisations apply. Joint operations stand for an infinite variety of possibilities and a general unpredictability regarding causes and their likely effects.[18] Emergence is the most important attribute of complexity. It works against causality since it refers to the way novel and coherent structures arise. Emergence cannot be predicted or anticipated in its fullness beforehand since it displays features not previously observed. Emergence is a holistic configuration that offers explanation into the dynamics of the system rather than explanation based on the system's parts alone. It does not allow for predictions based on deduction and causality. Emergence does not make it possible to explain the full richness of interactions and couplings, and the resulting multitude of possibilities, either. It is not a provisional construct, since the temporal and spatial dimensions of war point towards greater and greater unpredictability. Thus emergence does not allow exact prediction of future states and cannot be handled by analytical rationality. It produces unexpected or counter-intuitive results, which indicates that causes and effects are not only separate, but often disconnected in space and time. Consequently, under emerging conditions it becomes very difficult if not impossible, to say what causes what effect or to say what will happen in a specific place at a specific time. Emergence reflects attributes such as compensation and counter-action, which make most attempts to predict and plan for desired effects impossible, as such properties cannot be added together in a simple and system-wide way.[19] Unpredictability is further exacerbated by the fact that in an open and dissipative system such as joint operations that display emergent attributes, the environment must also be taken seriously into account. War and joint operations are a social phenomena as they are linked to and interact with the surrounding social, cultural and political context. The environment is never static, but changes over time, which indicates that interactions stand more for what one does not know, and

[17] Russ–Bacon 1999: 75–79; Griffin et al. 1999: 302–304.
[18] Waldrop 1992: 38–39, 60–63, 81–83.
[19] Goldstein 1999: 49, 57–62; Stacey 1996: 296–297; Axelrod–Cohen 1999: 11–15.

less so for the possibility to make accurate predictions in terms of causality. In order to get a better insight into the causal texture of the environment a simple matrix as below might be useful.

$$L_{11}, L_{12}$$
$$L_{21}, L_{22}$$

According to the matrix emergence arises as the interplay of $L_{11}$ that refers to the processes found within the system, $L_{12}$ and $L_{21}$ both referring to interactions between the system and the environment, and $L_{22}$ referring to processes and interaction within the environment itself. The matrix indicates that environmental interdependences of social phenomena such as joint operations are often incommensurate with those connecting parts of the system. In other words, the environment is not just out there, but constantly changes in ways no one can anticipate.[20] Environmental factors also indicate that emergence stands for two sorts of unpredictability. Whereas in spatial terms it stands for the fact that properties at a certain level cannot be predicted from other level properties, in temporal terms it means unpredictability from the properties that constitute the preceding condition. Consequently, emergence creates new properties regardless of the substance involved since it relates levels to each other by denoting the very passage connecting them. In a complex phenomenon such as joint operations, several levels coexist simultaneously and interpretations based on causality can lead to mistakes. This poses a challenge to the notion of causality since it refers to something that disrupts the notion of causality and cracks the power of causal explanations. Emergence stands for qualitative changes and suggests that causality and randomness are always interwoven in an intriguing way. It also indicates novelty in the form of new and random solution paths open to chance occurrences that do not allow for mechanical explanations. Although emergence might allow for the prediction of certain structural features in general terms, it does not help predict details of the future in terms of desired effects.[21]

[20] Jobbagy 2005a: 11–23; Moffat 2003: xiii; Emery–Trist 1965: 22; Green–Newth 2001: 1–12; Jervis 1997: 20–23.

[21] Emmeche et al. 1997: 83–100; Goldstein 1996: 163–182.

## Adaptation and self-organisation

Emergence opens both the door for a better understanding of unpredictability and a broader conceptualisation of joint operations as a complex adaptive system. Although the notion of a complex adaptive system generally applies to entities that show emergent properties across time and space, one must also acknowledge that not all emergent systems are adaptive. Complex adaptive systems display multiple interacting scales that mostly defy the utility of deductive and analytic categorisations. Thinking in terms of complex adaptive systems defies most assumptions regarding direct causality, identifying desired effects, and linking various levels in a direct and comprehensive manner. Retrospective analysis is feasible in a complex adaptive system, but prediction is only possible in the most general terms, which makes it very hard to see the consequences of our actions. Adaptation indicates a process that constantly changes, as the system never settles down. Although a complex adaptive system might be surprisingly stable, it is never in equilibrium.[22] Joint operations perceived as a complex adaptive system implies that the belligerents do not simply follow certain rules, but by changing those rules they create emergent futures. They are capable of learning from non-linear feedback and produce unpredictable actions. A complex adaptive system thrives best at the edge of stability and instability, which promotes creativity. A complex adaptive system stands for ambiguity, paradox and the anxiety it generates. Seeing joint operations this way is uncomfortable since a complex adaptive system cannot be planned or intended. The most important consequence of a conceptualisation based on a complex adaptive system is that long-term outcomes are unknowable since the ability to self-organise spontaneously can result in disappearing causal relationships. Emergence and adaptation explain why the general unpredictability of war takes hold if we want to get a grip on the future pattern it might display, or to reduce that pattern to its constituents.[23] Joint operations conceptualised as a complex adaptive system means that structures come from a process in which the constituents interact in an inherently complex way. These structures come as a result of self-organisation, which means that predictions based on direct causality can only be possible in the short term. The spontaneous adjustment of a complex adaptive system involves

[22] Levin 2003: 3–4, 11; Axelrod–Cohen 1999: 7–9; Gell-Mann 1994: 16–21, 54–56, 69–70, 72–74.

[23] Stacey 1996: 334–345; Coveney–Highfield 1991: 182–190.

complex interactions with so many factors that control becomes impossible. Self-organisation means that a complex adaptive system is able to dynamically adapt to changes even if those changes appear in an irregular fashion. Although self-organisation happens at all levels of the system, the components operate on local information and general principles that have only limited content for the system as a whole. Self-organisation runs against most assumptions of direct causality and indicate that joint operations are phenomena in which the operational conditions make it mostly impossible to see the output without considering the mechanism by which it is produced.[24] The internal development of joint operations might be determined by the underlying mechanisms, but cannot be predicted as the output does not make it possible to find reliable rules. One can say that a complex adaptive system displaying self-organising behaviour stands for complex and circular causality in which causes and effects cannot be mapped linearly for similar causes can have different effects and different causes similar effects. Small changes of causes can have large effects, whereas large changes can also result in only small effects. Nonetheless, small causes can have small effects and large causes large effects.[25] Self-organisation indicates that unpredictability in joint operations generally takes hold. Similar to friction and chaos, we can say that complexity in general, and the complex adaptive system and self-organisation in particular, indicate a rather low practical ceiling for prediction.

## Structural instability

Although joint operations can be described in general terms using causal relationships, effects that go beyond the immediate spatial and temporal levels cannot be predicted with any accuracy. It is only possible to come to grips with some things – especially those things which are local to us both in space and time. Friction, chaos and complexity suggest that everything is interrelated and all one can attain is a temporary and partial interpretation. Humans often confuse causation with correlation, and simulation with prediction. Whereas the former refers to the preference to create retrospective validation to identify best practices, the latter points to the fact that even if it is possible to simulate

[24] Cilliers 1998: 89–95; Krohn–Küppers 1989: 155–156.
[25] Fuchs 2003: 135.

something it does not obviously mean the possibility to predict its future.[26] Joint operations are full of discontinuities and uncertainty, which indicate a general unpredictability that can make both individuals and organisations disoriented. This uncomfortable feeling explains why earlier concept such as effects-based operations appeared attractive for so many. The international arena has been a messy place in the unfolding new millennium. It should not come as a surprise that linear and causality-based concepts have gained attention in the political-military community. During turbulent times in which orientation becomes difficult, humans increasingly turn to panaceas for advice. In cases one does not understand or can cope with, humans often look for simple or simplistic solutions that promise quick help.[27]

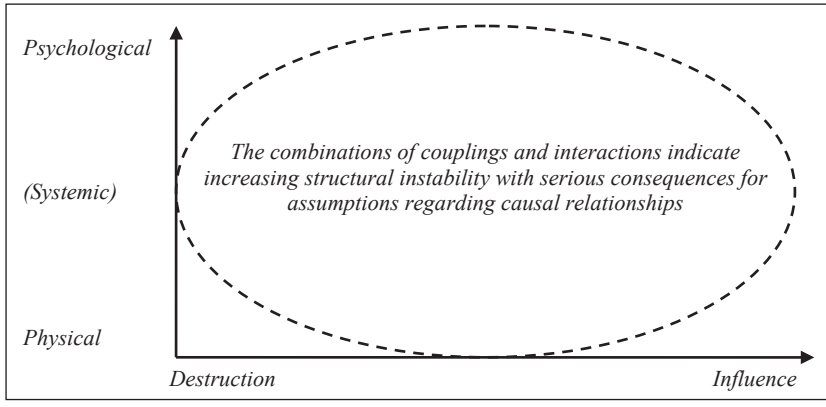


*Figure 3. Predictability and causality in war*
*Source:* Compiled by the author

As depicted in Figure 3, in the framework of the proposed and extended conceptualisation covering the full continuum of joint operations, one must constantly balance in terms of ends/means relationship. Friction, chaos and complexity indicate that one faces unpredictability both in terms of what one is trying to

[26] Flood 1999: 247–252; Kurtz–Snowden 2003: 462–463; Snowden–Stanbridge 2004: 146; Stacey 1996: 346–347.
[27] Ackoff 2001: 3–10; Christensen–Raynor 2003: 67–74; Rosenau 1999: 48–66; Mann 1997: 62–68.

achieve (effect), and in terms of how it becomes possible to achieve what one wants to (cause). The figure also indicates that joint operations stand for a general unpredictability in terms of ends and means. Several different futures are possible and there is not always time for mechanical, deductive systemic analyses aimed at detecting direct causality. The most important message of unpredictability is that instead of focusing on certain desired effects, one should rely on the ability to respond consistently to the unpredictable nature of joint operations. These operations cannot be conducted based on single and prescriptive models, but require that one evolves rapidly in order to handle dynamic and changing situations similar to the biological evolution of species.[28] The serious contradiction between the basic assumptions of causality and the unpredictable nature of joint operations naturally raises the demand for an enhanced conceptualisation. Friction, chaos and complexity indicate that one must be satisfied with understanding certain general features in terms of correlation, rather than attempting to discover a mechanism that links causes with effects directly. Thus friction, chaos and complexity should be regarded as opportunities that can explain qualitative behaviour instead of inaccurately predicting futures in terms of desired effects.[29]

[28] Snowden 1999: 16–20.
[29] Emmeche et al. 1997: 116.

A biological perspective on human behaviour has much to offer for a better understanding of the relationship between co-operation and conflict. Regardless whether one sees war and joint operations through the eyes of Clausewitz, approaches it as a complex optimisation process, or examines it along attributes that display similarities with biological evolution, there are timeless and innate characteristics. It is not difficult to conclude that both biological evolution and joint operations are intrinsically complex, and primordial violence is at the heart of both.

Thus comprehending joint operations in an evolutionary framework rejects classical theories and promotes complexity thinking that requires a shift from mechanics to biology. The emphasis should move from statics to dynamics, from time-free to time-prone reality, from determinism to probability and chance, and from uniformity to variation and diversity.

In this book the author approaches joint operations as a complex adaptive system in which the system properties emerge from the interactions of the many components at lower levels. Dispersed interactions indicate a mechanism that lacks global control, but feeds from a crosscutting hierarchical setup. Similarly to biological evolution, joint operations also feature perpetual novelty and are far from equilibrium dynamics that demand continual adaptation.

This requires soldiers to evolve rapidly to handle dynamic and changing situations instead of focusing on anticipated circumstances and conditions that come as the result of single and rigid prescriptive models. Biological evolution as a basis for better understanding the dynamics of military operations certainly does good service. First it helps value the many irregular processes found on the tactical level, second it can help find a balance between centralisation and decentralisation when executing tactical level tasks. Third, it can facilitate a better understanding for achieving a match between the external diversity of the environment and the internal variation of military organisations to cope with the many challenges present in that environment.

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