HDR 2020, Nr. 2, 50–64.

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INNOVATION METHODOLOGIES FOR DEFENCE CHALLENGES: ON DESIGN THINKING AND ORGANIC APPROACHES

DOI: 10.35926/HDR.2020.2.3

ABSTRACT: *It is a commonplace to state that the operational environment is inherently complex. In such a volatile, uncertain, complex and ambiguous, or in short VUCA, environment traditional approaches to plan, prepare and execute missions are no longer applicable. VUCA environment features challenges and problems that can be either tame or wicked. A tame problem is linear in nature and yield to engineering approaches. It is decomposable into parts and solvable through a chain of causal assumptions. The bulk of problems, however, posed by the VUCA environment is wicked and not amenable to linear solutions. These problems require design thinking that is a novel approach. Design thinking is a conceptual tool to deliver non-linear solutions by taking advantage of right-brain creative thinking and left-brain analytical thinking. If applied properly, design thinking can make the best of both worlds.*

KEYWORDS: *design thinking, wicked problems, Clausewitz, complexity, tame problems*

The Modernization Institute of the Hungarian Defence Forces and the National University of Public Service organized an International Military Design Thinking (IMDC) Conference-Workshop in Budapest on 3-4 March 2020. The author of this article had the chance to present in the lecture series part of the event. This article is an extended version of that presentation and serves the purpose of clarifying the need to solve wicked problems by applying a design thinking approach, linking design thinking with the proverbial friction of war and providing the IMDC community with a structural approach to better understand the underlying complex and non-linear attributes of the operating environment.

The term *design* has many definitions. The author of this article, who is a non-native speaker of English language, understands it as a creative process. *Design thinking,* the driving force behind is present in each stage of the process: from problem definition to problem solution, including iterations. A problem solution is a viable result that can differ widely in terms of applicability from other similarly good enough solutions delivered by other designers. Design as a creative process stands for a way of thinking that is messy and painful. High degree of creativity and originality must be controlled and directed in order to channel many early approaches towards few practical solutions from which in the end, one is selected. Design is thus a process full of tensions including unclear causality. It is

characterised by the constant need to balance between planning and adapting, knowing and sensing, executing and coping.[1]

WICKED PROBLEMS

The statement that at the dawn of the 21st century the operational environment is inherently complex is not new. The dramatic increase in the number of actors and the connections among them make it impossible to rely on linear approaches featuring causality, deduction, and analysis. The accelerating trend of technology development, the explosion in the number of information exchanges result in the simultaneous existence of a broad range of threats. In such a volatile, uncertain, complex and ambiguous, or short VUCA environment, traditional approaches to the planning, preparation and execution of missions are no longer applicable.[2]

Design thinking is a novel, non-linear, non-traditional approach that takes advantage of right-brain creative thinking and left-brain analytical thinking. Design thinking, if applied properly, can make the best of both worlds. The contemporary operations environment, in their extreme, features challenges manifest in a broad range of various problems that can be either tame or wicked. A tame problem is linear in nature and yields to engineering approaches. It is decomposable into parts and solvable through a chain of causal assumptions. Unfortunately, the bulk of problems posed by a VUCA environment is wicked and not amenable to linear solutions.[3] Wicked problems are open ended, which makes the formulation of any outcome extremely difficult. As a result, approaches emphasising reasoning, rationality, and analysis must yield to approaches that emphasise feeling, sensing, engagement, action, and overcoming.[4]

Wicked problems are ill-defined and inseparable by nature. Lack of clarifying traits allows for resolution rather than solution over-and-over again. They cannot be formulated definitively and exhaustively since formulating a wicked problem is a problem in itself. Setting up and constraining the solution space, constructing meaningful measures of performance are at the heart of the problem's wickedness. Another feature of wicked problems is that they are infinite with no criteria on how to find solutions. Terminating works are due to external reasons such as running out of resources rather than to internal ones coming from the logic of the problem. Wicked problems do not allow for objective criteria to define the correctness or falseness of solutions as they can never be true or false. They are only bad or good. Wicked problems posed by the operating environment come as the result of the interplay of many not immediate or ultimate social, cultural, religious and other factors.

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1 Ambrose, G. and Harris, P. *Design Thinking, the Act or Practice of Using your Mind to Consider Design.* Lausanne: AVA Book, 2010. 6-8.; Anderson, W. R., Husain, A. and Rosner, M. "The OODA Loop: Why Timing is Everything". *Cognitive Times,* December 2017. 28-29. https://www.europarl.europa.eu/cmsdata/155280/WendyR Anderson_CognitiveTimes_OODA%20LoopArticle.pdf, Accessed on 2 April 2020.

2 Porkoláb, I. and Zweibelson, B. "Designing a NATO that Thinks Differently for 21st Century Challenges". *Defence Review* 146/S1. 2018. 196-212. https://kiadvany.magyarhonvedseg.hu/index.php/honvszemle/article/view/235, Accessed on 2 April 2020.

3 Liedtka, J. *The Essential Guide to Design Thinking.* Charlottesville: Darden Executive Education, 2015. 3-6.

4 Rittel, H. W. and Webber, M. M. "Dilemmas in a General Theory of Planning". *Policy Sciences* 4/2. 1973. 157-158., 160-167. DOI: 10.1007/BF01405730.

Whatever the solution, it always generates unintended and undesired events, which often outperform the ones originally intended to achieve.[5]

History does matter for such problems since every solution implemented results in events that leave irreversible traces. Attempts to undo or reset past actions pose a significant challenge and represent further sets of wicked problems. Wicked problems do not have an enumerable set of potential solutions. Sometimes no solution can be found, or the selected solution is just as good as any other solution. What should be pursued, implemented, and enlarged is a matter of subjective judgement as wicked problems are essentially unique and exist only in the eye of the beholder. They always yield a distinguishing property of importance since there are no classes that allow for principles of solutions fitting to all members of a class. Despite obvious similarities there is no certainty about the particulars of any given problem.[6]

Wicked problems are always a symptom of other problems. Addressing the problem at any given level can never be logically approached as there is no natural level of wicked problems. Even systemic approaches and incrementalism can often make things worse and not better. Wicked problems are explainable in numerous ways since there is no rule that determines which explanation is correct. The choice of explanation is arbitrary and guided by attitudinal criteria that are most plausible. Wicked problems stand for ambiguity of causal webs in which solutions always point towards further sets of dilemmas. Actions always generate consequences and the events regardless whether desired, undesired, intended, unintended, good or bad matter a great deal to those who are affected.[7]

PROVERBIAL FRICTION

For the military wicked problems come as a result of friction in war. Clausewitz, who introduced friction to military terminology, regarded war as the realm of uncertainty in which three-quarters of the factors are hidden to various degrees. Chance played a great role for him in war as it interferes with the assumed regular course of events. In order to handle uncertainty he also referred to the military genius and called it coup *d'oeil.* It is manifest in a quick recognition that the mind would normally miss or perceive only after a long delay. No science or analysis, but coup *d'oeil* makes it possible to overcome fundamental elements of war such as danger, exertion, uncertainty and chance. According to Clausewitz, the single concept of friction expresses best the restrictive nature of war that can turn apparently easy phenomena difficult. He argued that friction is neither reducible to comprehensible elements nor measurable.[8]

Clausewitz warned that things do not turn out according to expectations. Friction always overwhelms the participants with various disturbing and encouraging effects. It is such a powerful constituent of war that even surprise, which Clausewitz thought to be the key element of victory, can be held up by its force. War displays both human strength and weakness and due to the multitude of factors, no causal concept is definable with any accuracy.[9] Friction reflects the limitation of human insight and the occurrence of unforeseeable accidents

5 Rittel and Webber. "Dilemmas in a General Theory of Planning". 160-162.
6 Rittel and Webber. "Dilemmas in a General Theory of Planning". 163-164.
7 Rittel and Webber. "Dilemmas in a General Theory of Planning". 165-167.
8 Clausewitz, C.: *On War.* London: Everyman's Library, 1993. 101., 102-114., 115., 138-142.
9 Clausewitz. *On War.* 227., 233., 304.

that do not allow for the elaboration and selection of meaningful options even under favourable circumstances. It stands for catastrophes, accidents and missed opportunities. All these indicate that war is more than an act of reason and reasoning is not its foremost activity. The means applied are neither absolutely necessary nor the only ones possible.[10]

War was for Clausewitz to a great extent a guesswork with numerous possibilities and wrong turns in which great results come by limited means. War has its natural inertia and friction goes together with various human failures such as inconsistency, imprecision and timidity. Friction reflects possibilities, probabilities, and luck all indicating conditions without logical reasoning. It is difficult to gauge the resistance as there is always impossible to pair the ends, ways, and means perfectly. Due to friction, causality, exact sciences, and mathematical logic are of little help since waging war was for Clausewitz an art in the fullest meaning of the term. Due to the vast variety of factors, methodological examinations are rarely possible and conclusions reached reflect the intuitive comparison and the qualities of the individual mind. War is shaped by character of men who take and execute decisions rather than by general and universally applicable causal rules.[11] Friction is manifest in inexplicable or random events that fuel the human desire for causality and, at the same time, makes its meaning for war irrelevant.[12]

Thus Clausewitz understood war as a complex web of interconnected constituents with circular causation and feedback loops. In such an environment there is always chance of escalation as tiny differences between causes can lead to completely different effects that indicate the impossibility to predict future time paths.[13] Friction produces wicked problems and stand for the sort of resistance that is responsible for feedback effects, constant novelty and the fact that things in war never go as planned. It is the noise in the system of war and expresses how information distortion and overload can produce uncertainty regarding the actual state of affairs. Friction indicates that it is not possible to calculate in advance exactly in what sequence events will follow and to predict which effect will turn out to be critical and decisive.[14]

CAUSAL RELATIONSHIPS

In order to better understand the properties of wicked problems and the way friction unfolds in war the author suggests a structural analysis that depicts the operational environment as a continuum characterised by an ends/means relationship as seen in *Figure 1*. Whereas ends are placed on the vertical axis characterised by the combination of physical and psychological effects, the means are located along the horizontal axis ranging from destruction to influence. According to the figure effects occur on a spectrum characterised both by tangible and intangible attributes. In a similar way Clausewitz also indicated the existence of a material

[10] Clausewitz. *On War.* 607-617, 623-626.
[11] Clausewitz. *On War.* 692-693, 702-708.
[12] Clausewitz. *On War.* 406.
[13] Stacey, R. D. *Strategic Management & Organisational Dynamics.* London: Pitman Publishing, 1996. 177-179.; Salmon, W. C. "Causation". In Gale, R. M. *Blackwell Guide to Metaphysics.* Oxford: Blackwell, 2002. 35-42.
[14] Beyerchen, A. D. "Clausewitz, Nonlinearity and the Unpredictability of War". www.clausewitz.com/CWZHOME/Beyerchen/CWZandNonlinearity.htm, Accessed on 2 August 2015.

and a non-material domain in war. He emphasised that war is "a trial of moral and physical forces through the medium of the latter" in which "psychological forces exert a decisive influence on the elements involved".[15]

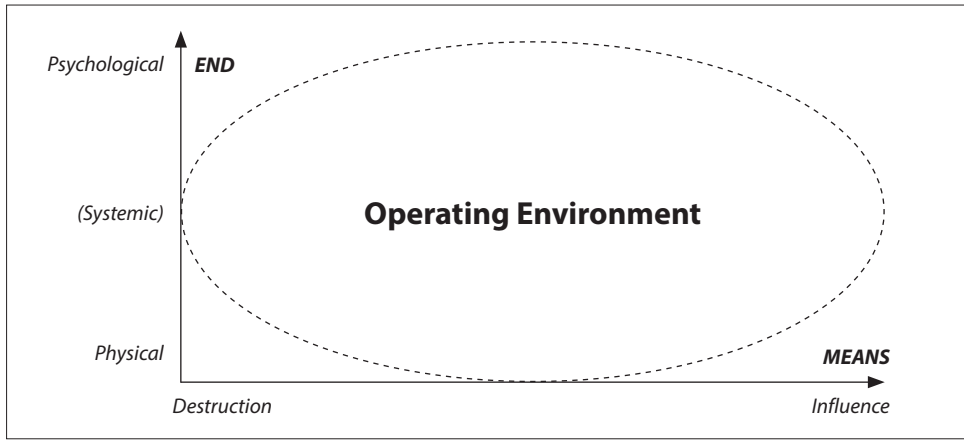

Figure 1 *The operating environment in terms of causal relationships*[16]

The material domain represents categories such as physical strengths and stamina. They describe the space the military tries to influence through combat and manoeuvre. Consequently, the material domain deals with tangible items the enemy usually needs to wage war such as physical platforms and communications networks. This domain is the traditional basis for measuring combat power that has to be rendered useless. The material domain can be defined as a sort of reality proper or ground truth. Attempts to achieve effects in this domain aim at physical ability and serve the purpose of changing functions. The non-material domain is characterised by psychological factors, such as moral strength and stamina. It represents the mind and attributes that generally influence the will in the form of perception, awareness, understanding, belief, and values. Effects in this domain stand for influencing intangibles the enemy needs to wage war. Consequently, effects in the non-material domain aim at changing behaviour.[17]

Despite the difference between the two domains the author assumes a strong correlation between them as physical and psychological factors form an organic whole. In a similar way Clausewitz regarded the physical the *"wooden hilt"*, and the psychological was for him *"the real weapon, the finely honed blade."*[18]

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[15] Quotations in Clausewitz. *On War.* 145.

[16] All figures are the author's own and can be found in his doctoral thesis. See Jobbagy, Z. "From Effects-based Operations to Effects-based Force: On Causality, Complex Adaptive System and the Biology of War". PhD Thesis. Leiden: Leiden University, 2009. 275. https://openaccess.leidenuniv.nl/handle/1887/14044, Accessed on 12 January 2020.

[17] Alberts, D. S. et al. *Understanding Information Age Warfare.* Washington DC: CCRP, 2001. 12-14.; Huss, J. "Exploiting the Psychological Effects of Air Power, A Guide for the Operational Commander". *Aerospace Power Journal* 13/4. 1999. 23.; McNicoll, I. "Effects-Based Operations: Air Command and Control and the Nature of the Emerging Battlespace". *RUSI Journal* 148/3. 2003. 39.

[18] Quotations in Clausewitz. *On War.* 217.

SEMANTIC ISSUES

Although detailing the cause-and-effect-based systemic approach as depicted above to better understand the underlying complex and non-linear properties of the VUCA environment forms the backbone of this article, it is equally important to properly understand what the term 'effect' stands for. Regardless if someone is a native or non-native speaker of English, in normal usage an effect indicates a result or outcome, something that is produced by an agent or a cause. It follows immediately the antecedent as a resultant condition and implies something that necessarily and directly follows a cause. Terms, such as 'result', 'consequence', 'upshot', 'after-effect', 'aftermath', 'sequel', 'issue', 'outcome' and 'event' are all regarded synonymous with effect and generally signify a condition that is ascribable to a cause or a combination of causes. Any further skim onto the dictionary makes it clear that effect refers to so many meanings that it might not obviously promote precision and clarity of military language. As one critical observer ironically remarked, if the proponents of the effects-based approach *"were aware of the many different meanings and usages of the term effect, it is doubtful that they would have made it the first choice among the words they wanted to use."*[19]

The second and probably bigger problem arises from the fact that although an effect follows an antecedent directly, the ultimate military focus is traditionally on achieving strategic, hence higher order, follow-on effects mostly in the psychological domain. Unfortunately, in semantic terms any reference to indirect or higher order effects becomes questionable at best and empty at worst. Semantically these effects should rather be named as 'consequences', 'outcomes' or 'events'. Thus the more one moves towards psychological effects aimed at influencing enemy's behaviour, the more meaningless a causality-based approach becomes as even Clausewitz pointed out that whatever soldiers do *"consequences of some kind [would] always follow."*[20] Even proponents who claim that a causality-based focus is meaningful, state that detecting such relationships is extraordinarily difficult and requires hard thinking. A single action can produce more than one effect, which requires the consideration of all potential consequences of the actions taken. Effects also have a dual nature as they ripple and cascade through the enemy's system. The effect of a given action may induce further changes with the result that it becomes increasingly difficult to predict indirect or higher-order effects.[21] As a rule of thumb it is possible to state that the more the focus moves towards higher order psychological effects the more difficult it becomes to identify causal linkages. Effects are complex phenomena and cause-and-effect relationships are of intricate nature. In order to better understand the mechanism of causality the author suggests examining it along two dimensions such as coupling and interaction as depicted in *Figure 2*. Although the dimensions were introduced originally to understand and study

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[19] *Webster's Third New International Dictionary of the English Language.* Unabridged. Springfield: Merriam-Webster Inc., 1981. 724.; Van Riper, P. K. "Precision and Clarity in Military Language". Manuscript. 5 September 2006.; Van Riper, P. K. *Planning for and Applying Military Force: An Examination of Terms.* Carlisle: US Army War College, Strategic Studies Institute, 2006. 5-6., 13-15.

[20] Quotations in Clausewitz. *On War.* 212.

[21] Among others see Gleeson, D. J. et al. *New Perspectives on Effects-Based Operations: Annotated Briefing*, Alexandria: Institute for Defense Analyses, Joint Advance Warfighting Program, 2001. 13-15.; *A Concept Framework for Effects-Based Operations: White Paper Version 1.0*. Suffolk: JFCOM, 2001. 8-15.; Mann, E., Endersby, G. and Searle, T. *Thinking Effects, Effects-Based Methodology for Joint Operations*. Maxwell AFB: Air University Press, 2002. 25-34.

the way accidents happen, in a slightly modified form they equally explain various causal mechanisms in simple terms. Their combinations indicate four rough areas representing different sorts of causality as interaction can be linear or complex, and coupling tight or loose.[22]

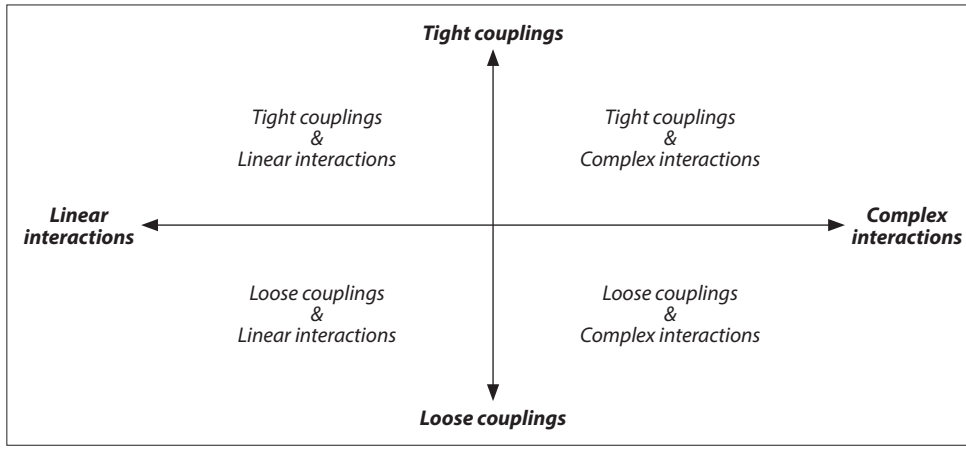

Figure 2 *Perrow's quadrant*

The first dimension that will be explored is interaction. Due to their simplicity and comprehensibility linear interactions allow for visible and simple relationships between causes and effects. Linearity can be anticipated since the underlying sequence of causality is directly comprehensible. Complex interactions indicate branching paths, feedback loops, and jumps from one sequence to another. Here connections multiply in unexpected ways often revealing unintended and unfamiliar effects. Causal relationships are outside the normal and assumed sequence of events as they are either invisible or not immediately comprehensible.[23] Linear interactions can also display invisible cause-and-effect strains but they occur mostly in a well-defined segment and sequence. Complex interactions do not stand for a well-defined segment or sequence as causes and effects can be linked differently and may interact in unexpected ways. Causal processes are more indirect and inferential, with a result that in the case of complex interactions often not even the top of an iceberg is visible. Thus one has to expect a wide array of misunderstood or missed signals and faulty information regarding causes and their likely effects. Whereas linear interactions have minimal feedback-loops and are generally clear and concise, complex interactions are more likely to display unanticipated or unintended relationships.[24] The second dimension is coupling, which refers to slack or buffer in cause-and-effect relationships. Tight couplings do not contain slack or buffer. It refers to direct causality since an effect is directly coupled to a cause. Loose coupling can best be characterised by ambiguity and flexibility in which the absence of intended connections can remain unobserved. Whereas loose couplings make possible to display own logic and interest in terms of causality, tight couplings restrict such attitudes. Unlike loose couplings, which are more stable since they can accommodate shocks

[22] Perrow, C. *Normal Accidents, Living with High-Risk Technologies.* New York: Basic Books, 1984. 63.
[23] Perrow. *Normal Accidents...* 75-78.
[24] Perrow. *Normal Accidents…* 79-85.

without destabilisation, tight couplings generally respond in a quicker and more disastrous fashion to perturbations.[25]

To wrap-up the preceding structural analysis the author states that linear interactions indicate spatial segregation and dedicated connections. They refer to attributes such as easy substitution with only a few feedback loops and allow for single purposed and segregated control since the emphasis is on direct information that makes an extensive understanding possible. Complex interactions are based on proximity and common mode connections. They display interconnectedness, which means limited substitution and many feedback loops, and require multiple and interacting control standing for indirect information and limited understanding. Tight couplings do not make delays possible. Due to the underlying invariance of sequences there is only a small amount of slack. Should buffers and redundancies exist, they are mostly built-in features that allow only for limited substitution. There is hardly any spatial and temporal separation between a cause and an effect. Loose couplings allow for delays due to the changeable order of sequences. The result is extended and often unanticipated sets of alternative methods, slack and buffers in which substitutions are fortuitously available.[26]

DIFFERENT AREAS

The examination of coupling and interaction in the form of a structural analysis makes it possible to subdivide the operating environment into four interrelated areas. Linear interactions refer to highly structured, logical, sequential, and predictable cause-and-effect relationships. In contrast, complex interactions offer less predictability due to the presence of unplanned and unforeseen relationships. Tight couplings can be described by high centralisation and rigidity that allow for a close monitoring and a certain tolerance. Loose couplings mean decentralised operations and allow for a wide variety of outcomes in terms of effects.[27] The four areas with different characteristics can be projected on the operating environment as depicted in *Figure 3*.

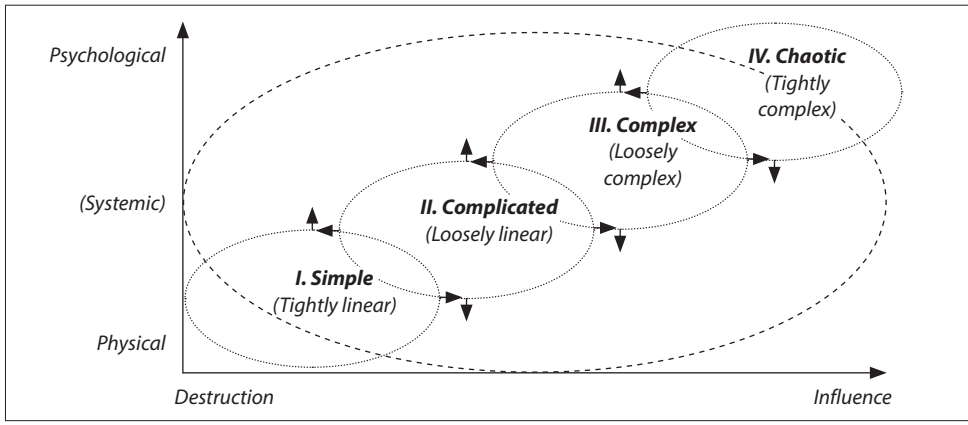

Figure 3 *Four different areas of the operating environment*

[25] Perrow. *Normal Accidents…* 86-92.
[26] Perrow. *Normal Accidents…* 93-97.
[27] Czerwinski, T. *Coping with the Bounds, Speculations on Nonlinearity in Military Affairs.* Washington DC: CCRP, 1998. 89-92., 96-98.; Perrow. *Normal Accidents…* 332.

The four areas stand for different sorts of causal relationships and are based on structural analysis, they can be named as 'simple', 'complicated', 'complex', and 'chaotic'.[28] In general one can say that the more one moves from the first area to the last, from tightly linear to tightly complex, the more the level of causality decreases and in the case of the latter it can disappear entirely. Even if it is possible to discern causality in terms of physical effects, due to the underlying mechanism it is mostly impossible to see which way a particular effect relates to subsequent and desired indirect or higher order psychological effects. The growing instability of couplings and interactions points towards difficult-to-decode causal relationships. Area I can be described as simple and stands for linear causality indicating known causes and effects. One can discern clear and visible cause-and-effect relationships that allow for prediction. Due to their empirical nature, causal relationships are not open to dispute and planning for effects makes sense. This area can be characterised by the predominance of centralised causes and centralised effects. Area II can be described as complicated and refers to knowable causes and effects. Although causal relationships exist, due to spatial and temporal separations they might not become fully known. The relationship between causes and effects are generally difficult to comprehend, which indicates limitations in terms of prediction. Planning for effects still makes sense but one must take into account that centralised causes increasingly yield to decentralised and unexpected effects. Area III can be described as complex. In this area cause-and-effect relationships still exist but they defy most attempts at categorisation or other analytical techniques. Effects can be perceived but not predicted as their relationship is not open to any inspection. Both interactions and couplings indicate that causes and effects are mostly decentralised and appear coherent only retrospectively but even then causality is subject to debates. Area IV can be described as chaotic. In this area no visible cause-and-effect relationships exist, which indicates that causality is not really perceivable. The amount of factors together with spatial and temporal separations make prediction either impossible or allow only for very general terms. In this area it is not possible to plan for effects or discern causal relationships in a meaningful way.[29]

In tightly linear systems anyone can detect causality. In loosely linear systems only experts might detect causality, in loosely complex systems causality often becomes clear only retrospectively. In tightly complex systems there is no discernible causality that can guide actions in a meaningful way.[30] The more the focus shifts towards tightly complex attributes the more unpredictability takes hold. It seems that the ultimate military focus on indirect or higher order psychological effects stands for an area where it is very difficult if not impossible to detect and exploit causality. Even the area in which it is possible to discern direct causality interacts with areas that are rather unpredictable. Consequently, one must expect novelty everywhere in war. Thus the Clausewitzian assumption that in war everything is simple but even the simplest thing can become difficult generally takes hold. The four areas reflect that if there is no firm basis for comprehending the initial state with all the factors that must be considered, there is no basis to judge which of the possibilities should be regarded

[28] Jobbagy, Z. "Wars, Waves and the West: Putting Effects-Based Operations into Context: TNO report DV1 2004 B077". Hague: TNO, 2005. 47-57.

[29] Kurtz, C. F. and Snowden, D. J. "The new dynamics of strategy: Sense–making in a complex and complicated world". *IBM Systems Journal* 42/3. 2003. 468-469.; Snowden, D. and Stanbridge, P. "The Landscape of Management: Creating the context for understanding social complexity". *ECO Special Double Issue* 6/1-2. 2004. 144-145.

[30] Kurtz and Snowden. "The new dynamics of strategy…" 472.

as desired effects. In general even if the causality-based approaches worked, they would offer considerable promise only for physical effects. In the case of psychological effects they appear to be pretty hopeless. Unfortunately, this is the area of the ultimate military focus. In the case of systemic effects the concept touches the borderline that separates prediction from pure guesswork. Focusing on causality is generally good for creating desired physical effects and might occasionally be good for generating desired systemic effects. However, in the case of psychological effects the causality-based approach does not work well but on occasion it might contain a useful set of information.[31]

DESIGN THINKING

Analysing the continuum of war along the four areas makes it possible to see the way structures form and dissolve. The areas make it clear that the operating environment stands for a general unpredictability and explain why a novel approach such as design thinking is needed. Moving towards the end-pole characterised by 'physical/destruction' indicates direct causality and prediction, but the value of the effects achieved is seen by the military as low. Although effects achieved around the 'psychological/influence' end-pole have high values, they increasingly prohibit predictions in causal terms. The operating environment stands for a place in which chaos meets order constantly in a disorderly way: pre-order meets order in disorder as occurrences move continuously back and forth through the areas. Due to such attributes the operating environment can best be described by the term 'complexity' as it denies the primacy of order and causality, and the drive for efficiency and constant affirmation. Tackling this complexity requires design thinking promoting freedom and openness, action and possibility.[32]

Design thinking demands that the various interdependences of the operating environment should be better taken into account. Links between causes and effects can become distant in time and space and in the case one proceeds as if *"simple linear links exist even if we do not know what they are, then we are likely to undertake actions that yield unintended and surprising results."*[33] Complexity displays a bewildering array of effects that spans over several scales. This complexity of the operating environment features emergent properties that come from the constant interplay of chaotic and non-chaotic forces. The result is continuous evolution and adaptation that contain a network of various alternatives. Design thinking as an approach offers more than analytical reasoning and focusing on causality since the combination of interactions and couplings often produce unforeseeable results. It helps to deliver at least an explanatory framework to better understand the consequences of actions,

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31 Lorenz, E. N. *The Essence of Chaos.* London: UCL Press, 1993. 102-110.

32 Lefebvre, E. and Letiche, H. "Managing Complexity from Chaos: Uncertainty, Knowledge and Skills". *Emergence* 1/3. 1999. 7-15.; Axelrod, R. and Cohen, M. D. *Harnessing Complexity, Organizational Implications of a Scientific Frontier.* New York: The Free Press, 1999. 28-31.; Lissack, M. R. "Complexity: the Science, its Vocabulary, and its Relation to Organizations". *Emergence* 1/1. 1999. 110-125.

33 Stacey. *Strategic Management…* 273-276. (quotation p. 275); Tasaka, H. "Twenty-first-century Management and the Complexity Paradigm". *Emergence* 1/4. 1999. 115-123.

and the spatial and temporal effects they generate.[34] The operating environment reveals both deterministic outcomes and random fluctuations. This constant shuffling between stability and instability explains why war can display *"growth and decay, capture and domination, periods of opportunity for alternative developments followed by solidification of the existing domination structures."*[35]

The four combinations allow for establishing generalised areas in the operating environment as depicted in *Figure 4*. In these areas different characteristics overlap and constantly influence each other. Linearity goes together with non-linearity, and stability always co-exists with complexity and chaos. Whereas stability stands for simplicity and linearity reflecting a tight and linear relationship between causes and effects, non-linearity points toward chaos that can be described by extreme sensitivity to initial conditions. The biggest area within the continuum of war is complexity proper, which stands for non-linearity, far-from-equilibrium conditions and emergence. The figure clearly shows that although war contains linear properties, its mechanism is mostly defined by non-linear attributes. Consequently, there must be a rethinking and reconsideration regarding the basic mechanism that drives the causality-based approach and a shift in the reasoning away from prediction aimed at identifying desired effects.[36]

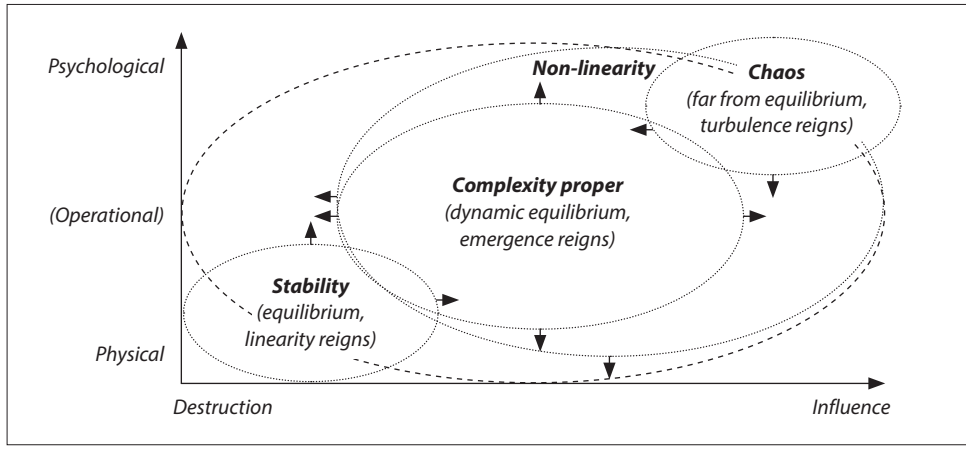

Figure 4 *Overlapping characteristics of the operating environment*

The operating environment displays emergent and interactive attributes that come as a result of unstructured or structured but non-additive interactions. Its complex and non-linear attributes are more than the sum of the constituents and feature a general unpredictability

[34] Levin, S. A. "Complex Adaptive Systems: Exploring the Known, the Unknown and the Unknowable". *Bulletin of the American Mathematical Society* 40/1. 2003. 3-19.; Baranger, M. "Chaos, Complexity, and Entropy: A physics talk for non-physicists". 9-11. http://necsi.org/projects/baranger/cce.pdf, Accessed on 24 November 2015.; Cilliers, P. *Complexity and postmodernism: Understanding complex systems.* London: Routledge, 1998. 2-5.; Nicolis, G. and Prigogine, I. *Exploring Complexity: an introduction.* New York: W. H. Freeman and Company, 1989. 5-8., 31-32.; Prigogine, I. and Stengers, I. *Order out of Chaos: Man's New Dialogue with Nature*. London: Heinemann, 1984. 131-137.

[35] Stacey. *Strategic Management…* 324-329. (quotation p. 324)

[36] Czerwinski. Coping with the Bounds… 39-60.; Briggs, J. and Peat, D. F. *Turbulent Mirror: An Illustrated Guide to Chaos Theory and the Science of Wholeness.* New York: Harper & Row, 1989. 174-180.

in relation to the input. The constant adjustments and adaptations result in multiple and often unexpected paths.[37] Exploiting VUCA attributes of the operating environment requires an approach that makes everything-affects-everything-else mode possible to get a grip on the entire web of various connections. The messiness of the operating environment cannot be examined through conceptual elegance reflecting rational thinking, deductive logic and analytical categorisation. It contains novelty that often comes from simple properties producing emergent and unpredictable effects. VUCA attributes contain structures to which different laws, concepts, and generalisations apply. In the operating environment there is an infinite variety of possibilities and a general unpredictability regarding causes and their likely effects.[38]

CONCLUSION

The causality-approach emphasises deductive reductionism and causal laws in order to help predict desired effects. The supporting assumption is that the operating environment displays order and equilibrium, the possibility for rational choice, and the ability to steer and control events. The VUCA attributes of the operating environment stand for variety and novelty in which certain properties remain inherently unknowable to the human mind. The preceding short analysis revealed that although the operating environment can be described in general terms using causal relationships, effects that go beyond the immediate spatial and temporal horizon cannot be predicted with any accuracy and require a different approach. Design thinking as a novel tool indicates something very different than the fundamental assumption of the causality-based approach, namely that it is possible to comprehend only some things especially those that are localized both in space and time. Everything in the operational environment is interrelated and all we can attain is nothing more than a temporary and partial interpretation. Complexity reminds us of the fact that the military often confuse causation with correlation and simulation with prediction. Whereas the former refers to the preference for creating retrospective validation to identify best practices, the latter points to the fact that even if it is possible to simulate something, it does not obviously mean that it is possible to equally predict its future.[39]

The operating environment is full of discontinuities and uncertainty. All indicate a general unpredictability that makes both individuals and organisations disoriented. The international arena has been a messy place since the demise of the bipolar world-order. During turbulent times in which orientation becomes difficult, humans increasingly turn to panaceas for advice. In the case people do not understand or cannot cope with challenges they often

[37] Russ, M. and Bacon, J. "Organizational Extinction and Complex Systems". Emergence 1/4. 1999. 75-79.; Griffin, D., Shaw, P. and Stacey, R. "Knowing and Acting in Conditions of Uncertainty: A Complexity Perspective". *Systemic Practice and Action Research* 12/3. 1999. 302-304. DOI: 10.1023/A:102240380230.

[38] Waldrop, M. M. *Complexity, The Emerging Science at the Edge of Order and Chaos.* London: Viking, 1992. 38-39., 60-63., 81-83.

[39] Flood, R. L. "Knowing the Unknowable". *Systemic Practice and Action Research* 12/3. 1999. 247-252. DOI: 10.1023/A:1022447617323.; Kurtz and Snowden. "The new dynamics of strategy…". 462-463.; Snowden and Stanbridge. "The Landscape of Management…". 146.; Stacey. *Strategic Management…* 346-347.

look for simple or simplistic solutions that promise quick help.[40] Design thinking is very different from that. It stands for a creative process balancing with several different possible futures where there is not always time for mechanical, deductive systemic analyses aimed at detecting causality. The most important message of design thinking is that instead of focusing on certain desired effects, emphasis should be on the ability to respond consistently to unpredictability. War cannot be waged based on single and prescriptive models but it requires that we adapt and evolve rapidly in order to handle dynamic and changing situations similar to the biological evolution of species.[41] The serious contradiction between the basic assumptions of the causality-based approach and the complex nature of the operating environment naturally raises the demand for a better conceptualisation. Unpredictability indicates that even with design thinking one must be satisfied with understanding certain general features in terms of correlation rather than attempting to discover a mechanism that directly links causes with effects. Consequently, the unpredictable nature of the operating environment should be regarded as an opportunity that can explain qualitative behaviour instead of inaccurately predicting futures in terms of desired effects.[42] And exactly here comes the power of design thinking fully to the fore…

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