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"C2 and Agility"

Wicked Problems and Comprehensive Thinking in Irregular Warfare

Topics: 3, 8, 10

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1. The "Wicked Problem": Globalization and "Messy Social" Challenges

Irregular Warfare is defined in DoD's IW Joint Operating Concept (JOC) as "a violent struggle among state and non-state actors for legitimacy and influence over the relevant populations …[1]. While the JOC may be new, the concepts of IW are not. Entities unable to field or unwilling to challenge a "regular" (or conventional) force have used IW techniques for centuries. While some may want to functionally assign military, diplomatic, informational and economic activities to their respective silos – reality is not so neat. An adversary employing IW is taking a more comprehensive, long term and politically motivated view of their reality. While unable or unwilling to challenge a conventional military in the classic domains, irregular warriors know they can exhaust the patience of an enemy who may not possess the will for a protracted struggle. IW requires more than a military response. It requires multiple instruments of national power to coordinate an effective counter. Some security experts call this more holistic view the "comprehensive approach" (NATO, UK). Other words that cover the same challenge in slightly different ways are "whole-of-government," "networked security" (Germany)[2], Unified Action (USA), and the latest term du jour – hybrid warfare[3]. Words are easy, execution is difficult. So what's new?

The impact of globalization has not been limited to the developing world nor to the problems of interlocking markets and financial structures. The accompanying information and communications revolution has left few peoples unaffected; the more traditional and isolated the society, the greater appears to be the social, cultural, and political impact on existing institutions. Non- or sub-state movements and failing states which cannot control their own borders have undermined the idea of "sovereign" states which lies at the core of international legal, diplomatic and political structures including the laws of armed conflict. Super-empowered individuals with weapons of mass effect can now tap into the globalized network to do real harm. The internet and news media have been exploited by non-state and terrorist movements eager to use them to their advantage.

Irregular warfare

This far-reaching conundrum has brought what has come to be called "irregular warfare" to the fore. Although it can be argued IW is not "irregular" for much of the world, is not new and has in fact been used throughout history, and involves much more than warfare[4] -- it departs from a model of inter-state war based on physical attrition of the means of waging war that has dominated Western military thinking for most of the past 150 years. It is instead focused on what General Sir Rupert Smith termed "war amongst the peoples."[5] The challenges of irregular warfare

are about human beings, human actions and human organizations of all shapes and sizes in competition and conflict and in peacetime and crisis response operations as well as in the combat operations of declared interstate wars. The battles are for minds and hearts and "victory" is about changing perceptions. The objectives are not so much conquest as "suasion" – actions to persuade or dissuade depending on the observer. Such "warfare" is less about physical attrition and more about psychological attrition that gradual wears down the will, a war that is waged in cyberspace and the global media especially targeting ones close to home. The Westphalian concepts of formally declared wars and peace treaties are replaced by a continuum of on-going, ever-changing, and multi-dimensional interactions that include economic, business, social, cultural, religious, political, diplomatic and military forms of competition -- from friendly and cooperative interactions all the way to deadly armed conflict. All of these events are interconnected and cannot be isolated or separated into neat categories, nor can we think any more in stark terms of friend or foe. Rather, we must deal with a wide spectrum of "actors" who may change roles from friend to foe to neutral depending on the evolving situation. Success in irregular warfare therefore hinges on our ability to deal with a host of "wicked problems" and "messy social" changes. It is, in brief, about coping with complexity.

What are "wicked" problems?

"Wicked problems" have neither a definitive formulation of the problem nor a replicable solution. Since each problem is both unique and part of an interlocking web of related problems, there will be disparate views of what the problem is, enumerable potential solutions and no definable and universally recognized end-state. There are no right or wrong answers; only those that are better or worse, good enough or not good enough.[6] If we carry this characterization to a logical conclusion, it might appear that wicked problems are chaotic, that solutions are random guesses, that we understand little and can predict nothing … and that there is no such thing as a rational actor. However, in reality the problems are not so much "wicked" as complex. The human beings, human actions and human organizations that are at the heart of wicked problem are "messy" and complex because they involve a seemingly endless array of interdependent variables, constraints, uncertainties and ambiguities, divergent viewpoints and conflicting values, all operating in complex social context.[7] But, they are problems we deal with every day. It is also why humans in the loop are the key to dealing with wicked or complex problems.

2. Complexity and Living Systems

The challenges and characteristics described above are basically those of complex systems. We may not be able to "solve" such problems in the classic sense of the scientific method, but we can bound them, that is, reduce to a core of most likely explanations and answers that are sufficient for planning and responding. We can explain this process in terms of Complexity Theory and Living Systems Theory. The first describes the problem and the limits of what we can know or measure while the second helps put it into a real world context.

Complexity Wicked problems are actually about complex systems characterized by the on-going interaction of many continually changing interdependent variables to the degree that we can never fully know all of the variables or how they will interact and, as a result, cannot precisely predict their behavior. Furthermore, these changing constellations of variables are interconnected in time, space and function, are shaped by what has gone before and help influence what follows. They can affect other systems in their geographic area or other areas that may appear far removed. Small actions in one system can produce disproportionately large effects in others and vice versa. Finally, as this interconnectedness implies, complex systems cannot be separated from the whole without changing the character both of the system itself and of the whole.

This complex, wicked "mess" can perhaps best be illustrated by the distinction between the English words complicated and complex. To use an example, a car engine is complicated to the point that operators may not know the exact cause and effect chain between pressing the accelerator and the car moving. They just know that pressing the accelerator produces a predictable outcome. They also know that output is proportional to input: the harder they press the pedal, the faster they go. The predictability and proportionality of input and output derive from the fact that the engine contains a series of known constants and linear cause and effect chains. It is complicated but not complex. If the engine were "complex," we would not know precisely what would happen when we pressed on the accelerator because we would never know all of the interdependent variables involved or how they interact at any given time. We would only know that the chain of causes and effects would probably never be the same twice and that the car would react in ways we could not predict. As a result, there would be no repeatability and no proportionality between inputs and outputs. If the complex engine were also a complex adaptive system, our uncertainty would expand. Not only would we be hard pressed to trace the cause and effect chain involved, but the engine would adapt to its environment independently of anything we did and do so in ways that we could not entirely predict. In brief, it would act more like a living system than a mechanical system.

Living Systems[8] At the core of the irregular warfare challenge is the fact that human beings, human organizations and the security environment as a whole are living, co-evolving complex adaptive systems. And at the core of a solution is the fact that all such living systems are survivors of a Darwinian selection, products of a continuing, interlocking co-evolutionary process, that has taken two distinct forms: the biological evolution of cells, organs, animals and man; and the sociological evolution of groups, organizations, communities, societies, states, and the international security environment as a whole (Figure 1). The latter—the evolution of human organizations—is purposeful in that it is the aggregated fruit of human assessments, opinions and decisions; for better or worse. In essence, these living human systems learn and adapt as they deal with their

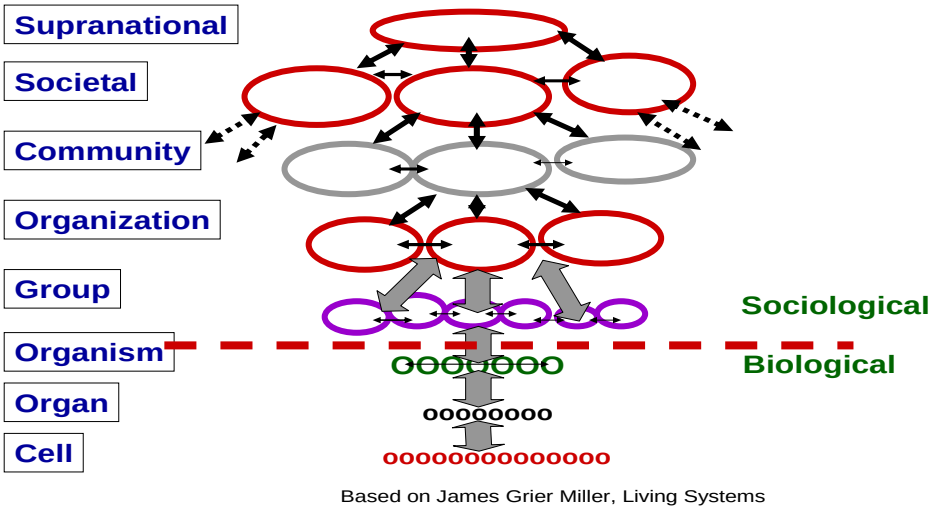

Figure 1

changing human and physical environment. Paradoxically, this implies that the "stability" of any human system actually derives from a dynamic ability to learn, adapt and change. In fact, because the environment is always changing, stasis or the failure to evolve would signal a system's eventual demise. Because evolution implies "survival of the fittest," we should be able to understand why certain systems, organizations and societies survived or failed and identify the processes and capabilities that were critical to their survival, e.g. learning and adaptation. Living systems theorists have identified 20 such "essential processes" common to all complex adaptive living systems.[9] These processes are reflected in the nature and actions of all human organizations and provide a starting point for any analysis of the systems or their actions.

3. Decision-makers and Decision-making

The idea of cumulative purposeful change embodied in sociological evolution puts man squarely in the center of any attempt to deal with the challenges of irregular warfare. This is to

say that we must understand not only the mechanical interaction of systems, but also the way in which the human decisions that engender change are made and how they evolve over time. Three constructs are relevant: the "rational actor," the decision making process itself, and the process of learning and adaptation.

The "Rational Actor"

In dealing with irregular warfare, if we were to assume a world of "irrational" actors, there would be little hope of bounding the problem sufficiently to cope with it or of having the rational behavior on our own part to even try.[10] But, what is a rational actor? The dictionary defines rationality as "the latent power to make logical inferences and draw conclusions that enable one to understand the world about him and relate such knowledge to the attainment of ends."[11] But this does not mean that to be rational is "to think like me." The message of complexity and living systems theory is that rationality, like the behavior of any complex adaptive system, cannot be separated from the whole without losing its meaning. By extension, this warning translates into two caveats.

- First, rationality as a complex behavior can only be understood within a specific context that has social, cultural, religious, economic, political, diplomatic and other dimensions, that has a "where you sit" structural and organizational setting, and that has an individual or group character based on education, experience and training.
- Second, given the continually evolving nature of complex adaptive systems, any context reflects a snap shot in time, the product of a particular constellation of variables and a physical and psychological environment within which the individual or group of decision-makers operates at a particular time. As this implies, the rationale should be expected to vary as the constellation changes.

The assumption of a "rational actor" even so contextualized might seem a shaky reed upon which to base any irregular warfare analysis but in fact, much of daily life is built around such an assumption.[12] Most of the social sciences work from a similar assumption of the basic rationality of human beings -- from Wall Street bankers to cannibals -- even though the rationality of one might appear totally irrational to the other. This same reliance on a rational actor construct is apparent in the work of historians and political scientists who see the rationale for a given action deriving from a particular constellation of variables and seek to understand the interaction of individual and organizational actors in this context. As history makes plain, the variables change over time as the natural and human environment evolves, as decision-makers shape and are shaped by that environment or are replaced, as thinking is shaped by the changes, and as organi-

zations and individual decision-makers learn and adapt. History is also important because it provides a data base that retains the entire complex holistic context of past problems and solutions as well as a running picture of this context. It enables us to take snapshots of particular constellations of variables and trace how they developed or how particular actions taken resulted in one or another set of outcomes. And, it enables us to identify which variables proved to be important at a given time and "tag" them to discern trends that might prove significant in a similar situation. By assessing the complex whole or a problem and by putting it in a retrospective context provides, history also provides a library of analogies and metaphors for communicating complex ideas and understandings about similar situations, a complexity shorthand used among decision-makers and in the larger society, for example the numbers 9/11 convey an understanding that could take up books.

Action-Reaction Cycles and Decision-making

Living systems theory gives us a model of a human system of complex adaptive systems in a state of continual and purposeful evolution fed by a stream of human decisions. The "rational actor" offers a construct for understanding the decision-makers. But there is another piece to the conceptual puzzle: the decision-making process itself. This process is rooted in the stimulus and response process basic to all sentient living systems. Yet, the purposeful decision-making outlined above implies more than a purely reflexive response. This process has come to be embodied in John Boyd's Observe, Orient, Decide and Act or OODA loop, that is, the decision-makers *observes* a problem of action, *orients* his thinking to consider the action and its implications for him, then *decides* on a course of action, and *acts* in some way.[13] This cycle can then be repeated time and again in an on-going spiral as first one and then the other actor continue the interaction.

Spirals of Action-Reaction Cycles With Spin Off Interactions

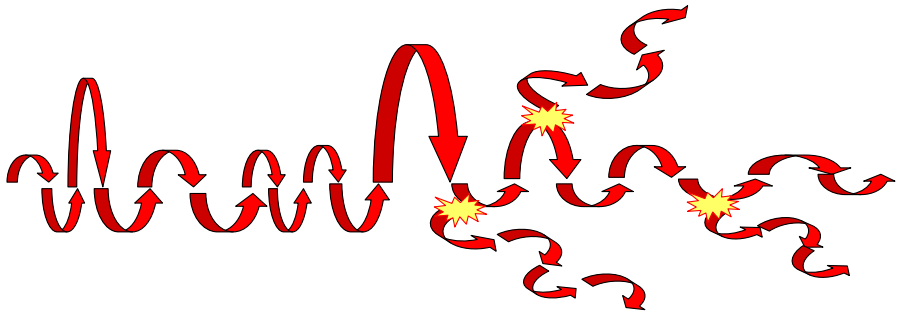

Figure 2

Although written for fighter aircraft engagements, Boyd's OODA construct is now broadly applied to all sorts of interactions and is widely accepted across government and industry. This OODA loop is consistent with both the behavior of complex adaptive systems and living systems framework. This is especially true because the OODA "loop" actually depicts an on-going spiral of cycles in which each interaction is shaped by those that preceded it and shapes all the interactions that follow (Figure 2). But as the preceding discussion of complex adaptive systems underlines, there are two things missing from the OODA construct:

- the context within which the actors decide without which neither the rationale nor the interaction can really be understood; and
- the multi-dimensional nature of any interaction that affects all parts of the living system.[14]

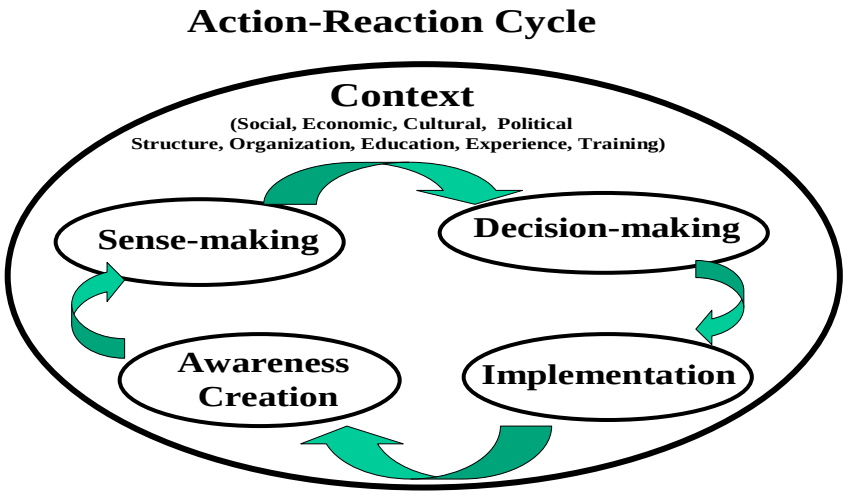

Figure 3

These ideas can be drawn together in an *action-reaction cycle* that includes the ideas of the OODA loop but expands on them and, most importantly, puts them in a larger organizational, social and system of systems context.[15] As used here, the context is both internal and external. Internally it is what defines one's own system identity and organizes and defines the limits of consensus within an organization and thus the internal limits of its freedom of action short of seeking anew consensus or changing the organizational culture. It is the complex context for all understandings, processes, information and knowledge including both the internal overarching and housekeeping functions that support and regulate the organization. Externally, it is the environment of interacting and co-evolving systems in which the organization and its action-reaction cycle are operating and encompasses the on-going spiral of interactions with those systems. As with any complex adaptive system, neither the action-reaction cycle nor any part of it can func-

tion shorn of this social, economic, cultural, political, and diplomatic context, nor can the external environment be understood if removed from the vast array of interdependent variables. The utility of the action-reaction cycle in this context is that it offers the possibility of examining each step in detail, breaking each down into separate tasks and groups of essential processes that the organization must accomplish to survive and succeed.

Learning and Adaptation

The living systems model and the discussions of the rational actor and of the decision-making process make clear the need to adapt to a continually changing constellation of variables and in turn the need for a continuing process of learning, a need that occurs throughout the entire system of complex adaptive systems from the strategic corporal to national leaders -- in fact everywhere human decisions are required. Indeed, it is the ability to learn and adapt that is central both to the process of sociological evolution and in the way that human complex adaptive systems cope with more immediate challenges. We can break this process down into five levels of adaptation: adaptive action, learning, learning to learn, defining/ redefining success, and co-adaptation.[16] *Adaptive action* is the immediate tactical action and reaction as one actor, our strategic corporal for example, learns and adapts to the actions of another. *Learning* implies a process of evaluating this interaction for lessons to be learned and disseminating those lessons, e.g. information shared over the Company Commander's Net in Iraq. *Learning to learn* takes this the next step to address how we adapt the ongoing process of learning to better capture and disseminate the lessons learned. *Defining or redefining "success"* involves a higher level adaptation in which the original objectives, risk versus gains calculus, capabilities applied and approaches to achieving those objectives are reassessed and adapted to changing circumstances. Finally, *co-adaptation* is the process of translating lessons learned from a set of external interactions into organizational and institutional changes to better deal with change. Together they outline a process that occurs through multiple layers and many individual actors in the living system.

4. Coping with the Complexities of Irregular Warfare

Since by their nature, complex problems are ever-changing and endlessly interconnected and have no right or wrong "solution," we are left to cope with a challenge for which we will never have exactly the right answer and whose consequences we will never be able to predict precisely. In this ever-changing challenge, we cannot analyze every possible explanation or prospective solution for even if we could come up with the "right" answer the process of getting there would probably take so long that the problem would have changed to the point that the answer

was no longer applicable. Although this certainly sounds "wicked," we do *cope*[17] with such problems in the complex human interactions of our daily lives. We do so by bounding problems, solutions, and potential consequences to come up with the best answer possible in the time available.

The Three-fold Synthesis

The discussion in the preceding sections points to a synthesis of three concepts: complexity theory, living systems theory and decision-making models.

Complexity theory describes in some detail the nature of the problems and solutions. Most importantly, it tells us that the actions and reactions of the human dimension of competition and conflict are not random or infinitely varied, but simply complex. Thus, we can assess and understand how and why events occur; we can bound problems, solutions and outcomes to a limited number of possibilities; and we can learn, adapt, and organize to optimize our ability to understand and deal with complex problems. Finally, as all of the above hints, we can identify and develop metrics and tools for coping with complex problems by separating the tasks and analyses into two categories, those that are susceptible to linear metrics and deductive analysis and those that are inherently complex and require an inductive holistic approach centered on human assessors and decision-makers.

Living Systems theory provides the context for complex and complex adaptive systems and, thus, for all of the above approaches and tools. It offers an interdisciplinary, interactive, co-evolving, multi-layered internal model that puts the complex adaptive systems and systems of systems with which we must deal into a comprehensive real world context in which all of the elements have social, cultural, economic, political, diplomatic, etc. contexts and historical precedents for their interactions. The fact that the interdependent variables in question are real world systems of specific types opens them to known social science methodologies while their history offers a data base for studying how the variables have changed and interacted over time. When this systemic framework is combined with an ability to identify a limited number of common recognizable essential processes, we can begin to dissect the decision-making processes of vastly different actors to better assess their actions, limitations and vulnerabilities … and our own.

By combining a contextualized "rational actor" construct of an individual or organization with the ideas of complex systems and of purposeful sociological evolution emerging from individual and aggregated human decisions, we arrive at a concept for bounding the behavior of complex human systems. The combination of the rational actor, action-reaction cycle, and multi-level

learning and adaptation constructs then permits decomposition of a problem into sets of processes.

Bounding

The objective of bounding is to narrow an almost limitless field of possible answers to a manageable list of most likely answers to three kinds of questions: what is the actual problem we are trying to solve, what might be potential responses, and what are the likely consequences of our actions or inaction. To understand a problem, we must attempt to identify its roots, detect patterns and trends in what we can observe and project them into the future. We must estimate the implications of these trends and patterns; and explore options to include assessing and evaluating their potential consequences -- both good and bad. This is where the bounding becomes necessary. We may not have a definitive answer to all these questions but we can generate answers that are <u>good enough</u> and if we do our work well, that are better than our competitors – the true metric for a good response. The starting point is a set of five bounding tasks: (1) knowing what we know; (2) knowing what we do not know; (3) knowing what can know; (4) knowing what we cannot know or cannot know in time: and (5) knowing what the answer cannot be. To the degree that we can master these tasks, the probability of a good enough answer increases. However, the tasks likewise point to areas in which analytical tools, information tools, and modeling tools might help if they can be tapped within the time available. The combination of complexity and living systems theory offers three contributions to this tool kit: internal models, building blocks, and tags.

Internal Models provide the context for a complex problem or actor. They open the door to understanding the problem in its holistic context. Such models need not be fixed or highly detailed merely sufficient to explain roughly how things might fit together. Given the ever-changing constellation of variables, the models also must be iterative, changing both as the subject changes and as more information becomes available. Living systems theory provides such a multi-level, continually changing and evolving model for the system as a whole and its interacting component groups and organizations. The action-reaction cycle provides a more detailed internal model for the actions of the human actors that also changes and evolves as the system does and as the decision-makers learn and adapt to changing circumstances.

Building Blocks are the component pieces of a problem or system. They may be things, forces, actors or other complex adaptive sub-systems in a larger system, e.g. the agencies, offices, or responsibilities, in an organization, or functions and “essential processes” that need to be undertaken for something to work. If we know the internal model well enough, we should be able to

identify the basic building blocks of its component parts and with them many of the factors influencing the problem.

Tags or indices are observable aspects of a problem that can be tracked so as to identify emerging patterns and trends either to understand the problem and how it developed or to forecast the direction it is likely to take. While we may not be able to identify all of the factors influencing a complex problem or appreciate how they might interact, the ability to discern and trace the interactions of a few significant factors or actors can be the key to understanding enough of the problem and where it is going to make logical decisions. A famous example of such tagging was monitoring the price of rice as an indication of local security based on an internal model hypothesis that the less the insurgent threat the easier it would be to get food to market and the lower the price would be. As one might expect in a complex problem, this tag was not decisive as other interlocking factors could equally have explained the changes in price. Rather, as with any other tag, the indicator needed to be understood in a larger context and needed to be revisited as that context changed. Nonetheless, it did provide some way of tracking a knowable element grounded in the essential processes common to all systems as a surrogate for performance of the system as a whole.

Complex versus Linear

It is sometimes argued that the complexity of the Irregular Warfare problem renders it an art in which tools have at best a limited place. Certainly it remains true that a complex problem can only be understood as a whole and that this understanding is inherently human, but it is also true that not all aspects of a complex problem are complex. In fact, a vast majority of factors in a complex problem may be subject to conventional statistical and other analysis. What makes most problems complex is their human dimension. Rather like multiplying a long list of number by zero, it only takes one human decision in a process to render it complex because that decision will be the fruit of a complex personality embedded in a web of complex organizations all of which will influence decisions and make them less predictable. The challenge is to recognize and distinguish between challenges that can be defined and solved and those that are open-ended, lack a clear definition and, as a result, can only be bound.[18] This distinction is critical because it is what enables us to use all the tools available in the social, information, and hard sciences in bounding complex problems. We may not be able to know fully or predict precisely the human input, but we can study and dissect the linear aspects of a question and then use the results to reduce uncertainties and ambiguities and increase the probability of good decisions. The decision-making in-

ternal model offers a way of distinguishing between inputs that are linear and thus subject to conventional analysis and those that are either human or are shaped by human inputs.

5. Tools and PEOPLE

The tools to support irregular warfare fall into two distinct categories: those for aiding human decision making by bounding problems, uncertainties and ambiguities and those for choosing, optimizing and networking the humans in the loop from the strategic corporal to the chief executive and from the neophyte to the subject matter expert. The first group will center on the specific tasks inherent in the decision making processes. The second group by contrast focuses on the people making decisions and how we organize, learn and adapt. A common and unhelpful debate is the one that pits human vs. a machine; intuition vs. computational analysis; micro vs. macro-cognition[19]. It does not have to be either / or; and probably needs to be both. The key is determining what decisions better lend themselves to macro-cognition and which ones need to be augmented by micro-cognition tools – to help offset individual perceptual bias.

Tasks and Functions in the Action-Reaction Cycle

By dissecting the four steps of the action-reaction cycle – awareness creation, sense-making, decision-making, and implementation – we can arrive at a series of more specific tasks and identify where different tools might be applied.

Awareness Creation.[20] All complex adaptive systems need some means of monitoring what is going around them in order to adapt and survive. Human systems do so purposefully and make continual decisions as to what to look for, how to collect it and how much effort to expend to that end. Although these processes will take different forms from one actor to the next given their varied contexts and co-adaptations, each may be expected to perform three basic functions as illustrated in figure 4.

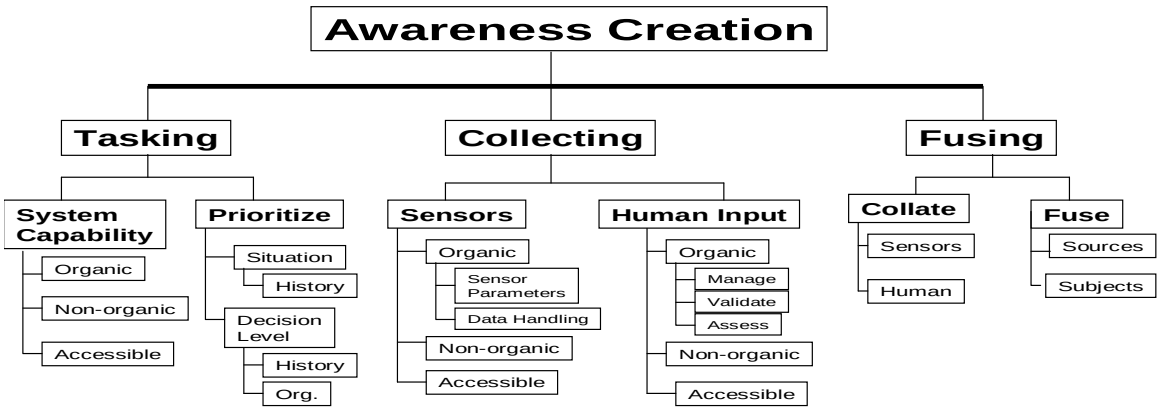

Figure 4

- *Tasking* directs assets in order to assemble the kinds of data, information, knowledge and expertise needed to make decisions. It can be decomposed into two components: monitoring sources and determining priorities. The former tracks available information and knowledge whether organic, non-organic, or accessible[21] and where, when and how might it be obtained. The latter identifies what information and knowledge will be needed by whom and how urgently, judgments that will change with the situation and decision-maker. Both these tasks are subject to further drill-down into more specific tasks each of which can be evaluated for application of information, analytical and other tools. In tasking for example, data management tools might be applied to tracking sources of knowledge and expertise and modeling tools to tracking overhead sensor availability, and in prioritizing, an historical model of how similar situations were handled in the past. However in both these cases, it would fall to a human decision maker to render judgments as to which sources and effort would contribute more to a particular complex problem. The object in each case is to narrow the problem and identify a limited number of most likely solutions.
- *Collecting* is actually gathering the required inputs from the resources available. These may be machine inputs from sensors or may be complex human inputs from intelligence and experts or from open sources – each presenting its own challenge. Sensor inputs, particularly from a specific set or type of sensor are linear and lend themselves to machine manipulation and collation. Human inputs are complex because they involve deep internalized knowledge, e.g. understanding intentions, and the value of the input depends on the source's expertise and reliability. As a result, it may be difficult for someone outside an expert's domain to fully comprehend expert human input. Here again data management and mining tools and pattern analysis among other tools can help bound the uncertainties involves.

- *Fusing* blends often conflicting and ambiguous information and knowledge collected on what are after all other evolving changing complex systems to determine what is valid and then fuses it into an acceptably coherent picture. Collating means critically comparing and integrating electronic and human information. Although collating data from a diverse array of sensors may present a metadata challenge, much of this work will eventually be done by machines. Similarly, although collating the often conflicting and ambiguous human inputs can be a massive challenge, historical data bases, models and pattern analysis can assist in resolving issues.

Even though the awareness creation process is complex and demands human intervention, there is ample room for analytical tools to help bound or otherwise narrow the unknowns to be considered by the human decision-makers or subject matter experts involved.

Sensemaking. [22] In order to make "rational" decisions, all human complex systems must also be able to make sense of information and knowledge collected so as to understand the actions and reactions of other complex actors. This suggests two component tasks and groups of processes:

- C*ontextualization.* Since the actions of "rational" actors can only be understood in context, awareness must be put into a context that is meaningful. The context must provide an explanation as to why and

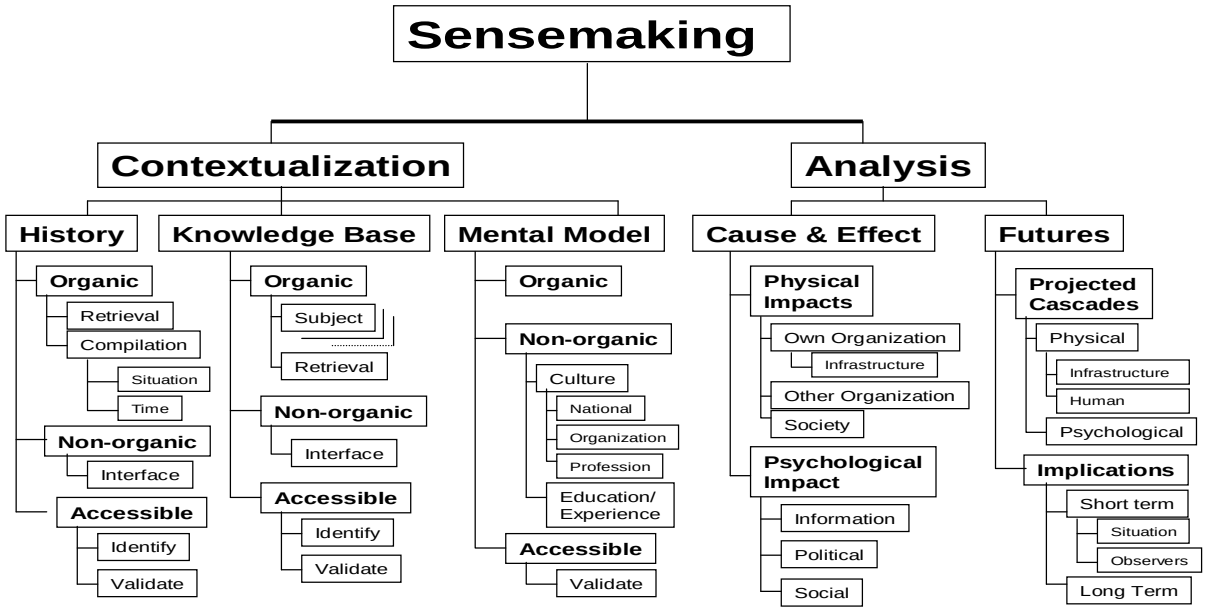

Figure 5

how others are acting or reacting. It must also unveil a "storyline" that is comprehensible across disparate domains – so decision-makers and supporters can better apply complex ideas and assessments to their deliberations. Context helps answer questions as to how our growing awareness and current actions resemble or differ from previous behavior -- and has three dimensions:

- a history that puts knowledge and information into a timeframe running over a series of interactions or in a long term cultural, political, economic, or other interaction;
- a body of complex knowledge and expertise to understand the problem; and
- a set of mental models as to how things fit together.

Contextualization tends to be most heavily dependent on an historical data base with sets of potential models to help frame existing knowledge. Although this has obvious implications for knowledge management and modeling tools, in a rapidly changing world, the biggest challenge will be in tapping human knowledge and expertise whether in "institutional memory," those of affiliated organizations, or a wider circle academic, industry or other sources across society – a clear role for social networking and decision-making tools.

- *Analysis*. The analysis function carries the context the next step with two additional processes. The first is to frame our awareness with a cause and effect construct starting with the chain of events that led to the current situation. Then we bound a set of most likely outcomes – if the situation were to proceed unchecked -- in essence to postulate futures that extend to all actors and to an assessment of the physical or psychological difficulties it might pose for our own, and other organizations. The calculations involved are to be sure complex and will demand human intervention but there is clearly also a major potential role for analytical tools – tagged indicators, pattern and trend analyses, modeling and knowledge management – to help bound the problem and better aide human decision-makers.

Decision-making.[23] All human complex systems must decide how to respond to a stimulus (with inaction being one choice) and how to carry out that response. Logically there are two major parts to this process: exploring options and planning a response.

- *Exploring options*. Options assessment essentially works backwards from a desired outcome to the actions needed to shape that end in a succession of "what if" questions. It involves an iterative assessment of objectives, of available capabilities whether alone or with others, of costs versus risks, and of the physical and psychological impact of potential courses of action on self and other actors. This requires understanding actions and their potential consequences and which capabilities in what configuration of actions might produce the desired effects. While the process is complex, there are again numerous areas where a variety of analytical tools, pattern and trend analysis, models and networking can help. We also need to better integrate the ability of domain experts to subconsciously eliminate unhelpful options through macro-cognition and intuition to make timely "good enough" decisions. This skill set will be all the more important in IW, wherever domain experts may have limited access to analytic tools. But the challenge will be to find a way to harmonize the best of both mi-

cro- and macro-cognition approaches. And since with IW we are not looking at a simple enterprise, but a complex one made from disparate actors with varying fitness metrics; there will not necessarily be ONE agreed upon desired outcome. But what makes human systems unique and purposeful socio-logical systems different from pure biology is the ability to look at long term fitness or success. This means that there are times when an entity will take action that may be detrimental to themselves in the short term, if there is a perceived better long term / system wide benefit – as a parent who sacri-fices in the short term for the sake of their children's future.

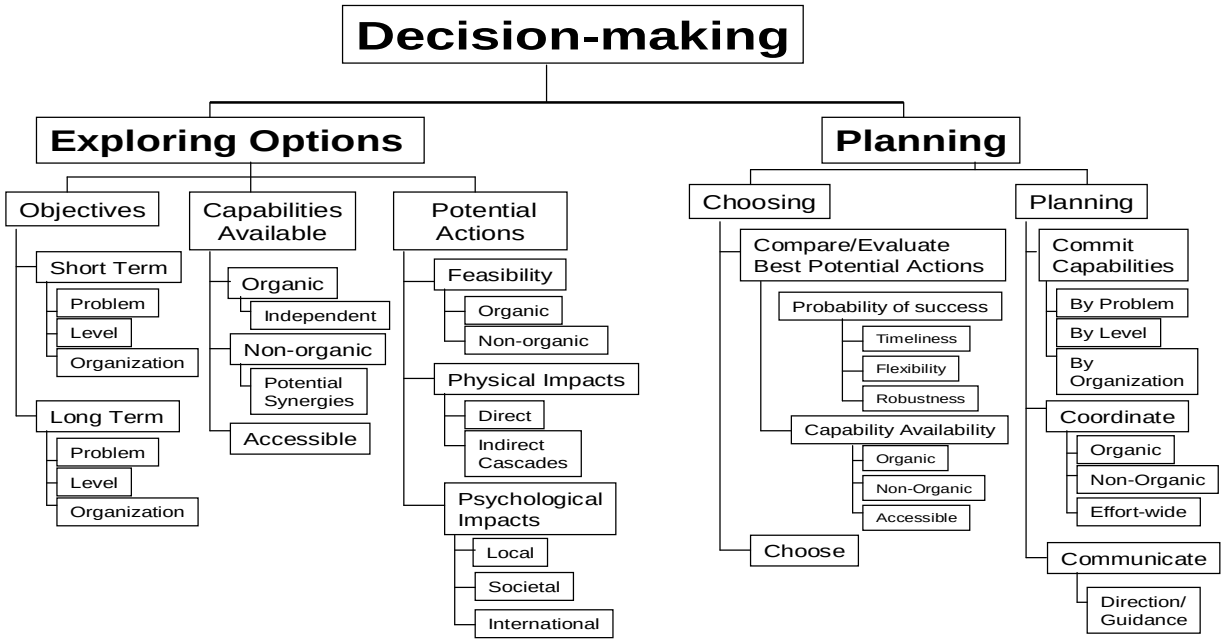

Figure 6

Planning, Once the most feasible option is identified, the organization must determine how to implement it. This is to say the option must be translated into a plan – the form of which can run from the simple to the very complicated will vary greatly depending on the organization and its context. This plan, its metrics for success, the resources being tasked, the timing – speed, dura-tion of action, and synchronization, the flexibility to learn and adapt to potential responses, the robustness or the tolerance of unknowns, and the assumptions upon which it is based must be then communicated to and understood by those carrying it out including any collaborators. Here again these is a role for a variety of planning tools many of which are already in use in the mili-tary and industry.

Implementation.[24] Implementing a plan in a continually changing constellation of variables means that it will have to adapt as the variables upon which it was predicated change. This points to three additional processes: learning so as to re-contextualize to deal with changing variables; adapting a plan or course of action to those new variables – even as it is carried out -- and the

feedback to continue the process of learning and provide decision-makers with new information derived from an on-going interaction.

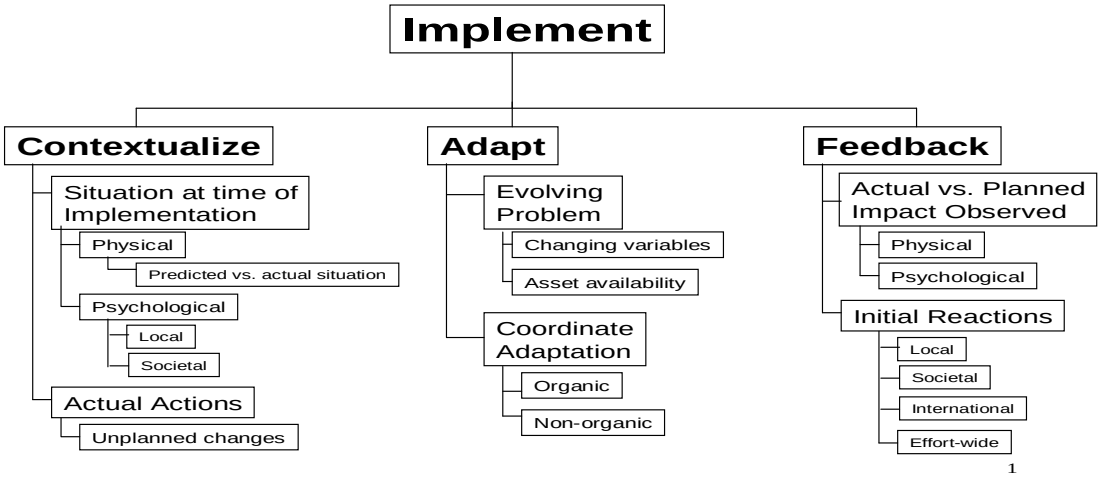

Figure 6

- *Learning*. Purposeful adaptation rests on an ability to learn both as a plan is implemented and as phases of an interaction unfold. The impact of this learning process although most evident in the give and take of actors in direct contact extends throughout the whole system to a broad spectrum of internal and external military, political, diplomatic, economic, social, and more -- and of collaborators, opponents, and neutrals who will also see and react to the actions in some way.
- *Adapting*. We must be prepared to *adapt* any action during implementation in light of a changing physical, psychological, and temporal context and then continually re-adapt and re-coordinate actions as the situation unfolds.
- *Feedback*. In addition to reporting whether an action was carried out, we will also need any evidence that it was "seen," and any immediately observable reaction – in essence recommencing the action-reaction cycle with awareness creation.|

The Real World: Scale, Timing and Perspective

The above presents a rather stylized model of the decision-making process as a base for tagging and tracing processes. However, it also needs a caveat: both the kinds of decision-making and the tools that may be applicable are a function of scale, timing and perspective. *Scale*. Military thinking all too often seems to succumb to what be termed a cult of the commander in which all decisions seem to be made by one person. In reality, successful commanders display an ability to orchestrate and inspire teams of decision-makers in whom they place their

trust and confidence so that they can concentrate on decisions that only commanders can make. This decision-making involves many different individuals and takes many forms from the opinions of subject matter experts, to those who must decide what pieces of information and knowledge fit together, to the planner assessing an option, to the commander. In the living system framework each level is an aggregate of all the complexities of lower level component systems plus those at that level. The same may be said of decision-making. Each level in an organization or government represents an aggregate of all the decisions of its lower level components to including that of simply acquiescing to decisions made. Accordingly, the kinds of decision-making and the utility of specific kinds of tools vary with the scale of the organization.[25] As a general rule, the lower the level of the actor, the more the decision-making will rely on an individual decision-maker's own education, experience and timing, and the greater the scale, the more room there will be for specialization and for inputs by analytical and other tools.

The military describes its planning and thought processes in three related, but distinct levels of war: strategic, operational, and tactical – the tactical being the point of action or "tip of the spear." To put in simple terms, let's look at building a home. At the strategic level is the developer or architect with a vision and access to resources to execute that vision. The tactical level actually builds the homes (carpenters, plumbers, electricians, etc.), and the operational level would be the general contractor – responsible for making sure all the pieces come together, are synchronized – bringing the blueprint into reality.

Since in irregular warfare, a tactical action may have strategic effect, (especially in our YouTube Age where video feed of an incident spread like a virus within hours), some may be inclined to think that the three levels / scales no longer apply, or at least the dividing lines have blurred. But while tactical actions can and will have effects at multiple levels, it does not mean that operational and strategic functions have been eliminated. The general contractor's role has not gone away. This leads to two separate, related but distinct gaps. The military domain is the master of the operational level and operational art. This is why governments often default to the military when disasters occur, whether or not the problem is one of a military nature. That said, most tools are built to address tactical level challenges. We design better hammers, saws, wiring and pipes – and then promote our best carpenters to become general contractors – giving them scant additional ability to assume the new role. But an even bigger gap … is the fact that other than the military and perhaps foreign aid organizations to a degree – no other branch or agency of government even HAS an operational level. This is what makes bringing the disparate groups in IW groups together to address a common challenge so difficult. Related to this is …

The Tyranny of Time. The information revolution has placed more tools in the hands of both low level decision-makers and commanders. However, the new tools can quickly encounter an old problem: the tyranny of time. No information or knowledge that can be generated by a tool or subject matter expert will be of use if it arrives too late to do anything with it. The utility in the decision cycle is shaped by a series of time windows: one window to understand the problem, another to collect the data, information, expertise and knowledge needed, another to make sense of it, and others to assess trends and options, to act and to learn and adapt to the changing constellation of variables including that brought on by our own actions. This time factor also imposes a series of trade-offs between tools and people. Each time window defines a strict requirement that a tools must meet to be useful. The less the time available, the less data and information we will have, the less access to outside knowledge and expertise, the less ability to tag and assess trends or to explore options or to learn and adapt in any more than an adaptive reaction. Correspondingly, the less time available, the greater will be the reliance once again on the human decision-makers and their existing training, experience and education.[26]

Perspective. The new tools also bring a temptation to "cut out the middle man" and centralize decision making but this carries an attendant opportunity cost. If upper level commander's tools only provide a more transparent view of the tactical battle, the tendency will be to try to micro-manage the tactical level at the expense both of the broader, more holistic view necessary to dealing with complex challenges and of lower level actors' intuitive "feel" or *fingerspitzengefuhl* for the local situation. The Living System internal model underlines that unique perspectives exist at each level and that the challenge of succeeding higher levels is to synthesize, synchronize and apply these to their own aggregated and therefore more complex view of the situation. Such a perspective is especially important in IW where the complexity of the problems demands holistic insights at each level. If the builder is forever telling the carpenter how to better strike the hammer, how will he manage the synchronization of the overall project? And what tools have we provided him for this higher scale task?

Organization and Networking: The Other People Factor

The foregoing trade-offs underline the enduring need for human decision-makers to deal with the myriad of interconnected interdependent variables that characterize complex problems. Indeed, they reinforce the nature of complex decision-making as an art in which "tools" bound facets of the complexity so as to enable these decision makers to function better. Yet there is another aspect to this challenge. The successful practice of an "art" involves the application of an internalized understanding of a domain's complexity, an understanding that takes time to acquire

and is difficult to explain to those who reside in another domain. IW and the application of a Comprehensive Approach will sometimes require a broad, holistic understanding and other times a deeper, complex understanding, competencies that will reside in diverse individuals across a wide variety of organizations and disciplines. This poses problems of social organization and networking. Do organizations need to produce and nurture more generalists or specialists, or do they need more of both? And in any case, how do they synchronize domains over time? Large militaries tend to deal with the first challenge by building the necessary expertise "in house," but the real test will be not how many renaissance supermen can be mustered to address a complex IW challenge. The better example might be that of smaller militaries and organizations which have no choice but to tap into expertise that is already existent. We must find the needed expertise – not a trivial task -- and ensure that complex concepts are understood by those who need to apply them. And they need to ensure that the right "expert" (or knowledge) is in the right place at the right time -- with a compatible sense of urgency. Dealing with these questions presumes a very different set of tools from those already discussed: those for organizing and managing people across a diverse array of often squabbling and distrustful organizations; and those for supporting the social networking that is at the heart of team building whether on military and embassy staffs, whole governments, coalitions, or the ad hoc collection of non-governmental, international, industry and private actors that is likely to be part of any comprehensive approach.

How will we encourage and empower the development of social networks that span the naturally-occurring stovepipes and collective constructs that arise? This goes to the heart of how complex multi-scale systems (organizations) can arise or emerge. We know of no evidence that they can be successfully deliberately designed. Rather, examples we know of such as markets, religions, and governmental systems, have arisen through natural processes of interaction between components and the situation, with feedback from those interactions influencing their ongoing development. If we wish to foster the emergence of effective multi-actor cooperation then we must start by adopting a more comprehensive approach to problem solving and articulating a multi-scale set of fitness metrics, and then growing communication networks and links between them in a way that enables, supports and is responsive to the developing social networks.

We also need to address the underlying motive force that pulls disparate entities into a more coherent whole. In a system of complex adaptive systems -- like we see in IW -- this motive force will stem from many adaptive processes, occurring at different scales, different tempos, linking different actors, and stimulated by many diverse events that arise. The scope, diversity and interconnectedness of these adaptive processes likewise offer us many options for interventions at various scales to foster the coherence of the nascent complex collective.

The value of cooperation between and among actors is a balance between the effort and opportunity costs and the potential for meaningful coherence. It is easier to establish cooperation and to grow coherence with similar actors, but it may be more valuable to establish limited cooperation with very dissimilar actors precisely because their dissimilarity could potentially yield more valuable results.

6. Conclusions

As the foregoing pages underline, Irregular Warfare demands a Comprehensive Approach. Such an approach has a deceptively simply definition: the use of coordinated sets of actions to shape the behavior of other actors. However, this "simple" definition is the source of the wicked problems facing IW. The "sets of actions" revolve about the human dimension of both problem and the solution. They run a gamut from social and economic, to political and diplomatic, to military action, and entail coordination on many different levels and in many areas and pose daunting organizational challenges. Similarly, the "behavior" we seek to shape is complex. It is the product of so many interdependent variables that we will never fully understand the interactions or be able predict their outcomes exactly. It represents actors' adaptation to ever changing interactions with other actors as all co-evolve and alter their environment. And this behavior can only be understood and "shaped" this rich ever evolving context.

This paper offers a threefold conceptual framework for dealing with these challenges and identifying the two dimensional tools that might prove useful in this three dimensional world. Complexity theory lets us identify what is or is not complex and ways to bound wicked problems. Living systems gives us a multi-level real world internal model of how systems interact and the processes involved in learning and adaptation. And decision making theory lets us translate all of this into the specific tasks to which we might apply specific kinds of tools. Together, they enable us to recognize how and when to apply specific tools and their limitations in dealing with the complex tasks at hand or in dealing with the tyranny of time. At the root of all of this, however, is the need to think *complexly* – not abandoning the tools of science and analysis but putting the search for metrics and useful tools into the context of a holistic inductive context so as to figure out which tools might best serve decision-makers of all stripes. There is a great paradox in all of this: **Complexity Simplifies!** If we accept complexity, we accept that we cannot know anything perfectly or predict precisely and that we must content ourselves with actions that are good enough and timely enough to be better than our competitors and adversaries. This too is the recipe for judging tools but with a corollary drawn from Ashby's Law of Requisite Variety, the

greater the variety of tools at our disposal the better the likelihood of having the right tool to deal with the problem at hand.

Finally, there is a profoundly human bottom line in the application and use of any tool or approach: the question of motivation– especially between disparate human and organizational actors in any comprehensive approach. Why should I pull out MY wallet, to help you solve YOUR problem? Perhaps there is a quid quo pro in it for me … but perhaps not. How can we explain why people donate time and resources to victims of natural disasters like Katrina or the 2004 Tsunami? Even within an identified collective, why would a soldier sacrifice his own life to save another? Why would a parent do nearly anything to protect their child? Some could argue that it's the human's unique ability to think of long vs. short term consequences, or that the overall propagation of the species is more important than their small part in it. Or maybe, there's an internal motivation to heroism – an understanding that there are some things more important than personal or organization survival, which demands self sacrifice. Or put another way: the real motive force needed – as John Lennon famously said – might be love.

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[1] Irregular Warfare Joint Operating Concept (JOC), 11 Sept 2007, pg 1.
[2] From "The White paper 2006 -- on German Security Policy and the Future of the Bundeswehr" pg. 29
[3] See " Hybrid Wafare and Challenges" by Frank G. Hoffman, Joint Force Quarterly, Issue 52, 1st quarter 2009. http://www.potomacinstitute.org/media/mediaclips/2009/Hoffman_JFQ_109.pdf accessed 16 Feb 2009
[4] As an example, the Joint Ooperating concept (JOC) on IW lists Stabilization, security, transition and reconstruction as irregular warfare. Aide organizations as a whole, do not like to look upon their efforts as "warfare" –and many are worried that we have militarized diplomacy (see "A Foreign Affairs Budget for the Future: Fixing the Crisis in Diplomatic Rediness" The American Academy of Diplomacy & Stimson Center report dtd Oct '2008).
[5] Rupert Smith, *The Utility of Force: The Art of War in the Modern World*, London, Penguin, 2005, pp. 17-18.
[6] Rittel, Horst and Melvin Webber, "Dilemmas in a General Theory of Planning," *Policy Sciences*, Vol. 4, Amsterdam, 1973, pp 155-169.
[7] Horn, Robert, "Knowledge Mapping for Complex Social Messes," Presentation to the *Conference on Foundations in the Knowledge Economy*, Packard Foundation, July 16, 2001.
[8] James Grier Miller, *Living Systems*, Denver, University of Colorado, 1995. pp. xix-xxv.
[9] Miller, p. xx.
[10] Admiral David Jeremiah USN noted to the author at the beginning of operations off Libya in 1986 that, if he accepted Libyan leader Muammar Qadahafi as irrational, there would be no way to predict his actions or the course of the crisis and thus no way to plan, but if he accepted his rationality and tried to understand it was, he would have some idea of what might happen and could plan accordingly. Edward A. Smith, *Effects-Based Operations*, CCRP, Washington, 2002. pp. 450ff.
[11] *Webster's Third New International Dictionary*, Unabridged, Britannica, Chicago, 1986. Vol. 2, p. 1885.
[12] For example, we show up at a bus stop with an assumption of the basic rationality of the driver and thus that the bus will show up at approximately the time scheduled and that the driver knows how and where to drive. The schedule and driver's rationality exists within a multi-dimensional context. The driver will seek to show up on time because he or she has a family to support and needs to hold onto the job or seeks to advance by good performance and the bus company will insist that the bus be on schedule to avoid a loss of customers. This is to say both are acting rationally but doing so within somewhat different contexts.
[13] Colonel John A Boyd, USAF. "A Discourse on Winning and Losing." Air University Lecture. August 1987.

[14] Boyd certainly did not ignore the question of context but appears to have seen it primarily as part of the *orient* step whereas the discussion of complexity and the nature of the human dimension of irregular warfare would indicate a more pervasive role touching every aspect of the OODA cycle.
[15]. The context includes the remaining eight of the living system essential processes: the *boundary* which maintains the identity and culture of the system or organization; the *reproducer* which ensures its continuation, the *ingestor* which provides the physical means for its sustenance, e.g. revenue and budget; the *distributor* which send the support throughout the organization; the converter which adapts the support to the needs of the parts; the *producer* which generates the support; the *storager* which maintains and operating stock of support; and the *supporter* which takes care of housekeeping functions. Ibid.
[16] See Anne-Marie Grisogono and Edward Smith, "Warfighters to Coalitions: A Case Study in Multi-level Adaptation," Paper presented at the 11th ICCRTS, Cambridge, United Kingdom, 2006, and Anne-Marie Grisogono, Edward Smith and Mark Clemente, "Cajole and Coordinate? C2 in Whole of --Government, --Nation, and -Coalition Action," Paper for the 13th ICCRTS, Seattle, Washington, 2007.
[17] "To face and to find necessary expedients to overcome problems and difficulties." *Third New International Dictionary*, Vol. 1, p.502.
[18] In the literature on complexity, these differences are often referred to as linear, that is, problems for which there is a predictable chain of causes and effects and definitive solution or end-state, where the whole is equal to the sum of the parts, outputs are proportionate to inputs, and results are repeatable, and non-linear, in which none of these apply. The differences, particularly as they apply to probability based models and analytical tools, are often categorized deterministic, that is, operating with a fixed set of variables, and stochastic, that is, apparently random relationships
[19] Gary Klein has written extensively on the value of macro-cognition and Recognition Primed Decision Making. In conducting research with firefighters and the military, he has found that experienced domain workers do not rifle through a complete list of alternatives and make a utility decision. They use their experience to recognize what works – and spend more time understanding and looking at the environment as it evolves than comparing alternatives. See "Intuition at Work" (Doubleday, 2003) and "Macrocognition" Klein, Klein, Hoffman, Hollnagel in "Human Centered Computing," http://ihmc.us/research/CognitiveSystemsEngineering/Macrocognition.pdf
[20] In Living Systems theory, awareness creation would equate to two essential processes: the *input transducer* which detects information about the environment and brings it into the system and the *decoder* which translates the raw data into information that can be used by the system. Miller, pp. xix-xxiv
[21] *Organic* sources are those under the direct control of the decision-maker and can therefore be tasked directly. *Non-organic* sources that are controlled by a different organization but can be tasked through some higher authority and *accessible* sources are those that cannot be tasked or directed but that are openly available, e.g. academia or media open sources.
[22] In terms of Living Systems theory essential processes, sense-making would include a *memory* that stores information on prior actions for retrieval, an *associator* that draws analogies between the new information and previous interactions to provide candidate cause-and-effect models, and a *timer* to assess the temporal aspects of these analogies and other models and to form time constraints. Ibid.
[23] Decision-making would equate to four Living System essential processes: the *decider* or the executive system that receives inputs from all other subsystems and transmits guidance, coordination, and control of the system as a whole; the internal transducer to transmit internal information such as the capabilities available; the *encoder* to translate decisions into plans and policy for internal and external consumption; and the *net* or communications means by which the plans and policy can be sent. Ibid.
[24] Implementation would include three essential processes: output *transducer* to manage the action set in motion and communicate it to other actors; an *extruder* to physically project an action to the exterior; and a *motor* to manipulate the external environment, e.g. a military or diplomatic corps in the case of a state. Ibid.

[26] Gary Klein's work on naturalistic decision-making in *Intuition at Work* makes this point in considerable detail.