CHAPTER 3
PLAYING WITH CARS: A PLURALIST APPROACH TO SUPPORTING EXECUTIVE DECISION-MAKING

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In the defense and security field there is an increasing awareness of the complexity of conflict and of the military expertise needed to successfully engage with and survive them. Yet, among the management, engineering and scientific sectors of government, the development of policy and capability are still rooted in conventional design and control paradigms. Enterprise executives seeking to design and manage complex human enterprises face many challenges not met by conventional knowledge paradigms. The value of complexity thinking lies in its ability to inform these challenges in the areas of policy analysis, strategies for managing adaptation, understanding cultural and social process aspects of management and generating practical heuristics for managers to use. Specifically, executives need two things from science and consultants – understanding of the options for effective intervention and confidence acting in uncertain circumstances. The paper provides an integrative and pluralist approach to informing executives and managers of Complex Adaptive Reflective Systems (CARS) – complex human systems.

Graham L. Mathieson had a career spanning 25 years in Defense analysis and modelling in the UK. After graduating in Applied Physics in 1980, he joined the Admiralty Surface Weapons Establishment (a predecessor to the Defense Science and Technology Laboratory) where he worked for six years on Naval weapon system analysis. He conducted studies to support major procurement decisions and managed the development of a series of new naval combat models. Graham then moved into Operational Analysis (OA) where he specialised in studies involving electronic warfare, command and control, intelligence systems, C2W and information operations. As well as pioneering the use of object-oriented simulation techniques for naval battle modelling, Graham also carried out fundamental research on the representation of human decision-making in OA models - a research theme that continues to the present day. Graham’s most recent position was a Fellow of the Defense Science and Technology Laboratory (a part of the UK Ministry of Defense), a technical leader in the area of C3I&STAR, and a leading member of the Dstl Human Systems Team. To the great loss of the OA community, Graham passed away suddenly in April, 2006. His considerable efforts to keep OA both scientifically rigorous, and at the same time grounded in real world organizations, will not be forgotten.
Introduction

Much is written about complexity from the perspective of those for whom it is a research topic, but it is a legitimate question for executives to ask, ‘so what?’ to these more theoretical arguments. What does complexity have to offer the busy executive or enterprise manager? How do these ideas interact with well-established management practices? What do they tell executives about how to manage better? What do executives need to know about a system to be able to analyze and interpret its behavior for managers? To understand the role of complexity for executives it is necessary to take a walk through a rich and varied landscape with no particular destination in mind, occasionally looping back across ground already covered or branching off temporarily into interesting cul-de-sacs. The goal is not to arrive at simple conclusions, but rather to explore and map a problem space as a guide to future, more directed travelers.

Complex Adaptive Systems in Human Enterprises: CARS

If it is accepted as true that human enterprises are complex adaptive systems (CAS), then it might also be assumed that management, as a human enterprise, would have some innate capacity for coping with complexity. If this is true, then complexity theory must prove that it adds value to the current repertoire of management practice. Further, what are the criteria for this validity? In managing a complex adaptive system these questions may be problematic, so partly because while adapting to changing circumstances the fitness of the organization may have changed as a result of or in response to the intervention.

This problem of complexity is compounded when one considers the internal politics of enterprise management and the fact that human enterprises have an added characteristic not present in many CAS – namely self awareness, the ability to reflect on their own existence, behavior and adaptive response. Avoiding, for the moment, the metaphysical arguments concerning the nature of awareness, it can be said that human enterprises are capable of anticipatory adaptation and respond to the possibilities of future problems, risks, and interventions with multiple interacting loops of perception and preemption. That is, the human CAS is reflective, rather than simply reactive. Therefore, human systems will be described here as Complex Adaptive Reflexive Systems (CARS).

CARS display the behavior of changing in response to attempts to manage them, or in anticipation of such interventions. Complex adaptation presents problems enough, but the self-reflecting nature of human systems adds additional cognitive and social dimensions which can confound analysis. The human character of the CAR therefore broadens the scope of the management problem by raising significant ethical issues for analysts and engineers.
Management and Complexity in the Defense Enterprise

An increasing awareness of the complexity of current conflicts and the potential of complexity in future conflicts is emerging in the defense and security field including recognition of the military expertise needed to successfully engage and survive these conflicts. In turn, complexity arises as an issue in the development and sustainability of Defense and Security capabilities in the sectors of management, engineering and science used by the government to direct and control the development of policy and capability. Yet these sectors are still rooted in conventional design and control paradigms. The core principle of these paradigms is the need to predict the consequences of interventions, using this prediction as the basis for planning and action. Historically, OA (Defense Operational Analysis) has used classical scientific methods to provide analytic support to management and engineering decisions. For complexity theorists this presents a challenge. How does the new paradigm help executives meet old management goals? In particular how does it address accountability issues in government – those that require the production of measurable outcomes?

The additional difficulty with CARS that makes the answer to these questions unclear is that outcomes are assigned different values by different people in the system. That is, definitions of value outcomes are, to at least some degree, socially constructed. Therefore outcomes are dependent on post-hoc rationalization, self-justification, and ego-maintenance on the part of enterprise stakeholders.

Therefore, in the face of both adaptability and subjectivity, conventional definitions of effectiveness in management support need to be reconsidered. A ‘complexity’ definition of effective management may, for example, suggest that all opportunities for useful action have been identified and fully exploited. This removes the dependency on outcome success. Instead, ‘useful action’, is localized in time in accordance with extant and emerging events and can be interpreted as action that could reasonably be understood to be useful at the time of the decision and with the knowledge then available. The importance of this somewhat hedged and complicated definition of effective management is that it encourages the practice of appropriate contextual action as well as building and sustaining the capacity for effective management among practitioners. At the same time, the new definition focuses attention on how complexity analysis can support the executive now, rather than merely speculating on ideal futures.

Executives need two things from science and scientific analysis (1) an understanding of the options for effective intervention and (2) the confidence to take action in the presence of risks. These needs correspond with the concepts of ‘Will’ and ‘Capacity’ in military doctrine – comprising the knowledge, skill, resources, organizations, and processes that facilitate the delivery of military outcomes. “Will,” for example, refers to the formulation of intent, the commitment to act and the morale to sustain action in the face of adversity. Similar expectations are made of enterprise executives. During the 20th century, however, too much attention was given to developing one’s own capability while attacking the enemy’s. Only recently has the emphasis shifted towards the more systemic approach of sustaining and engaging the Will. In the process, the sci-
Scientific knowledge base from which managers are willing to draw has expanded. However, it has largely been left to the executive to make sense of incongruence and incoherence in the scientific knowledge base.

**Taxonomy for CARS Executives: Domains of Knowledge**

Explanations of the mechanisms through which interventions influence and shape outcomes are needed to foster an adequate understanding of CARS among executives and managers – explanations which can span the various disciplines which address these issues. Here, I will employ the taxonomy of knowledge domains employed in Network Centric Operations: Physical, Informational, Cognitive, Organizational and Social.

Action and movements take place in the Physical Domain. Resources, like people and equipment, have physical existence. Information is created, manipulated, shared and consumed in the functional existence of the Information Domain. Perceptions, awareness, beliefs and values reside in the Cognitive Domain, along with sense – making and decision – making. The Organizational Domain is where enterprises are conceived, formed and operated. Finally, in the Social Domain people interact in cultural and social networks.

These several domains serve as reminders of the diverse range of knowledge that is needed to understand CARS. However, the problem remains of how explanations of phenomena derived from the various knowledge disciplines can be synthesized in a manner that is easily accessible and useful to executives, especially when little or no motivation exists for members of different scientific disciplines to integrate their knowledge in order to enhance understanding of CARS for executives. Even disciplines with closely related histories (like cognitive psychology, neuroscience, physics and chemistry) tend not to talk to each other. The disciplines are taught in separate schools and discussed at separate conferences. Success is measured by citations in discipline-based journals with largely incompatible review criteria that inhibit cross-publication and joint publication. Those who seek to operate across disciplines can suffer prejudice in equal measure from all sides – either because the breadth of their research implies that it has no depth in any one discipline or, more perniciously, because the specialization of disciplinary languages makes outsiders sound less than expert. If disciplinary siblings have so much trouble synthesizing their work, then what hope is there for more distant cousins who are in need of the synthesis in order to understand CARS? A strongly pluralistic approach - a willingness to see the world through a variety of conceptual and linguistic lenses – is needed in this scientific ‘Tower of Babel.’

**Looking through Different Lenses**

A pluralist approach to knowledge is explained best through the use of a number of metaphors. Conceiving the disciplines as islands of comfort set amidst a turbulent sea of reality, for example, is descriptive. The attempt to build bridges between the islands by stretching out from each shore with an ever less stable cantilever of knowledge is likely to have limited utility. What is needed for effective-bridge-building is for a few brave souls to step out
from the comfortable islands of knowledge and into the uncertainty of the intervening space where there are few solid concepts and little secure definition and start building foundations. However, if the result of these courageous steps is only a new specialist discipline – a new island of comfort – then little integration has been achieved. Complexity ‘Science’ runs this risk and at the expense of those, like executives, who need it to be the bridge rather than another competitor in the battle of the disciplines.

Another powerful metaphor for a pluralist approach is to think of disciplines as viewing the world through differently formed lenses. A lens allows the observer a limited view in which some features are brought to sharp focus and others are distorted and unclear. If we ask a global question, for example, such as “What is the best strategy to use if you are a manager\(^1\) or analyst embedded in a CARS” – then different lenses will reveal differently useful answers. Four such lenses are particularly useful in this context: philosophic, principled (ethical), pragmatic and political.

**Philosophic Lens**

*Key question: What does it mean to manage in CARS?*

The Philosophic Lens invites us to consider what could be. It is the lens through which possible futures are envisioned and conceptual models are brought to force. A rigorous treatment of language is required, while not losing the richness and diversity of meaning inherent in the many specialists languages involved. The Philosophic Lens also calls for reasoning without being too reductionist and to be clear about the nature of our models. Four key classes of model are used in normal philosophic reasoning: Description, Explanation, Analogy and Metaphor.

*Descriptive models* provide data about reality; organized using taxonomies and relational constructs. These models embody worldviews and can imply explanations. Analogies and metaphors are often used. Descriptive models are very weak forms of modelling, but are perhaps closest to observed reality. They can only be used for prediction on an actuarial basis, making the assumption that the future will be an extrapolation of the past.

*Explanatory models* go further; providing constructs that encode understanding of or conjecture about why the world is as it is and about what the mechanisms of its future evolution are. Explanations have more power than descriptions because, if correct, they allow evidence of current phenomena to be interpreted. Further, they are more reliable predictors of phenomena not yet experienced. Wrong explanations, of course, can be very misleading.

*Analogy models* are often resorted to when new areas of reality are being explored. Analogies take descriptions or explanations from other, seemingly similar, areas of reality. The analogy is then used both to describe and to begin

\(^1\) ‘Manager’ is used in the broad sense here. As such it includes diverse roles such as Military Commander and Policy Maker. Whilst there are important nuances implied by the use of these words, they are largely irrelevant to the present discussion, and what is common between them is the main focus of attention.
to explain. In the latter role, analogies can easily be stretched beyond credibility. Analogies can be very seductive in this regard; allowing for rapid development of apparent understanding which then facilitates sloppy reasoning. A common analogy in enterprise analysis, for example, is to use the language of individual cognition in the diagnosis of teams and organizations.

*Metaphor models* are perhaps the most dangerous type of model largely because, although they are intended to be aids to education in a new area of knowledge and not a model capable of sustaining inference and reasoning, they are often treated as analogies or even descriptions or explanations. The bulwark against sloppy use of modelling is a rigorous philosophic approach to the use of inductive and deductive logics as well as to data, evidence, and prediction concepts. This approach is of key importance to analysis for executives as they are looking for control through prediction – without this anticipation there would be no reasonable basis for action. Even managing through heuristics is based on the sometimes implicit assumption that employing those heuristics will lead to future success.

Serious philosophic and sociologic problems emerge, however, with concepts such as evidence and prediction as a basis for action in CARS. Yet, problems of absolutism *can* be addressed. Prediction need not be absolutely right, but only better than the intuitive pre-disposition of the executive – that is, it is more likely to lead to the desired outcomes. If intuitive executive decision-making is like throwing dice, then effectiveness is loading the dice in favor of better choices. Since an executive is responsible for the risks of a decision, even weak guidance can be valuable.

Time is a key variable in prediction. The temporal validity of assumptions and the time cycle of executive action combine to limit the utility of predictions. Concepts like dynamic, stable, adaptive, etc. are contingent on the time window of interest. Linking effects and interactions may require quite different or multiple time horizons. Hence, useful definitions of systems boundaries and effect spaces can be time sensitive.

In the context of CARS, therefore, the Philosophic Lens brings into focus what is predictable and by implication what is not. This allows the identification of what levers managers can pull with confidence as well as the achievability of different effects and effect spaces. Exploiting such knowledge may mean shifting the emphasis from managing behaviors and structures to towards managing goals and the mechanisms (processes) of adaptation. However, even these processes may be sufficiently adaptive to be beyond useful prediction for management, at least in the longer term.

The challenge to science and analysis then is to help elucidate the appropriate conceptual models and heuristics for managers to use. Many such models exist or are being created. Choosing the appropriate model may be aided by employing one or more of these basic filters: Reality, Relevance, and Realization.

The *Reality Filter* asks, “Is the concept firmly based in empirical science?” This filter helps weed out the inappropriate use of metaphor and analogy as well as the lure of elegance that many modelers fall prey.
The Relevance Filter asks, “Does the Concept describe/explain phenomena of interest? This filter rules out models of academic interest only and focuses attention instead on the useful.

The Realization Filter is applied after the first two filters and asks, “Can the concept be operationalized?” A conceptual model is only of value if it can be applied to the executive decision problem at hand. However, the imperative to apply the model can, and often does, lead to the application of unreal or irrelevant models which in turn leads to unreliable advice to executives – a danger that requires the use of the Principled (Ethical) Lens.

Principled Lens
Key question: What is the appropriate way to interact in CARS to achieve best value for the owner?

The focus then of the principled lens is not what could be but what should be. The lens prescribes an ethical role for managers and their supporters in order to achieve value for the enterprise owner. While philosophically many things could be, it would be unethical to direct or encourage managers to take actions that reduce value for the enterprise.

The likely consequences need to be considered in the principled application of models to support executive action. It is not enough to simply base interventions on learned heuristics unless there is some reason to believe that those heuristics will be effective or at least will do no harm. That is to say that effective intuitive heuristics have served to sustain a variety of human enterprises. Since intuitive heuristics are learned from past experiences, however, they may not be reliable for relatively new CARS configurations. Therefore a key ethical role for science and analysis is to develop reliable heuristics for executives to use in emergent conditions.

Scientists and analysts as well as executives need an understanding of human enterprises and why human and managers behave the way they do. This implies the need for a Pragmatic Lens.

Pragmatic Lens
Key question: Why do managers behave the way they do in CARS?

If the Philosophic Lens focuses on what could be and the Principled Lens on what should be, then the Pragmatic lens focuses on what is. To understand the behavior of managers an understanding of the behavior of humans both individually and collectively is needed. Significant behaviors and phenomena we ‘know’ to be ‘real’ lay in all five of the domains identified above.

In the Social Domain, for example, a correlation can be observed between the size of the organization and the formality of interactions within it. Cultural phenomena in organizations often take years to change even under pressure from enterprise management. By contrast, in the Organizational Domain it can be observed that people create and use informal structures which can be more influential than the formal ones. These structures can emerge even when the
overt intentions of organization members are otherwise. Further, these informal structures can re-assert themselves in the face of business process re-engineering. Even in safety-critical organizations people do not consistently follow formal processes.

In the Cognitive Domain it is observed that people most often process information according to their culture, experience, expectation and emotional state. Personality can be as important a factor in decision-making as information. In fact, people in decision-making contexts seem to use relatively little of the information available to them to trigger and guide their actions. Therefore, enterprise behavior viewed in the Information Domain is unlikely to follow the cause and effect chains usually assumed by those investing in information technology. Indeed, even in the Physical Domain significant phenomena can be observed. For example, a relatively minor technical fault in an enterprise communications network can lead either to a managed recovery or a disproportionate reaction that disables the service to most users. The difference between these consequences is critically dependent upon human and organizational factors such as the formal and informal processes followed by system managers.

Explaining the phenomena described above suggests the need to look more closely at the source of human variability both at the individual and collective levels. These sources are many and knowledge about them comes from a wide range of disciplines. Individuals vary over time. Human cognition, for example, often analogized to a digital computer, is instead an emergent property of a rich and complex system. From medical research it is known that the two halves of the human brain are capable of hosting different thoughts and even different life goals. Perception and awareness are largely constructed from prior knowledge rather than being dominated by contemporaneous sensation. Self-perception depends crucially on storytelling, the construction of explanations for personal behavior that satisfy social and personal needs. Memory itself is constructive and therefore able to be modified by subsequent experiences. Reasoning is deeply involved with the emotional response of the brain, allowing automatic emotional response from past experiences to be encoded in information processing heuristics and vice versa.

The common understanding of cognition has been colored by outdated notions of humans as rational agents for whom factors such as those above are constraints on our ability to choose optimum actions from the various options considered. Current psychological theories, however, favor a more naturalistic process based on serial consideration of options and a satisficing test of acceptability. In this newer model, conventional rationality, far from being the norm, is a highly trained behavior requiring much effort and expertise. The naturalistic model of human cognition allows for a richer understanding and appreciation of human enterprises and human variability. Understanding human variability also can be greatly enhanced by looking at it through an Evolutionary Lens.
Evolutionary Lens

Key questions: What are the sources of human variability in decision-making?

The Evolutionary Lens recognizes that humans are an evolved species. A key consequence of evolution is that multi-layered identities are created in which behaviors and the mechanisms from which they emerge, are combinations of primitive and modern elements. The fact that people use only a fraction of the information available to their senses even when they are capable of doing more, for example, can be understood from an evolutionary perspective.

Primitive elements of the mammalian neural systems process sensation in ways that had survival utility in achieving rapid identification of predators and caregivers. As higher brain functions evolved limitations emerged in working memory and processing capability that favoured the development of efficient heuristic approaches to cognition. Human brains have not evolved physically since the days of hunter-gatherers in the African plains, meaning that there is still a need to exploit efficient heuristic approaches.

Even if the challenges of survival in modern settings are different from primitive times, it is not always possible or efficient to simply switch off older mechanisms. More likely, new capabilities will be layered upon older ones and the combination adapted to new circumstances. From this perspective, naturalistic decision-making through emotional reasoning makes more sense as does the way humans tend to revert to more primitive behaviors when placed under stress.

Collective human variability can be similarly understood using an Evolutionary Lens. A more naturalistic view of organizations, one which considers both primitive socialization strategies and modern social development provides a more plausible explanation for the richness of behaviors and the response to stress. Such an approach also serves to explain why organization behavior frequently differs from what might be expected from an understanding of formally espoused structures and processes.

However, one further lens is needed to fully understand the needs of the executive. The behavior management in CARS seen through the Evolutionary Lens is the product of a rich social process in which the managers are intimately involved and personally engaged. Consequently, there is a political dimension to be understood before the criteria for effective decision support can be established.

Political Lens

Key question: What does a manager have to do to ensure continued survival in CARS?

It is a common mistake of analysts to presume that options for executive action should be judged by their predictive effectiveness if implemented. However, even chief executives are not entirely free agents. They operate within a social and institutional process which both empowers and constrains them. They have their own needs and aspirations as do their organizations – social and cultural mores then shape individual and collective behavior.
If we are to be effective in supporting executives, it is important that we understand what advice they are politically capable of accepting and also know how to formulate that advice to best effect. An understanding of the politics of the organization and the constraints on managers arising from their need to survive and thrive politically is therefore necessary.

In typical bureaucracies, for example, there is an ethic of rational decision – making as well as a demand for evidence to support the decisions. As has already been discussed, the natural mode of action for the human enterprise is a rich mix of intuitive and informal behavior in which classical rationality is a special case. In organizations the espousal of a rational evidence-based decision process often acts more as a social process – facilitating the corporate will to act by providing a plausible story behind chosen courses of action that does not challenge the self-stories of the participants. This facilitating narrative might explain how enterprises can operate successfully despite the fact that the evidence they generate to support decision – making arises from non-requisite models with poor predictive power.

Intriguingly, the importance of the social process surrounding the use of scientific and analytic evidence can present an ethical dilemma. If the chief effect of an analytic decision process in a particular enterprise is not to discriminate options for action, but rather to engender the collective Will of the executive, is it ethical to deliver evidence based on poor science provided that is does no harm?

Summary

This paper has sought to explore the problem space faced by executives and those scientists and analysts who support them in trying to drive CARS. The problem has been viewed using a variety of lenses, each one giving a different viewpoint and perspective. Overall, a deeply integrative and pluralist approach is recommended within which multiple explanations for enterprise behavior are derived using knowledge from multiple scientific disciplines and empirical experience.

Ethical issues associated with giving valuable advice and support to executives has also been discussed, including the importance of understanding the politics of the executive’s organization before deciding on the validity of analytic evidence.

Playing with CARS can be a tricky business, but the rigorous application of a pluralist analysis will provide CARS drivers with increased capability to plan effective interventions and to muster the collective will to undertake them.