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Abstract

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Keywords

Complex Adaptive Systems, Complexity, Metaphor, Organisation, and Action Research

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Understanding the dynamic behaviour of organisations is challenging and this study uses a model of complex adaptive systems as a generative metaphor to address this challenge. The research question addressed is: How might a conceptual model of complex adaptive systems be used to assist in understanding the dynamic nature of organisations? Using an action research methodology, 6 Air Force internal management consulting teams were exposed to overlapping attributes of complex adaptive systems. The study shows that participants found the attributes valuable in understanding the dynamic nature of organisations; however they did present challenges for understanding. Despite being challenging to understand, using complex adaptive systems to understand organisations, particularly as dynamic systems, is of value. Key Words: Complex Adaptive Systems, Complexity, Metaphor, Organisation, and Action Research

> Obviously, this is an act of the imagination. Things are perceived, of course, partly by the naked eye and partly by the mind, which fills the gaps with guesswork based on learning and experience, and thus constructs a whole out of the fragments that the eye can see. (Clausewitz, 1976, p. 109)

Introduction

Empirical evidence and a wealth of managerial experience suggest that organisational interventions undertaken in isolation (i.e., without consideration of effects on the organisation as a whole) vary widely in their level of effectiveness. While interventions are perceived to generate improvements, these improvements may be short term in nature and the dynamic aspect of organisational behaviour may not be recognized (Kiehne, 2003). As Sterman (2001) notes, "the complexity of the systems in which we are embedded overwhelms our ability to understand them. The result is that many seemingly obvious solutions to problems fail or actually worsen the situation" (p. 15).

There is now much commentary on the potential utility of complex adaptive systems (or complexity theory) in assisting understanding in many academic disciplines (Mainzer, 1994). Complex adaptive systems involve phenomena which are characterised by the interactions of numerous individual agents or elements that self-organise at a higher systems level, and then show emergent and adaptive properties not exhibited by the individual agents. It advocates the concept of an organisation being adaptive to its environment (Doolittle, 2002). In this paper I describe the use of one model of complex

adaptive systems as a generative metaphor to assist in enabling members of an organisation to better understand its dynamic nature. The paper commences with a short literature review before moving on to a discussion of the research opportunity that presents itself. A discussion of the action research method employed, and the theoretical implications of the findings are then presented.

Literature Review

Leaders and managers, if not all of us, have a tendency to interpret experience as a series of events. We are taught from an early age that every event has a cause which, in turn, is an effect of some still earlier cause (Brodnick & Krafft, 1997). This event-oriented, open-loop worldview leads to an event-oriented, reactionary approach to problem-solving. Experiments in causal attribution show people tend to assume each event has a single cause and often cease their search for explanations when the first sufficient cause is found (Sterman, 2001). An aspect of non-linearity is that cause and effect are distant in time and space (Brodnick & Krafft). When this is combined with our linear thinking, we tend to look for causes near the events we seek to explain. Sterman (2000) says that our attention is drawn to the symptoms of difficulty rather than the underlying cause, and calls this counter-intuitiveness. Intuition is a term sometimes used in discussion about complex systems. Wheatley (2006) argues that this intuition is a function of listening, watching, and picking up subtle cues in what is observed; it is an ability to feel when something is not quite right. In this context, it refers to how people can grasp those changes that may be required without dissecting all the parts of the system.

Attempting to understand complex adaptive systems is about embracing a new way of thinking (Pina e Cunha, Vieira da Cunha, & Kamoche, 2001). It involves a departure from traditional methods used to understand events such as considering the external environment as relatively static. Gell-Mann (1994) believes it requires standing back from highly detailed analysis of parts of a system and taking "a crude look at the whole" (p. xiv). Wheatley (2006) states that the Newtonian approach, which involves trying to understand the world by splitting systems into their constituent parts rather than analysing the entire system, has led to our inability to grasp complex issues. She posits that Newtonian thinking does not provide us with a strategy to facilitate systemic understanding. Complex adaptive systems, however, are non-linear and unpredictable. *Complexity* in this way, therefore, should not be confused with *complicated*. Complicated refers to a state where patterns cannot be made but details, parts, and subsystems can be understood (Lissack, 2001), whereas complex refers to a state where the details cannot be understood but the whole, or general result, can be understood by the ability to make patterns (Lissack). Hence, even if one is familiar with all the components of the system, one is still unable to determine exactly what will happen next, as is the case with the weather, human behaviour, and ecology (Doolittle, 2002). Further, in a non-linear system the whole is greater than the sum, or average, of its parts (Doolittle).

In complex systems, managers take in data from their environments, find regularities in the data, and compress these perceived regularities into internal models that are used to describe and predict their future (Doolittle, 2002; Gell-Mann, 1994). Glover, Friedman, and Jones (2002b) believe that adaptive organisations are led by

adaptive leaders who demonstrate cultural competency, understand knowledge management, can create synergy from diversity and have a holistic vision. An organisation's ability to adapt, they argue, is always in flux, perhaps because the environment is dynamic. Leaders have to know the history of the organisation and understand what has made it successful in the past. They also need to conduct scenario planning to prepare for possible futures so that their organisation can adapt in the future. Adaptive leadership is based on being open to the changes going on around us and then making effective decisions in harmony with these pervasive changes, including implementing them in appropriate ways (Glover, Friedman, & Jones, 2002a).

The rational decision-making model operates on the premise that a single individual can have enough information and intelligence to direct all aspects of a complex, evolving system (Bergmann Lichtenstein, 2000). Complexity theorists have confirmed that the more effective approach is to push control downward into the system, providing employees with a clearly articulated vision and the information resources they need to effect local changes in the system (Bergmann Lichtenstein). The use of complex adaptive systems as a metaphor for the behaviour of organisations has been adopted by some large management consulting and service companies, such as Booz Allen and Hamilton and Westpac (Fox & Trinca, 2001).

Schön (1993) coined the term, generative metaphor, for supporting the cultivation of fresh perceptions and the acquisition of new schemas of others. By using a metaphor, which makes an implied comparison between things that are not literally alike, new understanding can be generated. Schön believed this was characterised by carrying over frames or perspectives from one domain to another. Generative metaphor has been used by others such as Sementelli and Abel (2007) and Jacobs and Heracleous (2006) in the study of organisations.

Doolittle (2002) provides a list of attributes that provides some understanding of why organisations behave in the ways they do. He has proposed six overlapping attributes or principles of complex systems.

1. Complex systems are non-linear, open, and far from achieving equilibrium.
2. Complex system behaviour involves adaptation to the environment based on experience.
3. Complex system behaviour is a function of internal models or schemas that are the result of perceived regularities in experience.
4. Emergent global complex system behaviour involves the aggregate behaviour of agents.
5. Internal models and schemas are actively constructed, self-organised, and emergent.
6. Internal models and schemas are a function of both agent interaction and existing internal models and schemas.

Unfortunately, as Lissack (2001) states, in much of the work on organisations utilising complex systems, thinking has been descriptive. For example, Zimmerman, Lindberg, and Plsek (1998) provide nine ideas to assist managers in thinking of their organisations as complex systems, but offer no rationale as to why a practising manager would apply these ideas. Brodnick and Krafft (1997) give eight postulates that explain

organisational phenomena in complex systems terms but, again, suggest no reason why these phenomena occur. Rowe and Hogarth (2005) use a complex adaptive systems metaphor to explain the nature of organisational change in a health care organisation but do not suggest a model. Thus the research question, "How might a conceptual model of complex adaptive systems be used to assist in understanding the dynamic nature of organisations?" has not been answered in general or specific terms and begged further research.

Therefore, through this research, I seek to contribute to the application of complex adaptive systems to understanding the dynamic nature of organisations by: (a) identifying a model of complex adaptive systems, namely, Doolittle's (2002) list of overlapping attributes and (b) examining its utility with a group of experienced management consultants. Complex adaptive systems thinking is explored in order to offer a more adequate metaphor to understand the dynamism of organisational behaviour. The context in which this research was undertaken was part of a doctoral thesis supported by the Royal Australian Air Force. The researcher held the position of Director of the Management Services Agency (MSA), an internal management consulting agency. The MSA consisted of six small teams of highly trained management consultants working within the Air Force in various locations in Australia. Permission was granted by the Director General - Policy and Plans in Air Force Headquarters to conduct the study.

Action Research Method

Due to the nature of complex adaptive systems and their non-linear characteristics, I needed to actively participate in the research process. As such, action research was selected as the most appropriate research method. It allowed me to improve both action and research outcomes through a process of iteration (see Dick, 1993; Sankaran, 2001). The repeated cycles of action research allow the researcher to converge on an appropriate conclusion as increasing amounts of data are revealed in the results. Conventional research sacrifices responsiveness in the interests of replicability. In action research responsiveness is valued as opposed to replicability, that is, the ability to change the process (action) in response to what is learned (Dick, 1993). Multiple sources of evidence and documented measures and procedures were used to collect the data for this research.

In the reflexive element of the action research process, the researcher analysed the reflections gathered during the project (Sankaran, 2001). It is an important feature of this approach that later action research cycles differ from the earlier ones. This provided the opportunity to be suspicious of the researcher's emerging interpretation, and to refine the method and focus group structure. The use of brief cycles (Dick, 1993) added rigour to the research process, as did using six different MSA teams that would likely have different views on both the content and process of the focus groups, which were used to extract data.

A process of critical reflection was used to learn through the action research process. This is a spiral process which alternates between action and critical reflection, in which we learn both by acting more intentionally and by being critically reflective after the event (Dick & Dalmau, 1999). Each spiral is regarded as having three components:

Intent → Act → Review

Questions were built around each component and specified the researcher's assumptions about the important features of the situation, the desirable outcomes, and the actions to achieve those outcomes, as well as the reasons for forming those assumptions. Two sets of critical reflection questions were used by the researcher; one to enhance intentions and the other to enhance the review or reflection process. The researcher responded to the intention questions prior to conducting the action research cycle (focus group workshop) and responded to the reflection questions after the conclusion of each action research cycle. The questions utilised are listed in the Appendix A.

The MSA conducts internal management consultancies for senior clients within the Air Force, including commanders. Agency personnel are distributed around Australia in six geographically dispersed teams. This afforded the opportunity to conduct six action research cycles, using focus groups with similar groups of people. Each focus group examined Doolittle's (2002) six overlapping attributes of complex adaptive systems and discussed their usefulness in understanding organisational behaviour. There was sufficient time between cycles to reflect on the process and content, and amend the focus group format. By the end of the six cycles, there appeared to be fewer new comments and suggestions, so conducting further cycles was considered unlikely to have any benefit.

The focus group design consisted of a 1- to 2-hour intervention to determine whether the concept of complex adaptive systems assisted with understanding organisational behaviour. The focus group consisted of four sessions:

1. an introduction/explanation of the workshop and its parts;
2. a Microsoft PowerPoint® presentation on Doolittle's (2002) attributes of complex adaptive systems;
3. a focus group session to determine participants' views of the usefulness of the concepts of complex adaptive systems in understanding organisations; and
4. a feedback session on the first two sessions in terms of process and content, and possible improvements for the next focus group.

An explanation of how the information collected would be analysed and what it would be used for was also provided. Although each focus group only had a small number of people, ranging from three to five, everyone was asked to contribute his/her opinion. Participants of each focus group were asked to reach consensus on the major themes and opinions that emerged. In this way, the information was refined during the different phases, and the participants helped in interpreting it (Dick, 1998). In most cases, some explanation of the complex adaptive systems terms used was offered. Participants were reassured that it was acceptable to have alternative views about the material presented. They were encouraged to present a range of views, which was recorded on butcher's paper so that they could see what was being written. They were given time to think about the attributes and encouraged to take notes as an aid to memory. In later cycles a handout was provided to assist with this. Participants were also encouraged to correct the researcher if they felt that his interpretation of their comments was inaccurate, and to suggest amendments or additions. Participants were asked if any attributes were missed, which attribute they found most useful for organisational understanding, whether

they would be willing to use the attributes in their work, and whether there was a better way to conduct the focus group.

The data was gathered in the following cycles:

Cycle 1	29 January 2003	Canberra (ACT)
Cycle 2	5 February 2003	Amberley (QLD)
Cycle 3	7 February 2003	Edinburgh (SA)
Cycle 4	12 February 2003	Melbourne (VIC)
Cycle 5	18 February 2003	Williamtown (NSW)
Cycle 6	26 February 2003	Richmond (NSW)

Analysis of Data

The data from the action research process was comprised of two types: content data and process data. The content data and the critical reflection process data were presented and analysed, revealing the growing development of the tool over the six action research cycles. The content data was recorded on butcher's paper by the researcher and checked by members during the focus group, and used to revise the next cycle. Changes made are outlined below in each cycle. Process cycle changes were made based upon the critical reflection questions that were posed prior to, and after each cycle, in Microsoft Word™ documents on a laptop computer. The changes to the process are outlined below.

Based on the questions proposed by Dick and Dalmau (1999) and listed in Appendix A, the researcher recorded focus group participants' observations prior to conducting each subsequent cycle. These were used as the basis for the group members' starting assumptions. The researcher then recorded their observations of the workshop, both from content (on butcher's paper during the workshop) and on process, through critical reflection after the workshop. Based on his analysis of all the above data, the researcher made changes in process and content before the next action research cycle. This method conformed to the idea in action research to "let the data decide" (Dick, 1993)[1]. The following sections provide a brief summary of findings after each action research cycle. Text noted in italics was selected directly from the researcher's notes taken during the cycle process.

Action Research Cycle 1

From the first cycle it was found that the concepts under review were not easy to comprehend, even for intelligent and experienced management consultants. Many changes to the focus group workshop format were suggested by the participants of the first cycle. These included giving a better explanation of the various terms, such as *equilibrium*, *non-linear*, *entropy,* and *agent*, and explaining *how these related to organisations*. Participants suggested removing the term, overlapping, in relation to Doolittle's (2002) attributes, as it drew attention away from the attribute and more towards what aspects may be overlapping. They felt that the researcher should provide an explanation of what a complex system is compared to a simple system.

[1] http://www.scu.edu.au/schools/gcm/ar/art/arthesis.html Found in the section titled, *How Do You Do Action Research?*

Other ideas were to develop a handout for participant use, more summary slides, and a "so what?" slide to detail what value participants gained from the workshop. The participants suggested that the researcher add a point about "what does this mean for you," and mention how participants could use the information in their work with clients. They asked the researcher to explain to the next group how results would be fed back to participants as well as those who would have access to the research findings, and to provide more detail on the action research methodology and explain why it is relevant to MSA. They added that the researcher should provide a further reading list for both complex adaptive systems and the action research method.

Further suggestions included explaining the attributes in terms of how they related to facilitating planning activities with clients and why the research is of interest to the Air Force. Participants also felt that the researcher should lead the discussion less and take the pressure off individuals to contribute. As suggested by Dick (1998), the researcher had asked participants to offer their individual comments, in turn, after each attribute was introduced. There were many changes made to the tool as a result of these suggestions. A handout was developed with the attributes in the left-hand column and space for notes on the right side. Suggestions for further reading were also provided. Lastly, the researcher made a note not to ask each individual to comment in turn, but simply open the floor for discussion.

Action Research Cycle 2

The researcher was confident that the content and process of Cycle 2 were an improvement on Cycle 1, as changes were based on content and process suggestions collected from participants during Cycle 1. The researcher was interested to see what difference the changes would have on the focus group, *particularly, how helpful the handout would be*. The researcher understood that the participants were looking forward to the workshop and some of them may have investigated complex adaptive systems on the internet in preparation.

After the workshop, the researcher revisited the pre-focus group questions and asked himself the remainder of the reflection questions suggested by Dick and Dalmau (1999). There was a generally positive acceptance of the material and there were some suggestions on how the researcher could improve the process and content. The group confirmed that some of the changes from Cycle 1 were good, especially when the researcher disclosed what changes had been made based on feedback, and that the workshop flowed well. This group also appeared to be able to consider work situations where they could use the content.

Fewer suggestions for improvement were offered than in Cycle 1. Suggestions for improvement included:

- to explain the levels of agent interaction more;
- for each attribute, ask if it is useful for better understanding the behaviour of organisations; and
- to explain what is new about complex adaptive systems.

Addressing the suggestions made by the group added to the researcher's understanding of complex adaptive systems. Participants appeared to have more time to consider how they could apply the attribute in an organisational setting. They appeared to appreciate the handouts, and many used the space provided in the handouts to take their own notes, particularly in relation to the definition of terms.

Some of the comments were similar to those made by participants in Cycle 1. While not surprising, this indicated consistency in the findings. The researcher found himself questioning whether these similarities were due to the Air Force organisational culture or whether the same comments would arise, say, with a group of internal management consultants from private industry.

The researcher gave considerable thought to the question raised by participants about proactive adaptation. The researcher's final view was that adaptation could be in response to either events or expectations of events in the external environment. Even expectations of events must be based on some cues from the external environment. Participants were also asked about the role of leaders when organisations are viewed as complex adaptive systems. The researcher's view was that leaders could ensure openness to the external environment and encourage agent interaction. Participants also asked what the opposite or alternative to complex adaptive systems was and what was new about it. They sought a comprehensive explanation of the level of agent interaction. They suggested that for each of Doolittle's (2002) attributes, the researcher ask whether it is useful to them for better understanding the behaviour of organisations.

The researcher made additions to his notes on the Microsoft PowerPoint® slide, "what are complex adaptive systems?" to include that the alternative to complex adaptive systems for organisations is a range of management theories that are based on Newtonian thinking (i.e., analysis of the parts). The researcher also noted that complex adaptive systems are multidisciplinary (e.g., quantum physics, genetics, biology, evolution, mathematics, computer sciences) and that the attribute was not particularly new, but required a new way of thinking. The researcher added a question to all the attribute slides: "What does this mean in terms of understanding organisations?"

Action Research Cycle 3

The researcher was hopeful that the content and process of the focus groups could be further improved, and that the expertise within this team would provide a greater focus on the application of the attributes of complex adaptive systems to understanding organisations. After the focus group, the researcher felt that the outcomes had been achieved, but not in the way expected.

One participant got more from the focus group than he anticipated. He was also able to add some very good points for improving the next focus group and for using complex adaptive systems in understanding organisations. Another participant, although an experienced consultant, was more challenged by the academic nature of some of the material. Where he was able to add value was in the application of the theory to organisational environments. He was also able to give some excellent advice on how to make the presentation more user friendly, particularly in terms of the handout.

What the researcher learned in this cycle was that the process works quite well with a smaller group. It was more intimate and individual questions could be answered more fully. The main findings for Cycle 3 were that different individuals absorb the material in different ways and at different rates. Participants also need time to think about how to apply the attributes in organisational settings. The researcher also realised that it was paradoxical to present material on complex adaptive systems, which is inherently non-linear, in a linear manner. However, it is the method by which we are used to learning, so to use a non-linear teaching method (if there is one) would be challenging for participants on a number of levels.

What the researcher learned from this cycle is that, depending on the nature of an organisation's business and its operating environment, it may need to be rapidly adaptable to survive. Aggregation activity may need to be encouraged through more effective organisational structures that bring personnel into contact with others with dissimilar views and from different work areas. Participants suggested changing the questions after each discussion of attributes to:

1. How does this help in understanding organisations? (general), and
2. How does it help in understanding the Air Force and the MSA?

Action Research Cycle 4

For this cycle, the researcher hoped not only that the objectives would be achieved, but also that the team would consider the exercise worthwhile. Despite his concerns, the researcher needed to ensure that the process unfolded at a relaxed pace and that he provided an array of practical examples. The group quickly warmed to the ideas presented. The researcher gained the impression that participants had been looking forward to the focus group. The researcher was satisfied with the outcomes as the group was able to provide some valuable feedback that could be used in the next cycle. For example, they suggested that after introducing an attribute, the researcher provide more time for participants to digest it. A major finding from Cycle 4 was not to prejudge how people might react to the material presented.

Action Research Cycle 5

The members of this focus group worked with clients who harboured a degree of mistrust of organisational behaviour consultants. The researcher felt that some members of this group might struggle with the conceptual nature of the material. However, previous experience showed that, notwithstanding clients who mistrusted organisational behaviour consultants, complex adaptive systems have something to offer them in terms of understanding organisational behaviour. The post focus group reflections were that the outcomes of the research were achieved. As the researcher had expected, some participants were quite critical of the material; however, there was a range of views. The researcher found that they needed to establish a method of dealing with contradictory views during the focus group. Apart from recording the opposing views on butcher's paper, the researcher had no other strategy prepared.

The main findings for Cycle 5 were that people within groups would not necessarily agree with one another, and the researcher needed to develop ways of dealing with this from content and process perspectives. They received disconfirming evidence for the first time and if the same evidence is found again, the researcher would need to develop a process of exploring the difference. As a facilitator, the researcher was required to take more time explaining the attributes and why there were only six. He was also asked to define what a system was earlier in the workshop.

Action Research Cycle 6

The researcher would have been concerned if many new ideas for improvement came out of this last cycle, as there had been progressively fewer suggestions over the previous cycles. If feedback from the previous cycles was reliable, there should be a sufficient level of understanding of the content by the participants. Although no further cycles were to be conducted, participants were asked to suggest improvements. The outcomes were generally positive, and participants felt that they could use the complex adaptive systems attributes in their work.

Findings

The research question posed in this study was, "How might a conceptual model of complex adaptive systems be used to assist in understanding the dynamic nature of organisations?"

In terms of understanding, the general consensus was that Doolittle's (2002) complex adaptive systems attributes presented a useful basis for effectively conceptualising an organisation and its operations. Focus group participant comments are indented and italicized.

> *As a generalisation they are beneficial in explaining organisational complexities but they are only the tip of the iceberg. The linearity of organisations articulates a role/function, a "what" whereas complexity theory provides the 'how' to think about it.*

Although the complex adaptive systems terminology was challenging at first, MSA consultants could see how to apply them in the work environment to assist clients, not only in organisational understanding but also in other consulting tasks such as organisational reviews. A number of individuals felt that some of the attributes were too general to be useful.

> *Attributes 4 and 5 are too similar.*

However, the first attribute in particular (that complex systems are non-linear, open, and far from achieving equilibrium) was perceived to be applicable to a better understanding of the organisation.

On the other hand, some participants felt that Doolittle's (2002) first attribute was too general to be of much use to management consultants and, further, that clients who do not understand complex adaptive systems would have trouble coping with it. They took Doolittle's first attribute to mean that effective organisations should aspire to be non-linear, open to external factors, and not aspire to stability, as this is where they can be the most adaptive and responsive. Others felt that Doolittle's fifth attribute could lead to learned helplessness if models and schemas are not sufficiently tested.

> *A bit of a generalisation; some organisations are in equilibrium and must maintain stability (i.e., Government and Legal entities).*

The aspects of the attributes that discuss agent experience appeared to appeal to MSA consultants. As the Air Force recruits at the junior level and grows its people, experience is an important issue and evidenced in many of the organisation's structures and processes. They could see how these experience levels impact, positively and negatively, to a high degree those aggregation processes within organisations. Due to these levels of experience, organisational-wide behaviour emerges and leads to the establishment of dominant models and schemas in the organisation.

> *Greater experience can mean the ability to come up with more possible solutions. Lack of experience can mean novel approaches to problems and novel solutions.*

The value of attribute 2 (complex system behaviour involves adaptation to the environment based on experience), in terms of levels of experience, was also discussed as it related to the MSA organisation where it was seen that a balance of both experience and lack of experience could be used to find solutions.

Focus group participants acknowledged the value of attribute 3 (complex system behaviour is a function of internal models or schemas that are the result of perceived regularities in experience) in understanding organisations. However, the attribute can be viewed positively or negatively, depending on the usefulness of the models and schemas and their fit with the external environment. It was also acknowledged that much of the work of internal management consultants lie in attempting to change existing models and schemas.

> *Identification of internal models and schemas is required before you can attempt to change them.*

From a consultant intervention perspective, attribute 3 was seen as being more useful than attribute 2. That is, organisational consultants need to understand the internal models and schemas of organisations they are working with in order to understand the behaviours they observe.

The size of the client organisation and the number of levels within it was seen as being relevant in applying attribute 4 (emergent global complex system behaviour involves the aggregate behaviour of agents). MSA consultants viewed this attribute very much in terms of organisational change interventions and discussed it in terms of change

models that they had applied for clients. While it was seen that MSA consultants could use this attribute with clients in terms of stimulating agent interaction, it was acknowledged that the process would only be effective over a longer time frame.

> *The time factor is important with this attribute due to the need for the interaction of agents - interaction needs time.*

MSA consultants can, however, assist with the aggregation process in organisations.

Participants also felt that they could assist with emergent behaviours within client organisations. Possibly because of the level at which much of the MSA work is done, there was a high degree of agreement about the formal and informal aspects of organisational behaviour. Many felt that when they worked with a client, they actively facilitated the self-organising process. Some felt that attribute 5 (internal models and schemas are actively constructed, self-organised, and emergent) could lead to learned helplessness if models and schemas were not sufficiently tested. Attribute 6 (internal models and schemas are a function of both agent interaction and existing internal models and schemas) was seen as being relevant not only for client organisations, but also for the MSA.

For almost all the attributes discussed, MSA consultants took a very human view of the impact of the attribute on individuals within the client organisation and on the client himself or herself. Whereas Doolittle's (2002) attribute statements are impersonally written, they all require large amounts of human interaction within organisations. Some MSA consultants felt that while the attributes were useful, to fully assimilate them in a 3-hour session was a challenge. They also felt, however, that complex adaptive systems provided a *how* to what actually happens rather than a *what* the organisation is supposed to look like. In this respect, the attributes provide a dynamic model that can be used for working within organisations.

This is not to say that Doolittle's (2002) list of overlapping attributes is without any shortcomings. While the list is adequate at the conceptual level, it is challenging for practitioners to implement complex adaptive systems in their work. It does not provide a how-to list of activities that can provide organisations with advantages accrued through thinking in complex systems terms. Indeed, some of the terminology used in Doolittle's list could be changed to make it more user friendly without losing its conceptual underpinnings. Elements of the list, such as the overlapping nature of its attributes, detract from its use as an applied construct, notwithstanding their value at the conceptual level. While it may be possible to reword Doolittle's overlapping attributes, any attempt to do so risks losing the general aspects of the original list and imposing an organisational contextual boundary around the attributes. This would also involve a degree of interpretation that would impose a filter on further interpretation.

Limitations

The primary limitations of this study relate to three factors: only one organisation was studied; the period of study was limited; and only a small number of groups within the one sub-unit were asked to contribute to the research process. The first limitation could mean that my findings are considered not particularly relevant for other large

organisations, hence my results are not gereralisable. The issue of uniqueness is encountered in all instances where generalisability is suggested. However, the research focus on organisational attributes is not particularly unique to the Air Force, and therefore is more generalisable to other organisations than we might think. Indeed the focus group workshop participants did not raise any Air Force specific issues that could be considered barriers for use in other organisations. The second limitation, that the period of study is limited to a short period poses the question of whether my results are time and/or situational-dependent. While accepting that different results could be obtained over a longer period, the nature of the issues to be discussed are not necessarily time specific, and should therefore elicit the same responses whenever and wherever they are proposed. The third limitation, that only a small number of groups within the one sub-unit are being asked to contribute to the research process, is similar to the issue of generalisation.

Conclusion

While complex adaptive systems and Doolittle's (2002) list of overlapping attributes did appear to be useful, the terminology also appeared to be challenging for people exposed to complex adaptive systems for the first time. This can be implied from the fact that the workshop required 3 hours, and that was with experienced management consultants. MSA consultants felt that Doolittle's overlapping attributes of complex adaptive systems appeared to build on each other with subtle similarities and differences among the attributes. They could see how they might apply all the attributes in client organisations albeit with some misgivings. All felt that the attributes dealt particularly well with the dynamism of organisational behaviour. Based on comments from participants, a better approach may have been to conduct two workshops with a break in between. Participants felt that this may have allowed a wider and deeper understanding of complex adaptive systems and how they might relate to organisational understanding.

In terms of action research methodologies, the researcher found that in using the focus group workshop over a number of iterations, there was just no way of knowing with certainty how people would react to complex adaptive systems thinking. Notwithstanding, just about all the participants related to some aspect of complex adaptive systems thinking. For example, the idea of intuitiveness appeared to strike a chord with many experienced consultants. Further, participants in the focus group workshops often disagree with each other and the facilitator must manage this disagreement in a positive way, while still being able to capture and use the data in a meaningful way. Future research could change the scope of the research to include a greater number of respondents and a longer time period. Extending the focus groups to a wider audience within an organisation could also be considered, and this would provide the opportunity to gain feedback from participants not so familiar with organisational consulting. Whereas the researcher's thoughts are that this would be more challenging, people with less knowledge of organisations may well be better placed to adopt the thinking required for complex adaptive systems.

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Appendix A

Critical Reflection Questions

The questions used to enhance intention are:

- What do I think are the salient features of this situation?
- Why do I think those are the salient features?
- Given that situation, what do I think are the desirable outcomes?
- Why do I think those are the desirable outcomes?
- What actions do I think will achieve those outcomes in that situation?
- Why do I think those actions will achieve those outcomes in that situation? (Dick & Dalmau, 1999)

The standard set of questions based on revisiting the third and fourth questions from above and used to enhance reflection are:

- Were the outcomes achieved?
- If so, now that I've got them, do I still want them?
- Why/why not?
- If I don't want the outcomes that I achieved, then I progress to the following questions:
- Was I mistaken about the situation?
- If so, in what respect?
- What led me to that mistake, and what have I learned from it?
- Was I mistaken about the desirable outcomes?
- If so, in what respect?
- What led me to that mistake, and what have I learned from it?

- Was I mistaken about the desirable actions?
- If so, in what respect?
- What led me to that mistake, and what have I learned from it?
- Did I produce the actions?
- If not, why not?
- What have I learned from that in terms of the situation, about the desirable outcomes, about the desirable actions, about systems, about people, about myself etc.? (Dick & Dalmau, 1999)

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