17th ICCRTS: "Operationalizing C2 Agility"

Paper 014: C2 agility, different models of change and reasoning with time

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Authors:

Lorraine Dodd
University of Cranfield
Defence Academy of the United Kingdom
Shrivenham
Wilts SN6 8LA
United Kingdom

Geoff Markham
QinetiQ
St Andrew's Road, Malvern
Worcestershire WR14 3PS
United Kingdom

Point of Contact:

Geoff Markham
QinetiQ
St Andrew's Road, Malvern
Worcestershire WR14 3PS
United Kingdom
(+44) 1684 896399
gmarkham@qinetiq.com

C2 agility, different models of change and reasoning with time

Abstract

Agility is a theme which arises in relation to a range of endeavours in the military and the non-military world, appearing either in accounts of practical experience or in statements of aspirations. Concepts of agility have recently been surveyed in the course of an ongoing study of C2 agility conducted for the UK MOD.

Whilst the accounts presented of agility differ widely, common to all of them is the interplay between *continuity* (i.e. preservation of identity and forms of order) and *change*. Both continuity and change imply some notion of time, but different concepts of agility adopt different uses of time, and indeed different forms of time.

This paper will focus on different ways of reasoning with time in the context of agility, including both how agility is engendered and how agility is exhibited. The paper will show how using the wrong form of reasoning with time can produce inappropriate metrics for agility. The paper will further show that the pursuit of inappropriate metrics can frustrate the intention to realise particular concepts of agility in order to respond to key change drivers.

Introduction – the role of time in reasoning about C2 agility

Today's discussions of command and control (C2) arise against the background of increasing complexity observed in recent and current operations (complex multi-actor operational environments, military coalitions, interactions between multiple Instruments of Power). Moreover there is strategic uncertainty about the nature and context of future operations, and the interplay between defence and security concerns.

The term 'agility' is frequently cited (in both the military and non-military worlds) in circumstances where demands may be changing rapidly, where it is difficult to make firm commitments now as to how future demands will be met, and where pressures on assets and resources may preclude the insurance of investing in the capacity to cope with all unforeseeable events.

Alberts [1] defines agility as "the capability to successfully effect, cope with and/or exploit changes in circumstances". The term 'C2 agility' challenges us to understand the implications for C2 of approaches to agility, whilst understanding clearly that 'agile C2' is not pursued for its own sake but to facilitate broader operational agility.

The phrase 'changes in circumstances' has strong connotations of situations arising or events unfolding *over time*. Agility, having forms and natures of change at its core, is conceptually related to time. Many entries in the academic and military research literature under agility [2] refer to time, e.g. "timing = sooner or span = shorter".

Indeed one of the six dimensions of agility identified by the SAS-085 working group [3] makes an explicit reference to time:

- *responsiveness*: the ability to react to a change in the environment in a timely manner.

But agility is not confined to being about *reacting* (i.e. *acting* in response) to environmental changes; and there are other approaches to dealing with environmental changes than waiting and reacting. Intuitively we may think of some of these approaches as 'slower-time' or anticipatory[1].

[1] The ideas in this sentence could align with themes in Daniel Kahneman's recent book: "Thinking, fast and slow".

We may also think of the idea of requisite time [4], which acknowledges that actors may have room for discretion in the 'time targets' with which they engage: there may be actions which they can take which 'buy time'.

The issue for this current paper is that both continuity and change imply some notion of time, but that different concepts of agility adopt quite different uses of time, and indeed different forms of time. In exploring requisite organization [4], Jacques draws from previous work [5] in which he presents two dimensions (or forms) of time, and asserts that "In the form of time is to be found the form of living". These two forms of time, *successive* and *intentional*, can be related to the two Greek notions of time:

- *kairos* - opportune timing, more about time in between;
- *chronos* – sequential, according to an assumed chronology.

Put simply, *kairos* is about qualitative moments of opportunity whereas *chronos* is about quantitative, linear, clock-tick time. So kairos relates more to Jaques' successive dimension of time as it embodies elements of quality (i.e. assessment of "success" or appropriateness), whilst chronos relates more to Jaques' intentional dimension of time as it covers looking forward in time (i.e. short-term or long-term projections).

Clearly, using an inappropriate form of time to assess aspects of C2 agility can seriously mislead.

The structure and content of this paper

Armed with the idea that agility might involve different forms of time, the paper now looks at a series of agility-related issues to determine the form in which time appears. This paper is an outgrowth of UK MOD -funded research into C2 agility[2].

Following a brief note on agility and resilience, the paper considers ideas of *timeliness* in discussions of agility, and how time intervals can be both stretched and consumed by the various decisions which the commander may take. The paper then looks at the different forms of time involved when we seek to reason about the future.

How we respond to situations is clearly dependent on human, organizational and equipment capacities which reflect experiences and decisions made in the past. The the paper considers what forms of time are appropriate for reasoning about these historic contributions to our current capacities.

This brings us to a portrayal of the present (i.e. the 'now' of human and organizational life) as more than just an organizational state corresponding to a particular instant in linear 'clock' time. Instead, this portrayal shows both the historical past and possible futures as being compiled into an enriched view of the present.

In the course of this journey, a more rounded view of C2 agility begins to form. In this view, C2 agility resides (and can be measured) in something we possess today, rather than being defined in terms of properties and behaviours which will (or may) be exhibited in some possible future.

Agility and resilience

During our work on C2 agility, the initially-clear distinction between 'agility through change' (e.g. reactivity) and 'agility through resilience' (which has connotations of 'changelessness') has progressively given way into an appreciation of the ever-

[2] Command, Inform and Battle Management (CIBM) Research Task 10: C2 agility - 2011-2013

present interplay between *continuity* (i.e. preservation of identity and forms of order) and *change*. All forms of agile behaviour exhibit this interplay between things which are changing and things which are not changing (i.e. being preserved or maintained).

There are, for example, significant aspects of agility which relate to *resilience*, which is the second of the six CCRP [3] dimensions (see also [6]). Wright el al [7] offer the following definition:

- *resilience*: ensuring an enterprise has the current and ongoing capacity and capability to continue to achieve its specified (or unspecified) purpose(s) in the face of predicted and unpredicted exposure to hazards, disruptive events and continual stress.

Nominally, resilience is 'timeless', but of course the word 'ensuring' refers to actions taken at various times, and even the most resilient capabilities will need to be re-thought, re-worked and refreshed eventually.

"How much time do we have?"

In the CCRP definition of responsiveness [3], the word 'timely' is used, rather than (say) 'fast'. So the next question is clearly, "How much time do we have?"

The answer depends on whether we are seeking to be purely reactive, or whether there are more anticipatory elements to our coping with circumstances. A reliance on rapid reactivity may place challenging demands on capability, if not impossible ones. For example, time and proximity considerations may dictate that interceptor platforms may have to depart on missions *before* their targets (moving adversary force elements) have actually been detected! Loitering missions are an anticipatory response by which 'more time is bought' to think about and then take action in relation to the unfolding situation. In general, anticipation is likely to increase the range of options for action, and the ability to act at a time of our own choosing. But the corollary of 'not having to react so quickly' is that we have to take anticipatory steps a lot earlier.

In fact there are three levels of coping with circumstances, each of which prompt different ways of answering the question ""How much time do we have?":

- *reacting* to situations or events which have occurred;
- *anticipating* situations or events which may be about to occur;
- *shaping,* for which a working definition might involve seeking to create the conditions under which problematic circumstances will either not arise, or will be more benign, or can be more easily addressed.

Pro-active shaping can reduce the demands otherwise made on our predictive or anticipatory capacities; the corollary again is that the shaping steps may have to be taken even earlier, and it may take rather longer to see their impact. Whereas an operator of equipment sees almost immediately the results of any decision (e.g. driver deciding to turn right at the crossroads ahead), a strategy-former may have to wait months if not years before the consequences of for, example, establishing a new strategic relationship are seen (and indeed the causal impact which a relationship has on the events subsequently unfolding may be impossible to determine).

Well-conceived anticipatory solutions in relation to physical and kinetic operations may well have a strong dependence on ISTAR capabilities providing the supporting evidence. The effective operation of ISTAR capabilities again requires 'lead time' (e.g. for collection planning) and time allowed for interpretation and exploitation. The planning of surveillance is, in itself, anticipatory in nature.

In sum, anticipatory or shaping approaches trade 'time to take action' against the ability to understand and appreciate (if not to predict) possible future situations and

events. Whatever sensing and interpretation technological support is available, it takes human understanding and interpretation to look forward and to foresee.

Nesting of time within organizational processes

Not all commanders have the freedom of manoeuvre (and the assets and resources) to engage in shaping or even in anticipatory activities: the freedoms and the capacities (e.g. to access to appropriate STAR and Intelligence capabilities, authority to change aspects of the mission) may rest with superior commanders. Hence anticipation and shaping may be accompanied by some notion of escalation and resultant changes instigated by superiors. Some of the possibilities for interactions between command levels are shown in Figure 1.

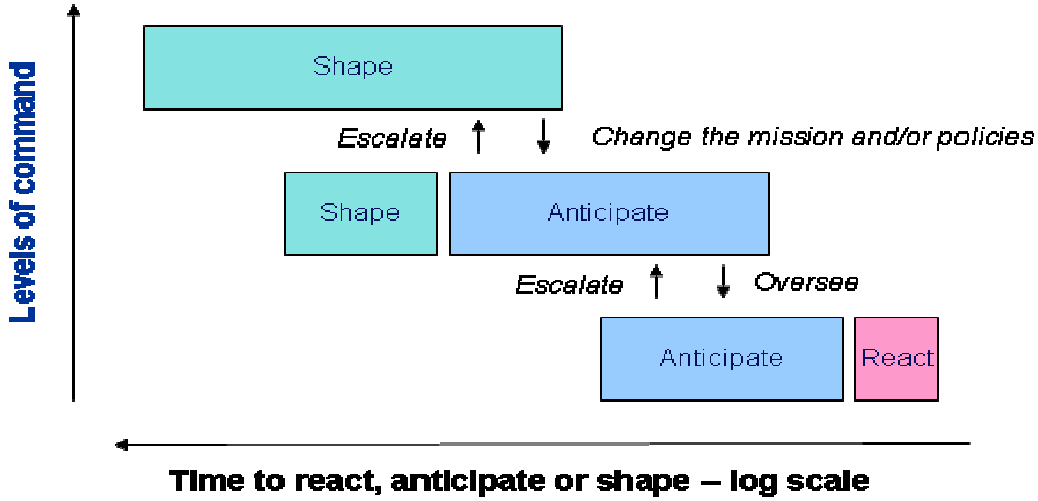

Figure 1: React, anticipate, shape, and the contributions of different levels of command

So Figure 1 is implying that a movement 'leftwards' (towards a more anticipatory or shaping posture) may be accompanied by a movement 'upwards' towards actions taken by, or consultation with, superiors.

Indeed, senior commanders (e.g. the operational commander) may see their role primarily as shaping. A key discrimination here may be the Level of the Fight (LOF) [8], above which shaping is the key activity. (Equally, below the LOF, shaping and even anticipatory activity may be constrained.)

But *why* can operational commanders *not* be required to anticipate or react just as quickly as their subordinates? Why are 'edge' organizations deemed to be better able to cope with rates of change in the environment than 'centralised' ones?

- This may be partly due to the 'scale' of the event or action with which the 'edge', or the 'coalface'[3], is dealing (although this is a more dubious argument when we recognise, in complex operational environments, the potential strategic import of even the most deeply-tactical circumstances).
- A more credible argument would point to the friction involved in ensuring that senior commanders are given a sufficiently tactile understanding of

[3] We use the term 'coalface' for the elements of an organization which are 'clamped on to the environment', i.e. engaging on a minute-by-minute and day-to-day basis with the realities of the operating environmental.

> the situation 'on the ground'; this friction consumes time as well as other resources. Commanders will be aware of the potential for this friction, and will endeavour to ensure that the operation (in terms of both the plan of action and the allocation of responsibilities) does not allow frictional losses to impede the collective capacity to anticipate or to react in an appropriate time.

In other words, senior commanders have to focus on creating the conditions under which their subordinates operate (and anticipate and react), just as senior management in commercial organizations have to set the policy framework and direction within which the rest of the organization operates.

If escalation creates the stimulus for shaping by senior commanders, then delegation can create the room for subordinates to deal with circumstances without escalation or the incurring of frictional penalties. Giving subordinates some 'wiggle-room' may also give them the freedom to exercise their own 'requisite time' strategies.

Dyer and Schafer [9] cite Dee Hock (former president of VISA International) who used the term 'chaordic' to describe the need for organizations to be both chaotic and ordered to achieve agility. Chaos allows initiative to flourish (i.e. through the use of personal agency with a hint of tolerance for generative instability and learning through failure), but is held within a system of overall co-operation (i.e. an appropriate holding structure for such agency, in the form of Jaques' sense of Requisite Organization [4]).

Freedoms or 'wiggle-room' take many different forms, and it is important to distinguish here the differences (and connections) between the extent of delegation (from 'centralised' to 'edge') and the manner of tasking (from 'action to be taken' to 'effect to be achieved'). Boxer [10] refers to these axes as North-South (N-S) and East-West (E-W) respectively. The UK construct of Mission Command[4] is primarily a setting on the E-W axis. Delegation and tasking need to be accompanied by allocation of assets and resources (which can then either support or inhibit the intended freedoms).

Collectively, these steps (delegation, tasking, allocation) determine or at least constrain the 'agility approaches' to which the subordinate commanders have recourse when faced with changing circumstances. These agility approaches include:

- modifying the actions being taken;
- replacing the use of one set of assets by another set;
- requesting and gaining access to additional assets and resources;
- modifying the appreciation of the operational situation;
- changing the form of the C2 organization;
- changing the mission (noting that this is a "shaping' response, and one that may not be open to subordinate commanders or 'middle managers').

Each of these change-types *consumes time*, and moreover pertains to time in different forms: we cannot measure the time taken to modify an appreciation of the operational situation using the same clocks as we use to measure the time in Time-Sensitive Targeting. Moreover it is clear that bending the form of the C2 organization can serve either to accelerate or slow down the other processes of change (so we immediately have at least two interacting forms of time, addressing plan changes and organizational changes respectively).

[4] Interestingly, recent discussion of these two axes has revealed that there are multiple interpretations of Mission Command within the UK military.

So, dependent on their delegated rights, tasking and allocation of assets and resources, commanders have access to a number of agility approaches which may both 'buy time' (in the sense of affording the organization a better chance of dealing with the dynamics of conflict) and 'consume time' (in the sense of taking finite time – albeit in a variety of forms – to effect change).

Different forms of future time

By 'future time', we are referring to the time in which things as-yet-unrealised may happen. Hence the different forms of future time affect the ways in which we view and approach *planning*, in particular, planning related to operationalising C2 agility. If planning is seen to be about producing a plan of future action, which involves action co-ordination, then the key ordinate system for planning will be intentional time (i.e. chronos or the forward-projecting form of time)[5].

If, however, planning is more about shaping potential future windows of opportunity for change, then this is more about patterns for flow, and time is about successive events and opportunities (i.e. kairos). The latter involves thinking about context, conditions, causal happenings and influences. This is in contrast to (and acts as a complement to) thinking about the 'text' of the operation.

The essence of the future, when set against the two forms of time, is composed of different models for projection. Intentional time addresses prediction and probability of future outcomes. Successive time addresses potential, propensity and possibility.

In his theory of evidence, G.L.S. Shackle [11] [12] criticises the use of probability theory for that which is inherently unknowable and unbounded; and adopts instead a set of notions (variously entitled belief and possibility), which, in essence, relate to the observer's degree of surprise[6]. Hence these measures pertain not to some objectively extraordinary event in the real world but to an entirely subjective set of conditions: that is, the observer's current estimation of degrees of surprise. Shackle is motivated in part by the failure of probabilistic models to 'predict' rare events, a theme taken up more recently by Taleb [13] [14] (see also [15]) in relation to economic forecasting[7].

Different forms of past time

The current CIBM research programme has conducted a number of interviews with military practitioners. Mental acuity has been cited by many as a critical component of agility. But having the cognitive capacity to recognise and respond to situations, and the will to exercise this capacity, is dependent on the individuals' pre-dispositions, knowledge and experience. All of this will have been acquired 'in the past', placed into memory in some form; although its recall and employment will be conditioned by the present.

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[5] Subsequent *execution* of this plan (in respect of which we may also require forms of agility) will also be occurring 'in the future' - but this will of course be occurring in the 'present time' of the future.

[6] Note that in itself surprise is an important 'weak signal', which indicates that something needs to change or to be changed.

[7] This picks up on the outlier aspect of Taleb's notion of a 'black swan', which he defines in his book, *The Black Swan: The Impact of the Highly Improbable* [14] "First, it is an outlier, as it lies outside the realm of regular expectations, because nothing in the past can convincingly point to its possibility. Second, it carries an extreme impact. Third, in spite of its outlier status, human nature makes us concoct explanations for its occurrence after the fact, making it explainable and predictable."

So whilst the emphasis so far has been on forms of reasoning about (and preparing for) the future, in this section of the paper we briefly consider the forms of time concerned with *reflection* and *learning* as related to situation appreciation and ways of framing and knowing.

Thus, somewhere in this 'past time', skills, knowledge and experience were acquired. When this was, and what happened in order to stimulate the acquisition, will be related to the role of the individual and the type of knowledge being employed [16]. The relationships between role characteristics and knowledge-types are illustrated in Table 1, the final column of which returns to the topic of *shaping* discussed earlier.

	Type of decision role			
Types of knowledge: "what has been learnt"	Operator (e.g. driver) - *practical*	Decision-taker (e.g. IED / ATO) - *tactical*	Decision-maker (e.g. Ops Cmdr) - *operational*	Shaper (e.g. JTF Comd) - *strategic*
Conjectural knowledge and cunning learnt through complexity: *metis*	Understanding modus operandii and decoys, etc., of adversarial operators	Plan robustness and ability to consider 'cunning' plans	Ability to defer plans and to balance all aspects of rules and freedoms	How to shape relationships for natural flow of complex operations
Experiential knowledge learnt through felt experience: *phronesis*	Self-reflection and creation of new options or actions – being resourceful	Create effective options outside usual course of action options	Understanding of situation as a whole – as felt OK to over-ride principles	Feel for when to re-generate or remove policy boundaries
Teachable knowledge: *episteme*	Learning how to cope with equipment breakdown	Operational and situational knowledge (e.g. ORBATs and geography)	Knowledge of own capability and organization – constraints and restraints	Knowledge of others' key strengths and weaknesses (power balance)
Technical skills and practices: *techne*	Skills and refresh of practical tasks	Estimate process and CoA selection	People skills for appropriate delegation of decision rights	Mechanisms for setting policy (e.g. veto, rules of engagement)

Table 1: Types of knowledge used in different decision-roles

The designation of the columns in Table 1 again alludes to a potential correlation between decision-roles, command levels and react-anticipate-shape options, although no hard-and-fast rules are intended here. The rows of the table now provide an appreciation of the different forms of knowledge used to fulfil these roles, forms of knowledge which will have been acquired in different ways and at different times.

The forms of technical and teachable knowledge (*techne* and *episteme*) can be acquired as part of formal training and study. These may have been instilled in the individual in the course of specific training and study events in the past – since which time, *techne* may have suffered from a degree of 'skills fade' if not subsequently practised, and *episteme* may have suffered from its own forms of erosion.

The higher forms of knowledge (*phronesis* and *metis*) are much more the product of multiple strands of *organizational life*, in the midst of which the personal psychology of the individual will play a key role in determining what is retained and what is recalled. So the instilling of knowledge in the individual may refer to complex

personal and organizational histories, for which a linear view of time seems inadequate. It is with these other forms of time that we have to reason if we are talking about instilling, exercising or indeed placing a value [16] on the cognitive capacity (or mental acuity) which practitioners associated so strongly with C2 agility.

These complex personal and organizational histories merit further inspection. Clearly, experience is acquired through past exposure to circumstances. But what happens to the record *after* situations and events, as those situations and events recede into the past, can have a profound effect on an organization's capacity (and individuals' capacities) to deal with future circumstances. The most pressing point to make is that *the record of what has happened undergoes change*.

Observations and reports may well be archived and, in principle, available for replay[8]. However, the human and organizational trace of what has happened will evolve from reportage[9] to a more distilled and abstracted account. Over time, specific circumstances, encountered at different junctures, may be blurred into some kind of *class model* or *script* (for 'this kind of circumstance', of which the individual instances may not be clearly remembered). Connections may be made with other past events, both identifying issues in common and drawing key differentiations deemed to be meaningful or valuable. Eventually the class models or scripts may be subsumed into archetypal accounts which both reflect and embody broader institutional logic and for which we might use the term *narrative*[10].

The time intervals in which these transitions take place and the other influences which are brought to bear (e.g. the normative effects of 'the official position', ideological interpretations) will be dependent on broader circumstances. There may also be competing narratives, and such contests can unfold (subject to external drivers and political / ideological pressures) over extended periods of time.

What is forming here is the organizational backdrop to the individual's learning and behaviour giving rise to the categories of knowledge identified in Table 1. Individual learning will include forms of personal reflection, which may result in the amplification or suppression (or even denial) of aspects of the record in order to create a more useful and/or acceptable memory for subsequent recollection. Memory fragments can also get refracted off recollections of other circumstances, in a process of sifting and sorting which makes the original events even harder to recall directly. The result is a composite and revisionist view of personal history.

In summary, whilst Table 1 points in one way to our capacities to cope with the unknowns of the *future*, it also points to the role of complex personal and institutional *histories* in creating our present capacities, as exhibited in the mental acuity which is being associated with C2 agility.

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[8] There may well be some finite 'dissemination time' for the exchange of the corresponding data across the organization. But this section is concerned primarily with a different sort of effect over time.

[9] I.e. 'reportage' in the sense of being contemporary. It may not be objective, and its subjectivity will again be affected by past experience. Indeed it would be possible to generate another table, similar to Table 1, to indicate the nature and influence of the interpretative schemata through which reportage might be generated.

[10] This evolutionary process presents some challenges to the parallel maintenance of a conventional 'Lessons Learned' database. Assessments made at one point in time may begin to appear 'dated' if re-inspected at some later point when the collective understanding (invested in class models, scripts and narratives) has moved on. But computer science can offer some interesting parallels (as well as some potentially-interesting implementation models) in the ways in which case-based reasoning systems and adaptive learning systems (e.g. Hopfield nets) evolve under the stimulus of new instances in the observed environment.

Capability development processes over time

The account above has focussed on the evolution of knowledge and ideas in the individual and in organizational space. For completeness, we note that there are a parallel set of processes taking place in the development of capability.

Specifically, in respect of the Equipment Defence Line of Development, UK MOD operates a 'normal' cycle of capability definition and equipment acquisitions and an 'accelerated' cycle of Urgent Operational Requirement' acquisitions. Both cycles may be stimulated by capability shortfalls observed on operations, but will also be influenced by changes in perception arising during the cycle's execution.

Much of this can be characterised as (merely) complicated, rather than truly complex. A formal history may be created which enables traceability (over time) from the generation of requirements through to the delivery of capability.

Hence a linear form of time may be perfectly adequate for the creation of a 'backwards roadmap' which explains where the delivered components of Equipment have come from (at least in formal terms), and can hence support a discussion of *acquisition agility*.

As always, the danger is of thinking that the particular case of the Equipment Line of Development provides a good model for the more general case covering human and organizational aspects of capability development. Mis-application of this model runs the risk of occluding the complex personal and institutional histories discussed in the previous section.

Understanding the now

Having understood that neither the future nor the past can be understood in terms of simple clocks or calendars, we need to move on to portrayals of agility which place less emphasis on a linear model of past, present and future. Instead, these portrayals show both the historical past and possible futures as being compiled into an enriched view of the present.

Looking forwards, the focus is on agility as a set of *valencies*, which are our *current* capacities for those as yet unrealised states, desired conditions and actions which may be realised in the future. Valencies may be viewed as *intrinsic* dimensions of the *current* organizational state. Realisation of any of these possibilities will of course entail consumption of resources (and time), but there is no one time axis against which all valencies can be referenced. Unrealised states and conditions which are undesirable may also be cited as a justification for our current position: this is similar to the use of counterfactuals in design rationale, but also echoes the function of *prophecy* as a warning rather than a forecast.

Kauffman's concept of pre-adaptation talks about "adjacent possibles" and is really about finding novel uses for things and novel ways of approaching things that cannot be pre-stated or pre-planned (or pre-assessed for their malevolence or otherwise) ahead of time. Kauffman [17] writes:

> "The set of uses appears to be unbounded and unorderable. Now consider an evolving cell in which one or more objects or processes, each with myriad causal consequences, finds a novel use which we cannot prestate but which enhances the fitness of the cell, so is grafted into the evolving biosphere by natural selection. This "finding of a novel use which we cannot pre-state" occurs all the time. The famous flagellar motor of some bacteria made use, by Darwinian pre-adaptation, of fragments of its flagellar proteins which were serving entirely different functions in other bacteria."

The assessment of organizational valencies (e.g. by asking “Could we do these things if required?”) embodies a form of counter-factual reasoning, which sounds rather weak. In fact the greater weakness lay in the earlier concept of validation of agility through the exercise of change observed through a specific sequence of circumstances (e.g. a scenario). Without a competent model of *how* agility is exercised (i.e. from what intrinsic properties the change-behaviour arises), the extension from observed behaviour to other circumstances looks like flawed inductive logic.

Instead, the assessment of organizational valencies, for which some forms of objective measurement may be determinable, is closer to an *architectural* approach. Architecture is deemed to be ‘good’ if it embodies some specific concept of ‘what it means to be good’. In this vein, we need to see agility as an intrinsic function or facet of architecture, rather than something which is exhibited by a set of use cases in which that architecture is exercised. So agility resides (and can be measured) in something we possess *today*, rather than being defined in terms of properties and behaviours which will (or may) be exhibited in some possible future[11].

Now looking backwards, the focus is on seeing ‘how we got here’ as an intrinsic component of ‘where we are’. This acknowledges that there is no objective way of divorcing the current state of the organization from the complex histories of adaptation, reflection and learning which have contributed to this current state and yet are usually regarded as ‘the past’:

- The current organizational form, procedures and expectations are likely to be the compiled products of history and cannot be understood independently of that history[12].
- The rulers and measurements we may employ to perform objective assessments of current state (and indeed future plans) are themselves ‘compilations of past experience’ (because where else do they come from?).
- Neustadt and May [18] provide a systematic treatment of decisions through the use of precedent and historical analogy. For example, instead of asking "What's the problem?", they suggest trying to ask "What's the story like so far … ?".
- The moral component of leadership and the exercise of the commander’s will include *seizing the narrative*. Narratives can be invoked, distorted or mis-used but they cannot be created out of ‘fresh air’: they come out of, and draw from, the shared experiences of the past.
- What we observe and report will be affected by past experience.
- We have the capacity to recall, remember and indeed re-invent the past when stimulated by the present. So the ‘past’ which is invoked under current circumstances may be subtly different from the ‘past’ previously invoked.

The idea of using forms of time other than linear time are not as novel or outlandish as they might at first seem. Indeed much of machine learning is based on adapting internal memory frames based on data that is represented in terms of phase-space,

[11] A similar argument is employed in defence of the use of intermediate measures in [16].

[12] C.f. Mintzberg’s observation that flattening (de-layering) of corporations in the earlier 1990s succeeded only in reducing resilience by removing the middle management “who could remember *why* it was organised this way”

because this type of representation appears to be better suited to learning, recollecting, re-membering and reflecting.

To go further, Morgan [19] provides, and advocates the use of, multiple images of organization based upon different *metaphors* (machine, brain, culture, etc.). Morgan argues that the exploration of organization both requires and benefits from the use of multiple conceptual dimensions which, in Morgan's account, reflect different *metaphors.* Morgan's metaphors are a powerful way of channelling thinking towards different issues and seeing different faces of organizational behaviour.

Of particular relevance to the present discussion are:

- the metaphor of *organisms*: how organizations are born, grow, develop, decline and die and how they can adapt to changing circumstances;
- the metaphor of *flux and transformation*, focussing on the logics of change shaping organizational life (e.g. self-producing systems which create themselves in their own image; organizational life and competing 'attractor patterns').

The use of non-machine metaphors is essential to the study[2] from which this paper derives: the military practitioners we have interviewed have repeatedly pointed to human cognition and behaviour as being key sources and determinants of agility. The more structural aspects of organization (notably procedures and equipment – for which the machine metaphor may be more relevant) are cited frequently as providing the enabling (and sometimes disabling) infrastructure, often through the resilience which they afford rather than their innate changeability.

Metaphors help us to recognise and then appreciate what normally cannot be directly observed but which needs, nevertheless, to be understood as part of a holistic appreciation. Metaphors help us to imagine what lies *between* the observable features. Different metaphors can provide us with different interpretations of situations, contributing to a richer understanding of both the environment and our own organization within that environment.

Metaphors also give us the insights to appreciate the forms of time being exercised in organizations, and specifically the forms of time relating to C2 agility. In particular, non-machine metaphors cope much better in providing languages in which the interpenetration of past, present and future, as discussed in this section, can be expressed.

Continuities and discontinuities

Adaptation can be understood as a direct 'coalface' response to the immediate challenges presented by the environment so as to become better suited to addressing these challenges. 'Coalface' changes may be within the envelope prescribed by extant organizational axioms, assumptions and values, or may indeed step temporarily outside the envelope. The mark of such excursions is that they do not get institutionalised, but disappear again when the immediate challenges have dissipated. So the change (e.g. to 'coalface' working practices) is accompanied (and indeed facilitated) by the resilience exhibited by the enduring nature of organizational axioms, assumptions and values.

When contextual time (which is usually slow and takes a form of shaping) begins to run ahead of textual or situational time (which is usually called "real-time"), then the result is experienced as discontinuity, where tiny changes in the real-time situation creates large discontinuous step-changes in response actions. These can be seen as shocks. Agility then requires a response which is less about *resiling* (and going back to the original state and form of organization) and is more about *transformation*, the exercise of a radical change in overall form, characteristics and operation.

Concluding remarks – the 'so what?' for agility

Time is only one aspect in the appreciation of agility, but the discussion above should have opened up insights on agility as a whole (for example, regarding the nature of options for choice) which would merit discussion in open session at 17th ICCRTS.

The specific contribution of this paper has been to show that this richness of understanding of agility cannot then be related to a single form of time derived from classical mechanics. There are rich and diverse forms of time being exercised in the exercise of C2 agility. These different forms need to be acknowledged in the assessment of C2 agility and in experimentation focussed on the measurement of C2 agility under different conditions.

There are some important concepts of C2 agility – particularly those associated with mental and agility – which can only be properly measured and valued using appropriate metrics. These metrics in turn need to relate to forms of time other than the chronos of sequential, clock-tick time or, equivalently, Jaques' intentional and forward-projected dimension of time [4]. By embracing richer and more diverse forms of time, a broader and more effective range of concepts for C2 agility can be embraced.

The study from which this paper derives[2] has provided clear evidence of the need to employ organizational metaphors [19] other than that of the machine in order to understand the organizational complexes from which C2 agility emerges. Use of different metaphors (e.g. brain, culture, organism) provides us with the stimulus to see the various forms of time being exercised in both the C2 organization and the environment in which it is operating.

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