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TITLE: **Valuing Investment in Military Command and Control Training: can we use intermediate decision-based measures?** [1]

ABSTRACT

With pressure on defence budgets, the military have a requirement to revisit the value of training, education and experiential learning in order to inform future balance of investment decisions. This paper introduces new approaches to the value of training, education and experiential learning through use of intermediate decision-based measures. It discusses previous research and experiments designed to investigate how we might capture such measures through experiments and structured interviews (such as Critical Decision Method interviews) aimed at eliciting the range and types of decision-options being considered by decision-takers.

The paper outlines four types of knowledge:
- *Techne*: Technical/practical skills (as developed by practice and repetition);
- *Episteme*: Teachable knowledge (as developed by being taught in company of those who already know or by reading training notes or books);
- *Phronesis*: Experiential knowledge (can be learnt only by direct personal experience – actually being there to know what it felt like);
- *Metis*: Conjectural knowledge (that combines wisdom, deception, insightfulness, vigilance, resourcefulness, opportunism and 'cunning').

It frames these knowledge types according to different decision-roles (e.g. action-taking, decision-taking, decision-making and option-shaping).

The presentation will also provide a more detailed treatment of an illustrative example of an investment decision for a future command trainer to demonstrate how measures relate to different aspects of value by adopting different stakeholders' perspectives.

Primary topics: Military training, balance of investment, measurement of C2 training effectiveness, decision-making, decision-taking, knowledge, capacity, learning.

Introduction

With pressure on defence budgets and increasingly complex operational demands, the military have a requirement to revisit ways of valuing training, education and experiential learning in order to inform future balance of investment decisions. This paper discusses different aspects of value and proposes use of intermediate decision-based measures and introduces a conceptual framework based on four types of knowledge and four categories of decision-role. Its purpose is to introduce new approaches to the evaluation of training options through the use of decision-based measures.

The major theme is measurement of effectiveness of training and so this inevitably involves discussions about how to measure changes in people's abilities as they go through training, education and operational experiences. The study of effectiveness measurement for training then aids understanding of how we might assess value in relation to the usefulness of the learnt abilities and knowledge gained through training when applied in today's complex theatres of operation.

Previous studies (Alston (2009), Dodd (2008), Sirett (2006a)) have suggested ways to capture decision-based measures through eliciting individuals' potential decision-options, which are then related to the individuals' capacities for open-mindedness and creativity. A framework has been developed linking different types of decision-options and different types of knowledge as might be gained through different forms of training. It then develops the issue of valuing training further by adopting different stakeholders' perspectives to address some decision-options for training, using a multi-perspective approach. The multi-perspective approach (MPA) will allow defence analysts to be well placed to carry out future Balance of Training Investment studies relating to investment in training, education and experiential learning, as well as providing a more comprehensive understanding of the training and education programmes as 'complex adaptive systems' preparing people to deal with the possible as well as the most probable.

The decision-based measures allow us to address the more challenging situations and roles; in particular, those relating to decision-taking and decision-making by tactical and more senior commanders (respectively).

Four broad categories of decision-roles are considered:
- Operators (e.g. drivers);
- Decision-takers (e.g. tactical commanders);
- Decision-makers (e.g. operational commanders);
- Shapers (e.g. strategic leaders).

Four types of knowledge are addressed:
- Technical/practical skills;
- Teachable knowledge;
- Experiential knowledge;
- Conjectural knowledge.

We tend to be more familiar with measuring how well training has imparted the first two types of knowledge. They can be tested for more readily and are easy to examine in order to appraise the degree and level of attainment. The latter two types of knowledge are more challenging to elicit and measure and also to understand in terms of their eventual operational effects.

The development of the conceptual framework takes into account all the aspects of knowledge, role-types, repertoires of action/option, measures, values, contextual settings and situational requirements and will also consider what is (and is not) readily observable and measurable. The resulting conceptual framework will be used to describe stakeholder positions and will show

routes, through value, to where they might want and need to be so that multiple perspectives and associated measures of effectiveness can be fully and openly explored.

The illustrative context considers two candidate options for a future command and staff training facility and use of a multi-perspective approach to draw out the many different types of measure relating training inputs via intermediate decision-based measures through to measures of operational effectiveness (more strictly, the potential for effectiveness). This helps to provide insight into a real and currently on-going training investment problem but it also develops the basis for the parameters that need to be made explicit in end-to-end analytical frameworks being used in valuing training.

Previous studies on sense-making and decision-taking

A two-year study with Improvised Explosive Device Disposal (IEDD) operators (see Sirett and Dodd (2007) and (2006a)) investigated the effects of training and experience on their situation assessments, when the IEDD operators were presented with different information sets. The experiments elicited the following assessments from each of the IEDD operators:

- potential Targets, Perpetrators and Intents;
- likely device types;
- confidence in own ability to deal with the situation and device, as assessed;
- response actions being considered as possible options (see Bradshaw et al. (2004));
- cognitive strategies being used (or not being used) more than others;
- individual requirements for any additional information; also what they wished they knew.

The experiments were carried out following a detailed pre-experimental phase using the Critical Decision Method (see Klein et al (1989); also Sirett et al. (2006a)) and a further thorough pilot exercise to verify and extend potential evaluation factors that IEDD operators used to make sense of their situations.

The experimental programme addressed individual sense-making[2] and decision-taking where, usually, the measures cannot be easily aggregated or compared. It also demonstrated that individual assessments and decisions are determined not just by situational information but are shaped and driven by an individual's frames of reference, predispositions, propensities, principles and priorities. All of these factors need to be balanced, based on level and nature of training, extent and nature of personal experience, individual motivations and ways of thinking, interpreting, etc. Their assessments were most strongly influenced by what they felt able and competent to do. The experiments showed that it *is* possible to elicit factors used for sense-making and decision-taking. It was also possible to gain some access to operators' rationales about strategies used and their reasons for not considering particular options or for coming up with new 'hedging' options.

The experimental hypothesis was that presentation of two different information sets would result in differences in:

(a) situation assessments, in terms of likely device types, triggering mechanisms, potential effects, perpetrators, targets, etc.;
(b) self-assessments of their own confidence in their ability to deal with the situation as assessed by them.

It was also hypothesised that these differences in assessment outcomes would lead to differences in options being considered as 'do-able' and, further, that these differences would vary according to the degree of training and level of experience of the IEDD operators.

The results as measured were somewhat surprising. The hypothesis held when the operators were dealing with a situation that was similar to the scenarios used in training and accreditation

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[2] Sense-making is the process of creating situational awareness and understanding in situations of high complexity or uncertainty in order to support decisions and action-taking.

exercises. The operators who had received more specialised training and who had had more years of experience did indeed make more of the enhanced situational information and were able to consider options that the less well-trained and inexperienced did not consider at all. The hypothesis did not hold, however, when the operators were asked to deal with a situation that was unlike training and accreditation scenarios, in that it was open-ended and had no obvious target. There were many possible targets, so the situation assessment was more about anomaly-spotting rather than classification of probable device-type and categorisation of potential perpetrator. The degree of experience had little or no bearing on the assessment of anomaly. Indeed, the assessment made by the most experienced operator and the least experienced operator was that they were dealing with something 'out of the ordinary'. Both operators also stated that they were using strategies of hedging against the situation being any one of the many possible, given the observed information.

The degree of experience did, however, have an effect on how they each assessed their ability to deal with their imagined 'worst possible' situation. Experience level was reflected in their degree of confidence in dealing with the situation and so influenced the final actions taken. The most experienced operator knew what to do and did what was needed. The least experienced operator knew that he did not know what to do, so he chose to refer the decision to his Squadron Duty Officer who was back at HQ. Both showed a high degree of self-reflection, of being open to doubt and a willingness to consider possible options that were outside the normal range.

The results from the experiments left us with questions about the risks of 'training-out' people's tendencies for dealing with situations that are outside the scenario set. The amount of exposure to training exercises appeared, in some cases, to have 'over-processed' the approach to situation assessment such that the potential strangeness of the situation was just not being seen as they rigidly adhered to working through the process. The training exercises tend to follow a process of: establish a potential target, then a likely perpetrator and a probable device-type, then choose an appropriate course of action that will make the device safe so that the cordoned area can be returned to normal as soon as possible. Time taken to complete the tasks and degree of confidence shown in own ability to recognise and deal with a situation are useful training measures. However, they may not engender ways of approaching situation assessment that would help operators to spot anomalies and to doubt the efficacy of their normal processes and practice in particular types of unfamiliar and unforeseen situations.

Intermediate measures for value of training

This paper hopes to open-up a discussion about what kinds of measure may need to be put in place to make sure that military training makes space for, and places value on, abilities to deal with unfamiliar and unanticipated situations. It has reviewed current analytical methods for measuring effectiveness of training and approaches to valuing training using benefit analyses. It suggests that we need an intermediate set of measures based on sense-making and decision-options. It also suggests that we need to take a multi-perspective approach to the value of training. Because we cannot define and project every feature of training outcome measurement into the space of operations, we may need to value intermediate measures in their own right.

Setting an illustrative context

It may be useful at this point to set an illustrative context so that readers can begin to understand the nature of the questions that this study has at its core for research into measures and value. Take, for instance, an investment question[3] relating to two candidate options for a future command and staff training facility (FCASTF). A simple exemplar question is: *Is Option 1 for FCASTF likely to train commanders more or less effectively than FCASTF Option 2?*

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[3] Note that this study is scoped to cover only effectiveness and not to cover cost issues.

Two candidate FCATSF system options could be, for example:
- FCASTF Option 1: architecture re-vamp with embedded war-game synthetic environment;
- FCASTF Option 2: architecture as now with additional extended ISTAR[4] representation.

In order to carry out analyses to measure and compare the effectiveness of the two options so that investment decisions can be supported, we need to establish (a) what each of the options might be contributing towards what needs to be learnt and (b) how what is learnt contributes to ultimate operational effectiveness.

Our approach to these questions may need to use collateral information, such as the knowledge that there have been recent losses in operational theatres which, it may be argued, could be related to training feature "X". Do the investment options address "X" differentially?
So it may also be necessary to consider a more hypothetically-based question:
- What could have contributed to recent losses in operational theatres, which could be related back to choice of, and investment in, training Option X?

Such 'cause and effect' questions are usually impossible to answer analytically[5]; mainly because there is no clear, assumption-free, linkage between training methods and operational outputs (see Grisogono (2007) and (2008)). However if we could take some decision-based measures at the point of exit from training and can then find relationships between such measures and a potential for providing general operational, organisational and individual benefit, then we will be closer to gaining insight into such questions.

Time for training effects to be realised

The next section on measures does not delve explicitly into the question of how much time it will take for the effects of training and education to be realised. The important role that time takes in measures of effectiveness also has implications for how long any effects of training are sustained and so has implications for setting and adjusting refresh rates.

Unless there is a developed conceptual framework that defines relationships between concepts such as time, measures of effect, types of knowledge, levels of work, values, and constraints, it will be very difficult to balance the needs and timings for Through-Life Capability Management (TLCM) and investment expenditure on particular areas of training, refresh, education and experiential 'on the job' learning (see Phillips (1995)).

Preparing for the 'big world'

Figure 1 shows the simple relationship between need for creativity (in terms of thinking laterally and innovatively or being able to improvise) and capability to engage with what cannot be or has not been foreseen (in terms of having to deal with the unfamiliar and unanticipated).

The small-world (bottom-left) box tends to cover what is generally familiar and well-known to trainers, educators and training establishments in the context of operational and organisational settings that are comfortably bounded. As such the 'training for the test' measures and programmes can be controlled and base-lined against normative performance scores. It is appropriate in the small-world to have notions of the military solution-sheets or 'pinks' where there is a set of correct or expected answers, outputs, best practices and 'good' behaviours (see Kimmering (1993)).

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[4] Intelligence, Surveillance, Target Acquisition and Reconnaissance.

[5] This doesn't mean, though, that analysts won't then be able to find a plausible probabilistic set of relationships based on different kinds of assumption, usually presented in the form of a Cause and Influence network or something similar that supports a systems dynamics analysis.

Education, in its broadest sense, then provides a transitional route out of the small world as people and organisations are encouraged to think more laterally; to add to or to change the options as instilled and practised through training. Such additions or changes can be minor adjustments to practised skills, adaptations to internal structures (e.g. 'mental models', organisational structures) or transformations to a whole new way of approaching problems. The movement up professional levels (e.g. from soldier/operator to commander) involves such a transitional move because options tend to move from being limited to courses of action to include options involving internal structural change (e.g. changing a military Task-Organisation, novel structures to carry out Joint Fires and transient organisations to make sense of socially complex strategic interventions), placing of decision rights and shaping tolerances. The aim of this type of extended education is to enable operation in the big world[6].

As we move around the space depicted in Figure 1 it is suggested that skills training tends to sit in the bottom-left but that extending education to address the different types of knowledge begins to move us into the top section. This leads then into building knowledge and capability for operating in the big world.
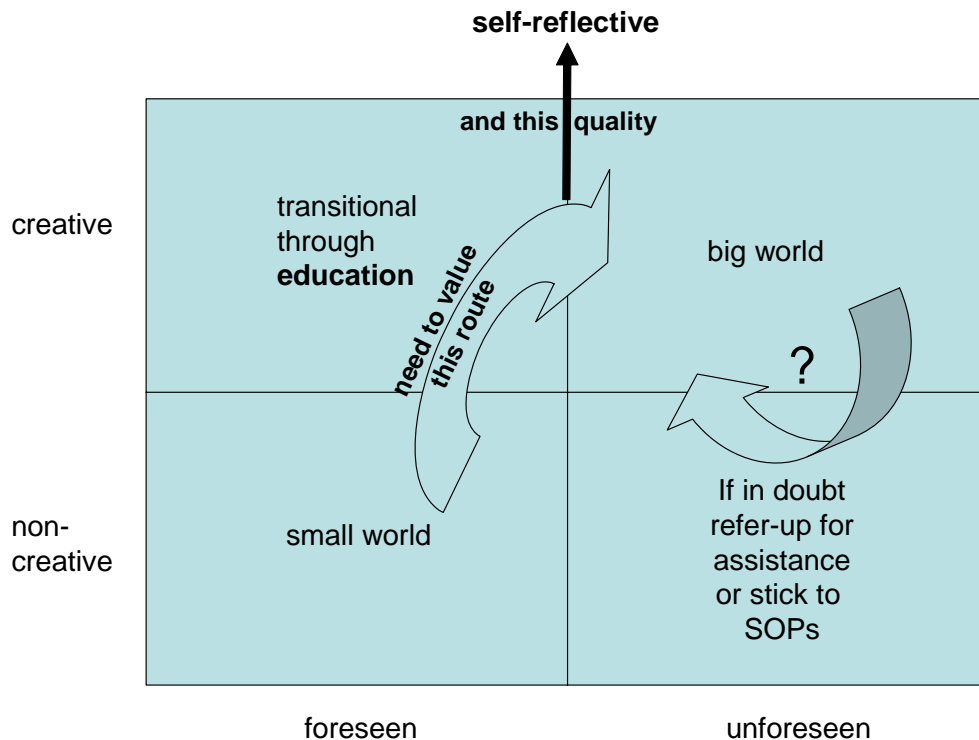

self-reflective

and this quality

creative

transitional through **education**

need to value this route

big world

?

non-creative

small world

If in doubt refer-up for assistance or stick to SOPs

foreseen   unforeseen

Figure 1: Journeying from small worlds to big worlds[7]

The nature of assumptions, both explicitly specified and unspoken, being made in small and big world situations can be accepted, questioned, worked around or rejected. Small-world operation tends to work within a set of, usually un-stated, assumptions that hold within the tolerances of the training or test world. The 'test world' demands temporary acceptance of such assumptions. The

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[6] Little more needs to be said about the requirements in the big world that has not already been said in Gen John Kiszely's recent papers on contemporary operations — Kiszely (2008).

[7] Adapted from Nigel Howard and Andrew Tait (www.IdeaSciences.com) and through further discussion with Gen Sir Rupert Smith (see also Smith (2005)).

assumptions then necessarily bound the 'test' problem to being within a small-world scope. It is then dangerously easy to build upon these assumptions to get causal and conditional assumptions that can be taken (as potentially fatal baggage) into, and used to interpret and solve, big-world problems (see Mitroff (1993)). For example, when operators are trained to look for specific indicators drawn from foreseen, known situations and equipment-types, and that support a practiced set of processes actions, then their focus of interest is on searching for those indicators. This focus on pre-defined indicators can cause them to over-look more subtle signs or anomalous features in the wider situation. Such directed focus could potentially prove fatal; and often is in theatres such as Afghanistan.

There are useful theories and examples (see Kitchener (1994)) of big-world demands for an increased ability to be self-reflective in order to recognise when creativity, improvisation and innovation could potentially be dangerous and therefore when it may be wise to refer to lower-level learnt practices (such as Standard Operating Procedures (SOPs)) or to a higher-level supervisor (see Weick (1993)).

Such big-world appreciation is discussed more fully in theories within complex adaptive reflective systems (CARS; see Mathieson, unpublished). Graham Mathieson explained CARS as follows:

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.

Knowing operationally when to move between the top-right and bottom-right boxes then begins to address points, in UK Doctrine Joint Interim Concept (JIC) *Prepare* [8], about limits on agility. It also raises the debate about specialist training and generalist education and places value on the skills kernel that must be kept alive and relevant. Such a skill base is there to build up from and to fall back on whilst developing and broadening education and experiential learning that engender more open and self-reflective situation appreciations.

Introduction to measures

Figure 2 shows an end-to-end analytical framework that has intermediate measures of decision effectiveness as a central set of measures, as might be assumed when tracing analyses through from training inputs to operational outputs. There are difficulties in applying the 'straight-through', end-to-end analytical approach to measurement of training effectiveness, as opposed to measurement of equipment or weapon effectiveness. These difficulties include:

- The time taken for the input changes due to training to percolate through to operational effects can be long and involves complex interactions [9] with other functional attributes, such as organisational constraints and operational pressures.
- There is no straightforward track through the formal process of lessons-learnt capture that can give credit to any particular input (or lack of input) for any specific observed outcome.
- Operational effectiveness outcomes are tied to one or more scenarios and so it may not be possible to establish a broad enough representative coverage such that training inputs are wholly effective in meeting future possible operational challenges.

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[8] For more detail see Development Centre Doctrine Concepts *Prepare* (2007).
[9] It is almost impossible to separate out the functional linkages between inputs and outputs due to all the various factors that can influence operational outcome; there is no single cause and influence network that can be functionally represented.

- Real operational outcomes are so contextually and circumstantially driven that they defy backwards-looking interpretation necessary to understand cause-and-effect linkages.
- Effects due to training and education inputs that are conditional not only on the nature of the particular operational setting but also on having an organizational context that then enables people to:
  — see and understand their situations using a broader perspective and from viewpoints other than their own to be able to judge appropriateness of any decision options;
  — improvise or create hybrid options if the existing set of options seems to be inappropriate;
  — reflect on own ability to deal with the situation and, if in doubt, refer up to a supervisory or higher level or ask for assistance or advice from team members or associates who may have more specialist knowledge or more relevant experience.

So we are often reduced to stating the obvious: that doing no training or education would result in poorer operational outcomes. It is also possible to make conjectures about the influence of degrees of training and professionalism in achievement of particular combat outcomes when compared against those of the adversary. It remains very difficult to find ways of analysing and measuring that allow us to say anything more useful to support training investment decisions. There is a need, therefore, to demonstrate more formally why intermediate measures of decision effectiveness offer a useful and viable way to capture effects of training and education.

The end-to-end analytical framework must be viewed first in an extended context that shows how changes in one part of the framework feed through or feed back into effects in other parts of the framework. This leads us to question of what is being changed and why (or why not). Then, in the light of developing a conceptual framework, we can begin to see how the changes and on-going feedback relates to other important elements in the operational and organizational contexts[10].

Having the freedom to put such abilities to 'good use' will also depend to a large extent on the permissive and supportive conditions within the organization and the command structures as well as the wider institutional environment (see Ford et al. (1992)). If there is a risk-averse culture or an over-bearing blame culture then such abilities will not be so readily brought to the fore no matter how much the operational situation might demand them. This adds a further set of factors that are not shown explicitly in Figure 2 but which add significantly to the non-determinism involved in going from training inputs to operational outputs.

The challenge, therefore, is to identify intermediate measures between training inputs and operational outputs and to investigate fully all instances of such measures in previous work (see Jaques (1994) and Jacobs & Jaques (1990) as reviewed and discussed in Dodd et al. (2007)). Such measures are based on factors such as the range of decision-options, the scope and nature of an individual's (or team's) frames of reference, and types of knowledge being used to address problems. Of great importance, also, are the abilities of commanders to sense and understand subordinates' strengths and weaknesses in order to organise and delegate decision rights and freedoms to act appropriately. Such intermediate decision-based measures are based on factors that are not readily observable, but they are necessary to inform a comprehensive systems model of training effectiveness.

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[10] This would show linkages from Training Defence Line of Development (DLOD) into the other DLODs.
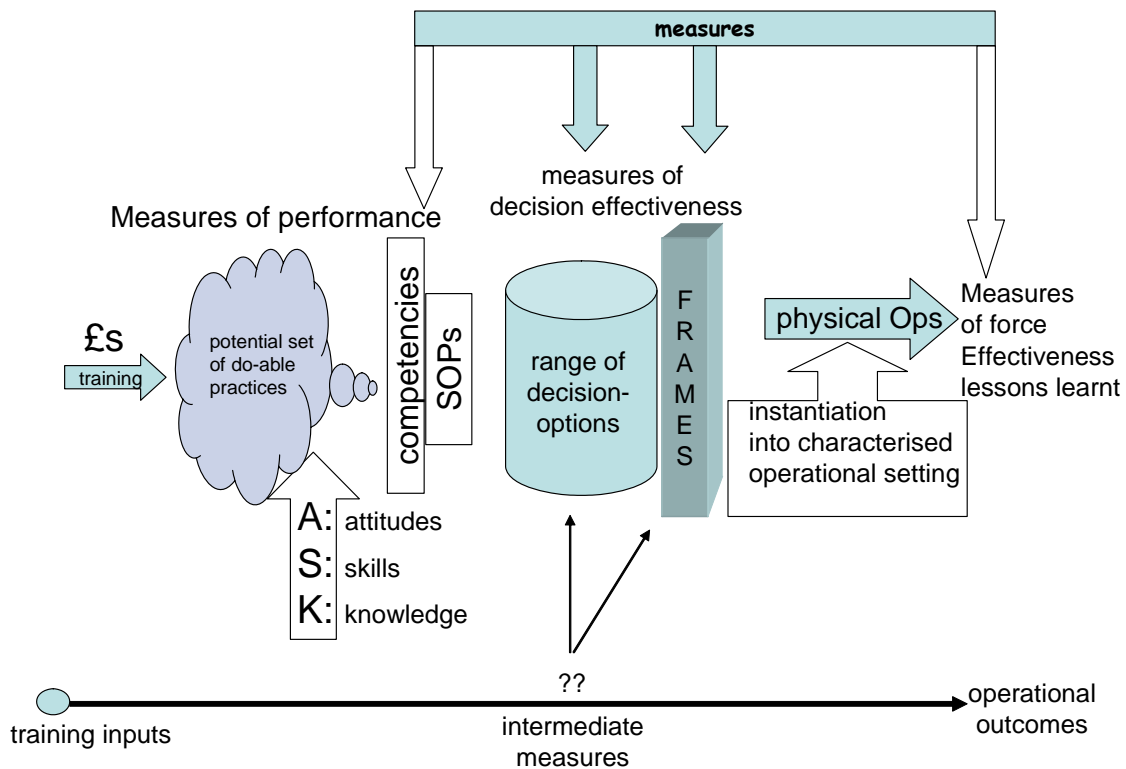
Figure 2: An end-to-end analytical framework

It is not, though, a straightforward case of enabling people with skills to undertake a wide range of actions. Enabling an option, due to broadening knowledge and attitude, can often lead to skill-enabled actions being considered 'out of the question' in the light of the new type of knowledge gained and increased robustness in attitude to the prevailing circumstances[11]. So evaluating the eventual effects of increasing decision effectiveness is not straightforward and will require an experimental approach using multi-perspectives to develop effectiveness measures.

If people are not prepared with such decision-agility and do not possess a broad set of coping strategies and a broad range of options for response actions, then they will not be able to recognise anomalies and will fail to see situations 'for what they are'; rather they will see them only as they know how to react to them. They will see what they feel comfortable to deal with as they interpret situations with closed frames of reference according to the restrictions imposed by their limited set of learnt response options.

The DCDC JIC Prepare states that investment in individual preparation '*appears to offer benefits in operational agility, because if commanders and their subordinates are better able to assess the situation, they will be able to adapt core practices and force structure to match the context of their employment*'. So decision-agility is required across all types of decision-role from practical operator to strategic leader. However, we need to define more clearly what it actually means to be "better able to assess the situation".

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[11] For example, knowledge gained by IEDD operators about devices with worse than explosive effect could cause them to decide not to disrupt the device in the usual way if it seems possible that such an action could make the situation more lethal rather than less.

The focus on broadening ranges of decision options, though, should allow us to get to the heart of the agility issue and should provide intermediate measures useful for individuals and collectives, such as cross-service and cross-coalition teams (see McEver et al. (2008)). In theory, then, the broadened range of options could be either added to or subtracted from existing sets of options to arrive at either usefully focused or extended sets of possible options that can be evaluated within the context of the range of operational challenges being faced. This 'additive-ness' of the repertoires of options allows very different sets of options to be integrated along with restraints on options being imposed by policy or engagement rules.

This study has aimed to set out an initial conceptual framework that should also help us to address the emergent properties of training (e.g. robustness, flexibility, agility). The focus then is on what training (in its many guises) allows people to have as an option that they would not have considered as an option before training. Such decision-options are not just about external actions but are also about options for changing internal structures, patterns and models. Therefore, the key set of relationships that any ensuing measures capture needs to uncover and make explicit is that between the range of possible decision-options and the breadth of types of knowledge. These must then be related back to the demands for such knowledge types due to the nature of the operational challenges.

Towards a conceptual framework

The study scope covered effectiveness measured across all areas of military training, education and experiential learning. This is a vast scope. Therefore, there was a need to establish a clear set of concepts based on categories of decision-options. These decision-options refer to sets of options being considered that span from practical operative actions (e.g. choosing how best to drive a vehicle down a road) to more strategic condition-shaping options (e.g. choosing to build an alliance with a specific nation or individual).

The scope of the decision-options also extends to options being considered when people are trying to make sense of situations. These 'sense-making' options relate to frames of reference that people use to perceive and interpret a situation, with obvious consequences for the ability to create and select courses-of-action, which remain the focal point for decision efficacy (Weick, 1995). The sophistication, breadth and depth of the frames of reference can be increased through training if we are cognisant of the different ways of perceiving the more subtle features hidden within situations, as well as the obvious indicators; for example, noticing, and understanding the possible implications of, inconsistencies or anomalies in local populations at a marketplace or at a checkpoint.

Decision-options precondition sense-making options (Klein, 1993) which in turn influence where attention is placed and focused. So the ability to notice subtle features depends on having appropriately open frames of reference which in turn depends on having an appropriately broad range of decision-options. So any framework must be able to address changes being made to externally-focused decision-options and also to internal frames of reference.

Starting with two dimensions

The two dimensions that form an initial basis for a conceptual framework are:
- Decision-role which is defined here according to the types of decision-option with which the role is primarily concerned. For instance, an operator will be primarily concerned with decision options that are practical, such as where to place a disruptive charge; whereas an operational commander will primarily be concerned with decision-options that are organisational, such as which units should be placed under different kinds of C2 structure.
- Type of knowledge which is defined according to the nature of the elements of a situation used in sense-making and to support decisions. For example, skills-training is concerned with knowing about mainly physical, tangible or technical elements, such as factual details about how to use machinery or equipment; whereas deceptive game-play training is

It is not the case that particular decision-roles would require only certain types of knowledge.

In the initial framework just four broad types of decision-role are considered:
- Operators, who take actions to sustain and maintain operative functions (e.g. drivers).
- Decision-takers, who select courses of action to achieve operational outcome (e.g. tactical commanders).
- Decision-makers, who can restrain, enable and empower the decision-taking, through organising and delegating decision rights, setting-up depths of supervision on behalf of others, tightening or loosening tolerances and freedoms of action (e.g. operational commanders).
- Shapers, who set and re-set policy and boundary conditions, veto arrangements and build relationships to shape the operational environment (e.g. strategic leaders).

It is the nature, range and scope of the decision-options at the time of situation assessment that distinguish the decision-roles. So, for example, a tactical commander may be mainly concerned with taking courses of action whereas an operational commander is more concerned with organisational options such as how to assign units within C2 structures. Military commanders do carry out actions (and interactions) that can be directly observed but their main role is to provide balance and direction and their main responsibility is to provide organizational conditions for maintaining the operative and effective status of all under their command.

Four types of knowledge (Carlson, 2008) are addressed:
- Technical/practical skills (as developed by practice and repetition).
- Teachable knowledge (as developed by being taught in company of those who already know or by reading training notes or books).
- Experiential knowledge (can be learnt only by direct personal experience – actually being there to know what it felt like).
- Conjectural knowledge (covering the ability for handling complexity that combines flair, wisdom, forethought, subtlety of mind, deception, resourcefulness, vigilance, and opportunism. It can provide the ability to anticipate, modify, disambiguate and influence the shape of events, which can be interpreted as 'cunning') (Detienne, 1974).

The basic framework, therefore, is a four-by-four grid of knowledge types against decision-roles. Table 1 shows how we might begin to link types of knowledge with types of decision-role so that we can see routes through the framework that the different areas for training, education and experiential learning are able to support. It addresses four types of decision-role from operator to shaper. Then, through examples of what might be seen as learnt abilities, it links the decision-roles to the types of knowledge.

In the bottom-left of Table 1 the decision-options and types of knowledge are concerned mainly with situation content (e.g. target or device type) and outcome (i.e. a predicted or assumed 'result' of choosing an action). What is being trained in those cases is reasonably well-defined and can be readily measured by observable achievements in test-settings measuring skills performance. The top-left boxes cover what could be learnt through developing insight and by encouraging experiential learning and improvisation. This may involve learning through failure and exposure to risk, and so is more difficult to manage and any decision-based evaluation requires more subtle elicitation techniques and more challenging problem-types.

The right-most columns in Table 1 relate to decision-roles whose decision-options are about creating, adapting or shaping organizations. Therefore the decision-options are concerned more with form than with content; however, sense-making to support adaptation and innovation depends on a person's openness and ability to adopt a suitably 'high' vantage point with broad

enough scope of view to allow abstraction from situation content to see any emerging patterns (Dodd, Stamp & Prins, 2007).

This initial framework draws attention to potentially important areas of training, education and experiential learning that are currently being left to chance and to individual impulse and flair. Some types of knowledge could eventually be overlooked entirely when it comes to decisions about where to place training investments if they are not formally evaluated in benefit analyses.

The types of knowledge that are being potentially overlooked present us with the most difficulty in measurement and evaluation of benefit. Measurement of any changes in knowledge 'uptake' will allow us to see how people are moving and developing through the framework. This will become the main longer-term research theme for future study.

The development of the conceptual framework will take into account linkages between types of knowledge, types of decision-roles, repertoires of actions and sense-making options, measures, values, contextual settings and situational requirements. It will also consider what is (and is not) readily observable and measurable. The resulting conceptual framework will be used to describe different stakeholder positions and will show routes, through value, to where they might want and need to be positioned; as such multiple perspectives and associated measures of effectiveness need to be fully and openly explored.

	Type of decision-role			
Four types of knowledge	Operator (e.g. driver) Practical	Decision-taker (e.g. Battle Cmdr) Tactical	Decision-maker (e.g. 2* Cmdr) Operational	Shaper (e.g. 4* CINC) Strategic
Conjectural knowledge and cunning learnt thro complexity (*metis*)	Understanding modus operandi and decoys, etc of adversarial operators.	Plan robustness and ability to consider 'cunning' plans.	Ability to defer decisions 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 & 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 break-down.	Operational and situational knowledge (e.g. ORBATs and geography).	Knowledge of own capability & organisation: constraints and restraints.	Knowledge of others' key strengths and weaknesses (power balance).
Technical skills and practices (*techne*)	Skills & refresh of practical tasks.	Estimate processes and CoA selection.	People skills for appropriate delegation of decision rights.	Mechanisms for setting policy (e.g. veto, rules of engagement).

Table 1: Linkages through knowledge types by type of decision-role

New ways of thinking about measuring training 'effects'

This study has proposed an intermediate set of decision-based measures that begs questions about having a concept of decision effectiveness. The main research questions therefore are:

- Are we able to accept that these intermediate decision-based measures are reasonable precursors that lead us through to operational outcomes and that they can act as more than just useful proxies for measuring effects of training, education and learning?
- Can such measures be elicited successfully and usefully across a cohort of individuals or teams?
- Will the intermediate measures signify and encapsulate effective changes that can be attributed to particular elements of training, education or learning, explicitly or implicitly?
- If so, can such measures be readily elicited and captured during training exercises and educational courses and could they be indicators for need for refresh or potential for advancement?

Any thinking to address these questions will need to consider the ways in which the measures might form the balancing link between operational demands (i.e. principles of agility), organisational agility, C2 and operating ability (i.e. in terms of knowledge, skills and attitudes).

One key issue that separates the different types of measure of effectiveness is whether training and education are evaluated and assessed based only on the established teaching of practices (i.e. how 'best' to do things) or whether they are also based on guiding the teaching of principles (i.e. why it might be more appropriate in this particular situation to aim to achieve something different). Both are important: the first is more straightforward to measure, and the second gives the power to generalise and to cope with unforeseen situations.

Practice-based outputs are much easier to measure and test. For example, can HQ staff carry out the practices necessary to complete a Command Estimate process? Principle-based outputs, on the other hand, are more difficult to observe and test because they involve a combination of a person's abilities to assess the nature of the situation, to estimate which of the principles take priority, then to consider alternative or innovative possible options and finally to carry out an appropriate action. Only the final action is observable. The internal assessments, estimations and considerations are all tacit.

These tacit rationales give us important insight into requirements for measuring training effects, so we must ensure that they are included in the set of concepts being developed and that they are elicited through carefully designed decision-based experiments and interview methods.

Existing measures of training performance and effectiveness are based on what can be readily observed at the individual or team level and what already exists as data from previous gross observations of force-on-force outcomes. Existing skills training and the associated ways of measuring performance in carrying out skills and attainment of factual knowledge are all necessary but are insufficient. Measuring the effectiveness of training in terms of operational outcomes is essential, but we have a problem: conventional OA methods are based on a known set of probable scenarios and as such are insufficiently robust or general for our purpose.

We need to open up a discussion on decision-based measurement that will help us to address people's abilities to deal with the unexpected, to be flexible, robust, cognisant of ambiguity and to know about coping strategies such as 'hedging' or to be capable of improvisation or of creating innovative options (Weick, 2001).

The aim is to gauge changes, due to training or education, in a cohort of individuals with respect to their overall spread and coverage of knowledge types. The changes could be measured according to outputs (measured before and after training) that could indicate a broadening of their decision-options and sense-making options. The eventual operational effectiveness of such

changes can only be assessed, then, according to what combinations of knowledge-types would be useful in particular theatres of operation. For example, post-conflict reconstruction operations would require a different combination of knowledge-types than fierce fighting in Helmand.

Figure 3 illustrates how an up-take of knowledge might be captured and measured according to types of option being considered when making sense of a situation and when deciding what to do about it; first before training and then after training. This gives some overall sense of the spread and range of knowledge-types now resident within the cohort. Figure 3 also suggests that the use of knowledge types exhibited (as captured) can then be compared against a profile of knowledge types (represented crudely here as green bar chart) as deemed requisite to provide effectiveness given character of a particular operational context.
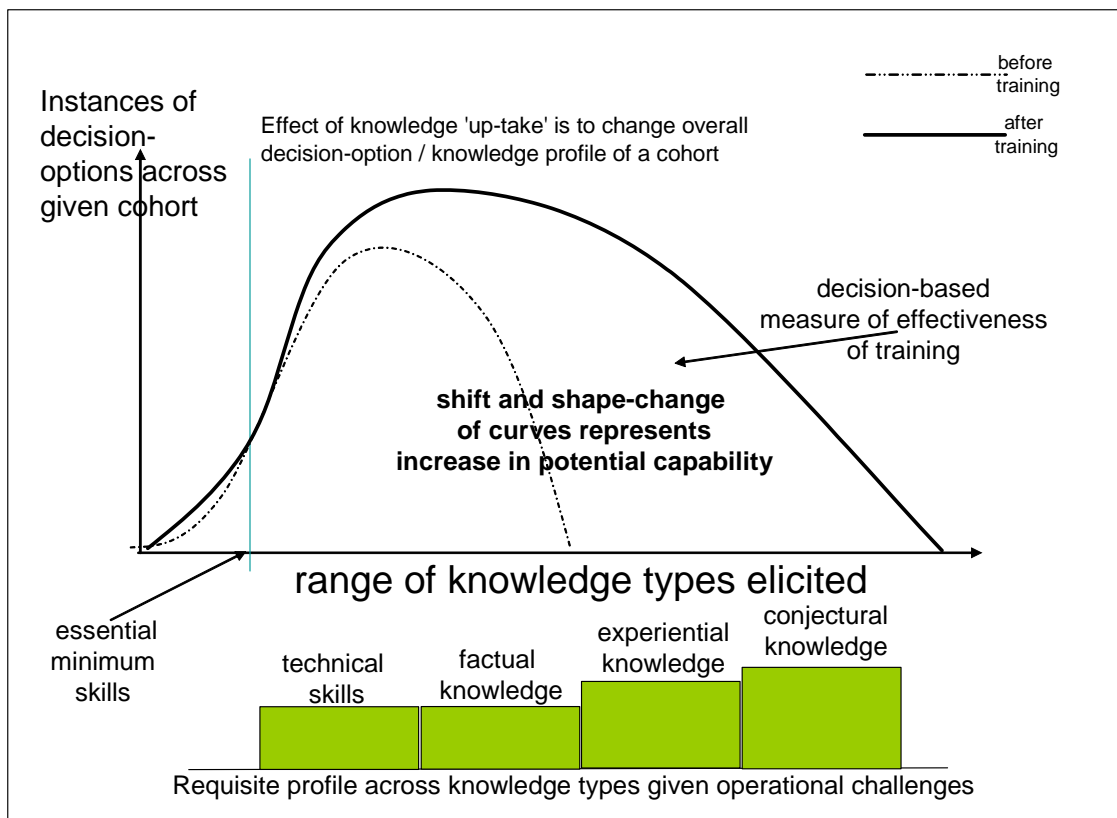

Figure 3: Measuring decision-based effects and 'up-take' of knowledge types

Difficulties associated with decision-based measures

Decision options depend partly on the available situational information (due to the attributes of the supporting information 'systems' and the inherent complexity and 'un-knowability' of the operational context) but also depend heavily on the subjective experiential frames of those imagining and considering the decision options. Previous research and experimental studies have focused on specific operator actions and single-point command decision-taking. These experiments now need to be extended to address the degree of option-creating being done.

The experiments with IEDD operators showed that it is possible to elicit such a range of options and then to interrogate further to gain access to their strategies and reasons for not considering or adopting particular options.

The hypotheses for any experimentation will be drawn from the list of research questions given in the previous section.

There needs to be two separate classes of hypothesis focused on the different requirements to address:
- Measurability and accessibility of intermediate decision-based measures for individuals and teams.
- Efficacy of such measures in terms of their correlation and hypothesised relevance to eventual operational effectiveness.

The first can be addressed through a pilot exercise but the second will need to be addressed over a longer-term, more open-ended, series of studies and lessons-learnt research programmes.

Relationship between value and measures of effect

The purpose of this section is to reflect on some of the broader implications of the previous analysis. Measurement of change is one thing but then evaluating the nature of the changes according to any particular yardstick of value becomes even more difficult. What one person feels is a change for the better, others may see as a change for the worse; or at least that the change makes one aspect of their lives less easy or comfortable. Such evaluations and assessments of measured changes may well differ according to particular viewpoints and perspectives. So this part of the discussion tries briefly to introduce approaches to measurement that address different viewpoints and multiple perspectives.

What does it mean to have 'better' training and education?

Now we need to look carefully at two issues: first, why certain aspects of training and education might be valued more than others; second, why certain measures of outcome are considered 'better' than others.

Evaluation of training and education at present tends to focus on learnt skills, processes and expertise. It is difficult to know whether this is a true reflection of what programme managers actually value or if it is because skill and expertise are easier to measure, audit and justify. Evaluation of HQ and command capability tends also to be based around activity-based operational settings, played out in standard scenario settings and training exercises. This tends to engender expertise in HQ and command processes and information systems management but this may be at the expense of de-valuing experience and creativity.

The other emphasis training evaluation is on 'teaching for the test', having the concept of the military 'pink', and preparing for verification exercises, having the concept of achieving a successful exercise outcome; all of which skews the appreciation of value towards outcome achievement in pre-defined (often 'canned') operational settings. Reinforcement of normative measures of 'better outcome' is potentially dangerous when the world that people find themselves in is full of the unforeseen, in which opponents are being deceptive, devious and deliberately confusing and disruptive. Normative measures of 'better-ness' or benefit mask the un-stated assumptions about an assessor's standpoint and reinforce measurement from one particular view.

How value might be viewed across different stakeholders

Different stakeholders will tend to focus on and value different aspects of training and so it will be useful if there is a construct through which these differences can be compared and also which will make explicit any measures that are being applied. This could begin to highlight any important aspects of training that are difficult or impossible to measure normatively and are, as a consequence, being ignored in Through-life Capability Management evaluations.

So the central importance of the concept of value can be drawn out by adopting viewpoints of the many different stakeholders (e.g. analysts, educators, learners, auditors, programme managers, commanders, politicians) to see what aspects are important to them. This will draw out different lines of perspective that could be, for example, mainly financial, analytical or professional.

These underlying perspectives are what each stakeholder will use to define measurements to determine where their desired 'best' positions are for certain types of training. They will also determine measures with which they evaluate how 'good' training and education appears to be. If we can understand stakeholders' values and we can look at what is currently valued in cost-benefit studies then we may be able to identify what is being over-looked and at what detriment to the principles that are laid down for operations and training generally. This more broad and inquiring look at training effectiveness, through the way it is currently measured and valued, may help to avoid any tendency to value only those aspects that are readily observable and easily measurable.

Conclusions

We cannot rely solely on operational outcomes as the only measures of effectiveness used in the analysis of the value of training. There are too many inter-related, intermediate variables whose effects are often hidden in assumptions within analytical models, which are set within standard scenarios or against historical data.

This paper proposes intermediate decision-based measures that are essentially generic and so do not need to be evaluated across a range of operational environments. It should be possible to investigate decisions in terms of nature of decision-options being used, in conjunction with types of knowledge, as these relate to what might be sensed, understood, considered and selected for action.

These decision-based abilities are affected by what is known and understood already:
- what can or cannot be learnt and reflected upon;
- what can or cannot be done – either outwardly or to change something inwardly.

The intermediate decision-based measures are about much more than measures of improvement in sets of behaviours. They will be affected by specific contextual elements such as:
- constraints imposed due to lack of available resources;
- information amount or quality;
- time pressures;
- organisational limitations;
- institutional and policy restraints, etc.

Such measures will highlight the importance of command and organisational abilities to provide conditions (e.g. clarity of intent, responsibilities, authorities and permissions) for what has been learnt to be put into operation. *Training often fails not due to the lack of learning or training but due to the lack of education and preparedness of the receiving organisational context.*

There are many problems associated with such decision-based measures. The changes made through training can be embedded in individual or organisational frames of reference that then support reasoning before deciding on an action or option. Therefore, factors that are important to achievement of eventual operational effectiveness remain hidden and tacit and are difficult to articulate. They are often factors that we are not aware that we are using and they tend to monitor higher-order situational attributes such as overall degree of variability, volatility, uncertainty, lack of freedom of manoeuvre, etc. Yet, if we really are to achieve agility (operational, organisational and mental), it is exactly these types of measure, factor and attribute which must be exposed as the conceptual framework is developed so that they can be included in our analytical frameworks.

The recommended experimental work will help to demonstrate that the decision-based measures relate to training effectiveness that can then be realised in real operational circumstances.

The proposal is that the measures based on decision-options offer a useful intermediate position from which to make and take measurements of effectiveness; that is, in addition to, and as an alternative to, working all the way through to assessment of operational (or force) effectiveness. However, to call this type of measure 'an effectiveness measure' assumes establishment of linkages through a supporting framework that relates the decision-based measures to eventual operational effectiveness. Currently this framework is based on conjecture, some useful theory and empirical evidence (Donovan et al., 2001), but without a sound basis of analytical and experimental evidence.

Through developing a conceptual framework, and then seeking to adapt and develop it through further study (e.g. recommended case studies) and careful experimentation, we will then not be in danger of ignoring the characteristics for agility which are so important for military effectiveness in respect of C2 and HQs and also for eventual operational outcomes. Through such proposed future activity, the MOD would be well placed to carry out future Balance of Training Investment analysis and decisions relating to investment in training, education and experiential learning, as well as having a more comprehensive understanding of its training and education programmes as a 'complex adaptive system' preparing people to deal with the possible as well as the probable.

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