Credible Defence Capability: Command and Control at the Core

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ABSTRACT

Defence may be regarded as an insurance policy toward protecting a country's sovereignty. It is prudent for governments and defence forces to ensure a cost-effective insurance premium, commensurate with the perceived threat level. It is posited that this presents itself none other than a command and control (C2) challenge at defence corporate level.

In the acquisition environment, smart systems and equipment represent the tip of the proverbial iceberg – it takes much more to realise a credible defence capability, that is, one that comprises all components of a user system to enable a mission to be carried out effectively. A capability may be conceived of as comprising nine POSTEDFIT (Personnel, Organisation, Sustainment, Training, Equipment, Doctrine, Facilities, Information and Technology) constituent elements or dimensions.

If the emphasis moves from system acquisition to capability acquisition, affordability often emerges as a problem. Capital acquisition budgets typically cater for the "E" of POSTEDFIT, neglecting to account for the cost of establishing and maintaining the other POSTEDFIT elements during upfront planning and decision making. This inevitably leads to fielding of systems and equipment without all POSTEDFIT elements being in place, resulting in an ineffective capability…. an ineffective insurance policy and a waste of taxpayer's money.

This paper considers some different approaches toward ensuring an effective capability whereby the POSTEDFIT framework and the principles of C2 are applied at strategic level to direct capability acquisition. A concept of maintaining capabilities at certain "readiness levels" is proposed, based on the premise of fielding a fully ready capability only when it is required (just-in-time principle), as well as the time it takes to field the capability in question. An essential element of effective C2 at this level is situation awareness in the techno-political domain.

1. Introduction

The contemporary buzzword "capability" is often used, but poorly comprehended in the defence environment. Capability is all too often associated merely with tangibles, such as equipment, neglecting to consider hidden dimensions such as personnel, doctrine and support systems.

The essence of a "capability" is captured in Wikipedia [1]: "Capability is the quality of being capable; to have the capacity or ability to do something, achieve specific effects or objectives. Enterprises in essence consist of a portfolio of capabilities used in various combinations to achieve outcomes. Within the portfolio, a capability will be transient unless managed and maintained over time. Typically, capability is assessed and managed in several dimensions." Key aspects underlying a capability are that it is objective driven, is a whole-life concept, comprises several dimensions, and needs to be managed.

It is contended that the defence acquisition process tends to focus on the tangibles, ie equipment, and neglects to address certain essential elements necessary to ensure an effective capability. The equipment should be regarded merely as the proverbial "tip of the iceberg", floating on a substantial base of "submerged" capability enablers. Thus, defence acquisition is generally product rather than capability centred, and almost certain to field an ineffective capability.

This paper considers some shortcomings of present defence acquisition environments in terms of the key aspects addressed above, and suggests some concepts underlying a more holistic, capability-centred, approach toward defence acquisition.

2. Capability Objectives

A country's defence capability may be regarded as an insurance policy covering the ability of a government to ensure the sovereignty of the nation and the security of its people. The insurance policy is financed from taxpayer's money, thus government and its security agency (the department of defence) is responsible, and accountable, to ensure a cost-effective insurance policy (the defence capability).

The question arises: what is a cost-effective defence capability? It is suggested that realistic objectives and timely fielding of capabilities are the two most fundamental determinants of a cost-effective capability. It is no use being prepared for war against aggression if the threat is against terrorism, or maintaining a prepared conventional war fighting capability if the probability of a conventional onslaught is negligible.

Strategising and planning associated with national security is a formidable task set in a complex environment characterised by uncertainty and unpredictability. Despite these challenges, government and military command have the responsibility to predict the nature and timing of threats to national security as basis for defining the required future defence capability – a daunting task indeed.

It is evident that shortcomings in capability objectives will have a profound impact on the effectiveness of capabilities ultimately fielded. The two main factors impacting on the accuracy of future capability definition or estimation are the unpredictability of the socio-political environment, and the long duration of establishing a capability. These factors cannot be negated, therefore have to managed.

Consequently it is imperative that capability definition is afforded the highest degree of attention by military command and that appropriate management processes to plan, direct, coordinate and control future defence capability requirements are in place.

3. Capability Life Cycle

A capability is associated with a life cycle, comprising different stages as illustrated in Figure 1. The defence organisation, or user, is in control of the Employment and Definition stages of the Capability Life Cycle (CLC), whilst a procurement agency usually takes the lead in the Specification and Establishment stages of the CLC.

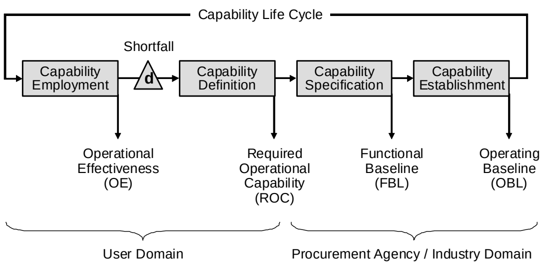

Figure 1: Capability Life Cycle

The Capability Deployment stage output manifests itself in the form of Operational Effectiveness (OE). If the OE fails to meet objectives it results in a capability shortfall, or requirement, which initiates subsequent stages of the CLC. The output of the Capability Definition stage is the Required Operational Capability (ROC), which triggers the procurement agency to initiate acquisition action.

The Capability Specification stage leads to the formulation of a Functional Baseline (FBL) as basis for contracting to industry. Capability Establishment is achieved after commissioning and hand-over of the system to the user and establishment of an "as-delivered" Operating Baseline (OBL).

In practice, it is seldom that an entire new capability is defined from scratch; rather, requirements emanate from shortcomings in presently fielded capabilities. Shortcomings are most commonly the result of changes in the operational environment, reflected in enhanced requirements, or obsolescence manifested in lower operational availability or reduced cost-effectiveness.

The important underlying characteristic of the CLC is that it has no beginning and no end – it is in fact a continuous process. It is thus more appropriate to perceive of the life cycle as "cradle to cradle" rather than "cradle to grave" as is customarily done. A key reason for this misconception is the fact that the defence acquisition environment is product rather than capability centred. If the focus is on capability, it is quite evident that underlying capability elements such as personnel, doctrine and infrastructure are not phased out with obsolete equipment.

From Figure 1 above, it is quite evident that capability effectiveness assessment is an integral part of the CLC. It lies at the core of the CLC – the engine that fuels the entire process. Capability assessment is equally important for capability acquisition, as will become evident further on in this paper.

Capability assessment must encompass the entire spectrum of capability dimensions as outlined in the next section.

4. Capability Dimensions

As outlined in the introduction, a capability comprises many dimensions, or constituent elements. One such capability framework is the POSTEDFIT (Personnel, Organisation, Sustainment, Training, Equipment, Doctrine, Facilities, Information and Technology) used in the South African Department of Defence (DoD) shown in Figure 2.

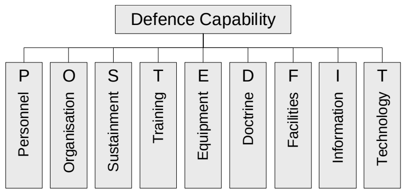

Figure 2: POSTEDFIT Framework

All dimensions contribute to an integrated capability; a deficiency in one dimension impacts on the capability as a whole. Thus, capability manifests itself in the emergent behaviour of its constituent elements.

For example, the acquisition and fielding of new systems without appropriate doctrine and trained personnel being in place, will not render an effective system capability.

The decomposition of a capability into its constituent elements has the advantage that trade-offs can be made amongst elements in order to optimise the capability and/or to compensate for shortcomings in a particular element. From a capability "engineering" perspective it allows some flexibility as it increases the degree of freedom of choice.

The impact on acquisition is substantial, as all capability dimensions associated with a system must be considered in an integrated and co-ordinated way. This is a departure from traditional acquisition models, which tend to focus on the "E" element.

The concept of acquiring across the entire spectrum of capability dimensions underlie the capability acquisition and management frameworks addressed in the remainder of this paper.

5. Capability Acquisition

Whilst the concept of capability (rather than product) acquisition has gained ground in the defence acquisition environment over the past decade or so, it is contended that less progress has been made in the actual implementation thereof. Capital acquisition budgets still focus on the procurement of equipment and associated logistics, whilst in-service operating costs are catered for by an operating budget. Quite often, defence acquisition and technology budgets have less than ideal correlation. Even in cases where co-ordination is evident, demarcation of responsibilities remains a major bone of contention, leading to inefficiency.

5.1 Capability Dimensions

Upon closer scrutiny it is not at all evident that acquisition, operating and technology budgets cater for all POSTEDFIT elements; for example, organisational, personnel and doctrine development activities typically are not explicitly covered in these budgets. Whilst these activities do take place in some form or another, they are rarely aligned and co-ordinated with acquisition programmes. It is contended that effective capability acquisition is not feasible unless all constituent elements of the capability are addressed in an integrated and co-ordinated manner.

5.2 Levels of Acquisition

Capability acquisition is associated with all stages of the CLC, and also takes place at different levels as illustrated in Figure 3.

It will be noted that capability acquisition levels are aligned with the CLC stages with the exception that it also makes provision for technology acquisition. The reason for this is that technology establishment is a lengthy process that needs to be addressed in the early phases of acquisition.

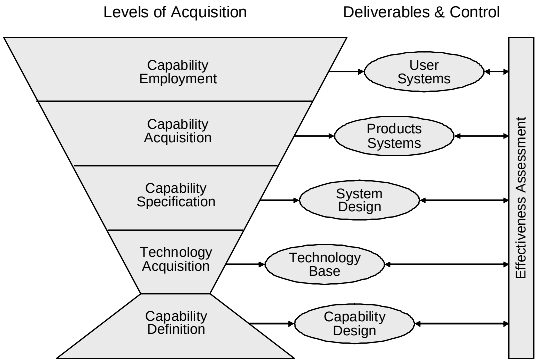

Figure 3: Capability Acquisition Framework

The acquisition activities represented at the different levels result in outputs which are assessed in order to ensure that they meet the requirements. Capability Definition is triggered by a gap or shortfall in the desired capability and has as output a capability design manifested in the form of ROCs and Required Technology Capabilities (RTCs). The Capability Definition activity forms the base that supports the rest of the acquisition activities. It directs the effectiveness of the capability eventually fielded many years down stream, hence Capability Definition is considered the most critical acquisition activity.

Progression along the rest of the acquisition chain ultimately leads to the commissioning and fielding of user systems representing the desired operational capability.

Figure 1 indicates that capability is assessed during the Capability Employment stage in order to provide the shortcoming which triggers the next stages of the CLC. From an acquisition point of view, however, assessment is embedded in each CLC stage in order to ensure that the output of that stage is verified and validated against the (input) requirement – see Figure 3.

5.3 Capability Readiness Levels

The concept of capability readiness derives from the technology readiness levels (TRL) framework [2] illustrated in Figure 4.

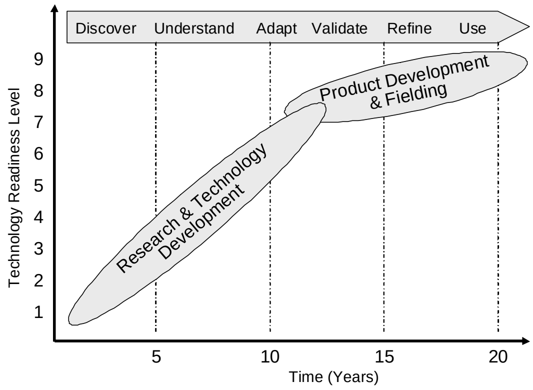

Figure 4: Technology Readiness Levels

TRLs are widely applied as a measure to assess the maturity of evolving technologies prior to incorporating that technology into systems. Using this concept of maturity levels, the five capability readiness levels illustrated in Figure 5 are proposed as a measure of capability readiness assessment.

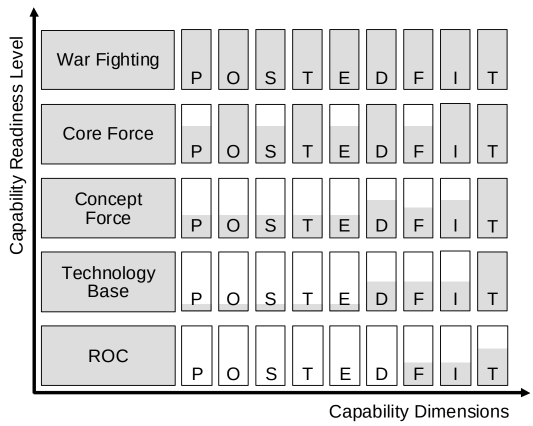

Figure 5: Capability Readiness Levels

In the capability readiness framework, maturity indicated by the "fill" level of each POSTEDFIT element is related to different capability readiness levels, which in turn are related to capability acquisition levels discussed earlier.

Underlying the capability readiness concept are "time" and "cost" attributes attached to each POSTEDFIT element – funds and time are required to acquire the resources to define, develop, acquire and commission each constituent element.

The premise is that POSTEDFIT elements need be developed to a level commensurate only with requirements at any particular capability readiness level. For example, a war force capability requires that all POSTEDFIT elements be developed in full, whilst the Capability Definition readiness level requires, for example, that Facilities, Information and Technology elements only be partially developed. The framework therefore provides a means of defining and controlling capabilities in terms of their POSTEDFIT elements, at various capability readiness levels.

Control implies that the effectiveness of a capability at the different readiness levels must be assessed in terms of all constituent elements of the capability.

The framework is based on the notion that it is essential to maintain a comprehensive capability from a POSTEDFIT perspective, but that the readiness level of the individual capability constituent elements may differ, depending on considerations such as time to fielding. Consider, for example, the lowest readiness level, namely ROC, where it is postulated that it is necessary to activate the FIT elements of POSTEDFIT only. At the Concept Force level of capability readiness, however, it is also necessary to activate, to a certain level, the POSTED elements in order to enable the user to participate in the requirements definition of the capability in question.

The basic idea is to plan based on the required capability, but to implement only to a level of readiness commensurate with the the time to the required in-service date. In effect a "just-in-time" (JIT) principle is subscribed to, offering various key benefits. First, the operating cost of a prematurely fielded capability is avoided, thus reducing the cost of the insurance premium. Second, the latest technology can be employed, particularly in view of reducing product and technology life cycles, thus increasing the effectiveness of the insurance policy. Last, an opportunity exists to make performance adjustments to compensate for requirements changes, thus increasing the effectiveness of the insurance policy.

Skeptics might argue that a JIT policy could compromise capability effectiveness by denying the opportunity for training.. This argument can be countered by supposing a JIT date that allows sufficient time for combat and mission training. Even so, a Core Force is sufficient to enable combat ready training. Furthermore, modelling and simulation (M&S) is a cost-effective means of supporting training in instances where fielded systems are not available.

5.4 Capability Assessment

As mentioned before, capability assessment lies at the heart of ensuring an effective capability. Assessment must be done at all stages of the life cycle, and the objective is to focus on the early stages of the CLC in order to maximise the gearing effect on latter stages.

M&S can contribute substantially toward capability assessment at different levels as shown in Figure 6. Constructive simulation is likely to be the prevalent method during Capability Definition. Virtual simulation will find a place once hardware in the form of technology demonstrators or prototype systems become available. Once systems are fielded, live simulations, field exercises and lessons learned during operations are likely to be the key assessment methods.

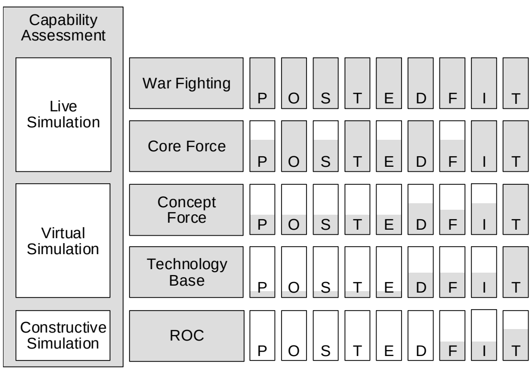

Figure 6: Capability Assessment Methods

The Capability Definition acquisition level is of particular concern, as it forms the basis for the rest of the capability acquisition activities. In is necessary to ensure that sufficient resources and funding are made available to ensure the best possible staff work and quality of the ROC.

6. Capability Management

"Capability management is a high-level integrative management function, with particular application in context of defence. It aims to balance economy in meeting current operational requirements, with the sustainable use of current capabilities, and the development of future capabilities, to meet sometimes competing strategic and current objectives of an enterprise." [3]

6.1 Command and Control

Effective C2 requires the systematic management of numerous social-technical components (personnel, communications, procedures, equipment and facilities) to perform the functions of planning, directing, coordinating and controlling operations to achieve organisational objectives.

"Commanders within an organisation effect C2 by means of decision and execution cycles comprising four sequential phases, namely Observe, Orient, Decide and Act, from whence the acronym OODA loop developed by Boyd" [4]. A simplified version thereof is depicted in Figure 7.

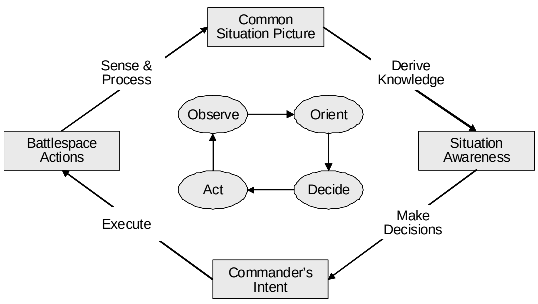

Figure 7: Command & Control Framework

Battlespace actions are observed and data is collected, processed and made available in the form of a common situation picture. The commander extracts knowledge from the situation picture with the objective to achieve situation awareness upon which the decision is made to execute the intent of the commander.

6.2 Situation Awareness

Situation awareness cannot be achieved without contextual understanding. It is a cognitive quality that exists in the mind of the commander, and applies at strategic, operational and tactical levels.

Once situation awareness exists in the mind of the commander, judgement is employed based on intent, experience and knowledge with the view to attaining an understanding of the situation. Once an understanding is achieved, a decision can be made.

6.3 Decision Making

Uncertainty surrounding decision making is highest in the earlier phases of the CLC due to the long time span between requirements definition and the realisation thereof. How, one might ask, is it possible to predict a future required capability ten or twenty years into the future with any degree of certainty? The simple answer is that there is no easy way – it is a difficult task, period.

The JIT concept underlying the capability readiness framework proposed can at best reduce the timeframe. The truth of the matter is that decision making during the Capability Definition stage of the CLC is immersed in a complex environment. This calls decision making and problem solving approaches and tools suitable for complex environments.

Cynefin is a decision making framework developed by Dave Snowden and co-workers whilst in the employ of IBM in its Institute of Knowledge Management [5]. It was initially applied in the knowledge management domain, but has since found much wider application. The framework has five domains, characterised by the relationship between cause and effect – see Figure 8. The characteristics of the Cynefin domains are summarised as follow:

- Simple – relationship between cause and effect is obvious to all.
- Complicated – relationship between cause and effect requires analysis or some other form of investigation and/or the application of expert knowledge.
- Complex – relationship between cause and effect can only be perceived in retrospect, but not in advance.
- Chaotic – there is no relationship between cause and effect at systems level.
- The fifth domain is Disorder, which is the state of not knowing what type of causality exists, in which state people will revert to their own comfort zone in making a decision.

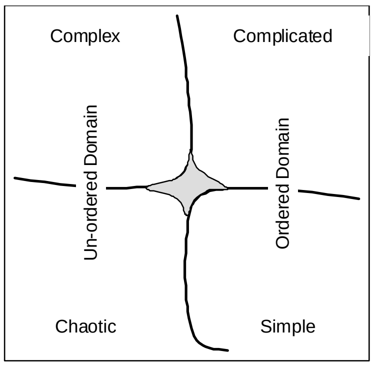

Figure 8: Cynefin Framework

The right-hand side of the Cynefin diagram represents the so-called "ordered" domain, whilst the left-hand side represents the "un-ordered" domain.

"Ordered-systems thinking assumes that through the study of physical conditions, we can derive or discover general rules or hypotheses that can be empirically verified and that create a body of reliable knowledge, which can then be developed and expanded. As we have mentioned, this assumption does not hold in the domain of un-order." [6]

"[Un-ordered systems are characterised] by circumstances in which "cultural factors", "inspired leadership", "gut feel", and other complex factors are dominant. All of these are patterns, which arise through the interaction of various entities through space and time." [6]

Following the cause and effect guidelines above, it is suggested that different levels of capability acquisition are represented in the Cynefin framework as shown in Figure 9.

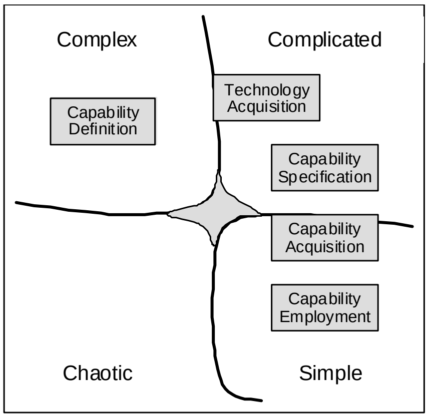

Figure 9: Cynefin Framework – Capability Acquisition Level Mapping

It is apparent that all capability acquisition levels, except for Capability Definition, reside in the right-hand side of the diagram representing the so-called ordered domain. Due to the fact that management methods and analytical tools used in the "ordered" domain are neither appropriate nor effective in the "un-ordered" domain, it implies that management methods and toolsets applied at the Capability Definition level should be appropriate for complex environments.

In view of the afore going it is proposed that capability management be considered in C2 context, utilising the OODA model as a framework for analysing and determining situation awareness needs and decision making aids. In particular, it is contended that the Capability Definition activity needs suitable management methodologies and toolsets to assist in precipitating situation awareness in the complex techno-political domain.

7. Conclusion

The challenge to provide a credible defence capability was analysed from a premise of cost-effectiveness and sustainability.

Capability was defined as a never-ending "cradle-to-cradle" activity and the concept of a CLC was introduced.

A case was made for managing capability in terms of all its constituent components, proposing the POSTEDFIT framework as one of the possible frameworks.

Capability acquisition was discussed and the concept of capability readiness levels was introduced based on the POSTEDFIT and CLC frameworks. The importance of capability assessment was emphasised. The capability readiness framework provides a means to manage and control capability at different stages of maturity. Furthermore, it subscribes to the principle of JIT as a means of optimising cost-effectiveness.

The Capability Definition level in the CLC was identified as a critical activity due to its profound downstream impact on other capability acquisition activities.

The capability acquisition framework was used as basis to discuss some aspects of capability management in C2 context. This led to the realisation that the Capability Definition activity cannot be managed in the same way as other capability acquisition activities due to the fact that it exists in a complex techno-political environment.

8. References

[1] Last seen at Wikipedia: http://en.wikipedia.org/wiki/Capability_management

[2] Last seen at Wikipedia: http://en.wikipedia.org/wiki/Technology_Readiness_Levels

[3] J.H. Roodt, J.J. Nel and R. Oosthuizen, *Decision Support Framework & Roadmap for JC2&Int Capability Portfolio*, DPSS-SM-EDERI-MSDS-015 Rev 1, Internal Report, CSIR, January 2007.

[4] Col John R Boyd, *An Organic Design for Command and Control*, Unpublished Lecture Notes, Aug 1987.

[5] Last seen at Wikipedia: http://en.wikipedia.org/wiki/Cynefin

[6] C. F. Kurtz and D. J. Snowden, *The new dynamics of strategy: Sense-making in a complex and complicated world*, IBM Systems Journal, Volume 42, Number 3, 2003, e-business Management.

1 Wikipedia, Capability Management
2 Wikipedia, Technology Readiness Levels
3 Page 27, Paragraph 5.1.1.2, C2 Functions
4 Lecure notes
5 Wikipedia, Cynefin
6 Page 4, Methods for un-ordered space