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Authors: Robert J Barton, Richard Whittington

POC / Principal Author: R Barton, BAE Systems UK

bBAE Systems Brennan House
Aerospace Centre Farnborough
Hampshire, United Kingdom GU14 6YU
Telephone: +44 1252 38 5075
Bob.J.Barton@baesystems.com

***Embracing and working the Lines of Development –
Trades and options for effective delivery of military capability through-life***

Abstract:

The Defence Lines of Development – Equipment, Training, Doctrine, People, Infrastructure, Logistics, Organisation and Information – must be developed, synchronised, delivered and evolved in harmony if improvements to Command and Control practices are to continue to deliver the much needed benefits and agility.

In particular, the ability to demonstrate the relative worth of disproportionate investments can be a serious challenge to decision makers. The agility to address this challenge starts with enabling the trades that are needed to optimise and balance across the lines of development, including notional extensions to these to recognise Industry as a key provider. The complexity of these trades demands specialist models and a user friendly environment in which casual users can make rapid iterations through the plethora of high level options before undertaking detailed analysis of the likely candidates.

High level OA techniques are still relatively poorly used and trade-off techniques have tended to rely on spread sheets and military judgement, with the potential benefits of OA not playing the definitive role that it should. The analysis and decision process is complex and dealing with the variables requires good modelling techniques.

Over the past three years a number of new techniques have been developed to generate a set of consistent views which enable a much more objective basis for analysis and assessment of trade-off, leading to more effective and agile decision making. These techniques have been developed and tested through direct working with the UK MoD customer, to ensure that they represent practical solutions. The use of SMEs to help develop the tools and techniques has increased responsiveness and encouraged innovation.

The paper will outline some of the work undertaken in this area, the nature of the models and the types of visualisation and decision aids that have been developed, and will show how these have been used in practice to deliver positive contribution to the overall capability development process.

*R J Barton, BAE Systems
R P Whittington, The Salamander Organization Ltd*

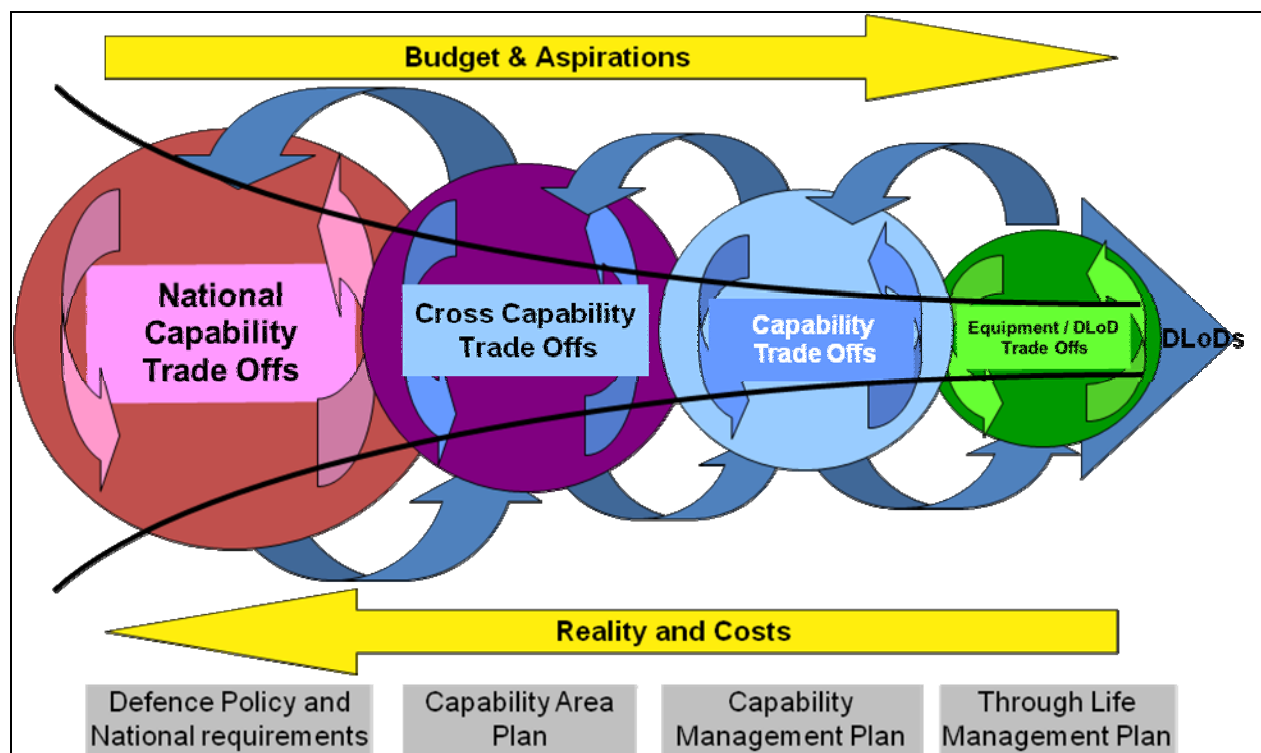
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Introduction

Background: the importance of trading for effective capability projection.

Capability acquisition in the defence arena involves consultation across a wide body of stakeholders. These extend from the end User – the front line – through to the diverse roles involved with specifying, designing, procuring and configuring of equipment. But equipment alone is just one aspect: the Defence Lines of Development (DLoDs) comprise seven more aspects, each of which contributes to the overall capability, and the complex configuration of these components has to be effectively balanced and synchronised before a capability can be “projected”. The problem with having to consider so many different aspects is that there is no easy way to optimise the “mix”. The way in which the DLoDs are brought together has long been an area for improvement and in the UK during 2008 a key focus was brought to the whole process of delivering new Military Capability through the drive for “Through Life Capability Management” (TLCM). See references [1] and [3] for background on the initiative and on DLoDs.



The need for specialist Decision Support and the key role of Information Management

TLCM forces due consideration of both extant and future capability and how these can be managed through time. A central aspect of this process is the set of options or “trades” that need to be considered, as depicted in the Figure above: the means of delivering a way to contrast, compare and combine these is a complex decision support problem. An environment is needed which not only brings together the right information but also presents it in a way that supports balanced, evidenced decision making. Furthermore, although information, or data in context, is a fundamental requirement for both effective analysis and decision support, the necessary information can be difficult to get and subjective to compare. Consequently, the specific aspects of Information Management have also taken on a new focus in the UK MoD through the appointment of a “key Systems Advisor”, an external appointment of a team who will take a primary role in bringing together and driving solutions

across the deployed and fixed domains, aimed at improving the quality, type and appropriateness of information for decision making purposes.

Decisions regarding what constitutes an appropriate Military solution to a given capability need, or choices based on the merits of one capability versus another, are largely subjective. There is no “common currency” and, as a consequence, the widespread use of “Military judgement” becomes the norm. Indeed, given that in many cases we are comparing “apples and Wednesdays” it is difficult to make such decisions truly objective. However, there is no doubt that better evidence, better information and greater consistency would remove some of the subjectivity. Military judgement will remain a critical parameter in the judgement of what is best, but in a period where funding is tight, demands on the military are high and accountability is essential, there is a growing need for traceable and evidenced based decisions on investment.

This paper looks at the complexities and specific needs of the required decision environment and the way in which TLMC can be supported through better information, visualisation and use of analytical modelling. The work has been underway for over two years and during the last year it has been applied to realistic pilot areas, enabling specific evaluations and changes to be implemented.

TRAiDE™: an Environment for Identification and Analysis of Capability Trades

BAE Systems and the Salamander Organization (TSO) have developed a Decision Support Environment (DSE) based on a sound Information Management (IM) approach. The environment we have created is customisable and incorporates intuitive interfaces, and because it is based on a number of key principles we are able to ensure that specific solutions will retain the inherent flexibility necessary for a dynamic but robust working environment. The environment is called **TRAiDE** – Through Life Capability Management (TLMC) **R**obust **A**cquisition **i**nclusive **D**ecision **E**nvironment, to emphasise its intended focus on addressing capability management decisions. See reference [2] for details of background and initial motivation.

The underlying principles can be summarised as follows:

- **Open approach** – enabling utilisation of disparate sources of data.
- Information flows through a **single information manager**, regardless of its source/destination
- **Inclusivity** – designed to utilise new and extant mechanisms, tools and their providers
- **Intuitive visualisations** – enabling simpler interpretation of results
- **Evolutionary** – incremental and pragmatic development based on user feedback
- **Scalable** – enabling aggregation of information at all levels
- **Timeliness and quality** – appropriate outputs, matched to customer need and decisions

The environment is underpinned by a MODAF¹-compliant (see reference [4] for background and definition of MODAF) meta-model and a robust methodology that draws together a proven collection of models, processes, tools and techniques.

¹ The Ministry of Defence Architecture Framework, www.modaf.org.uk

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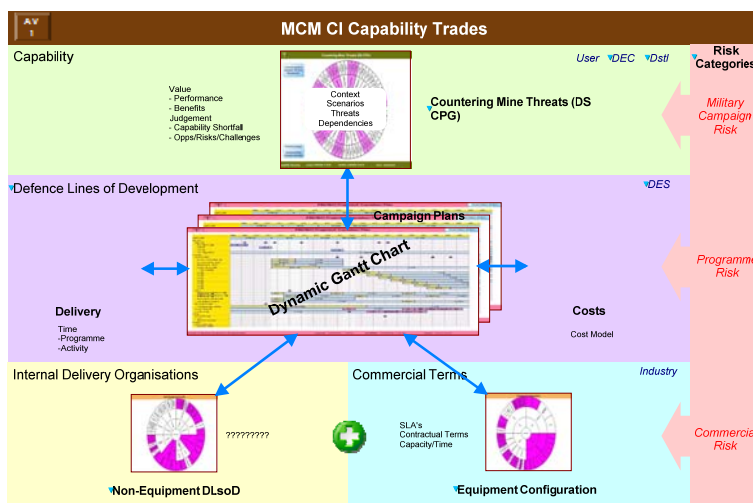
In short, TRAiDE is an environment that enables tools and techniques to be applied within a managed, consistent decision-making process. It provides a single point of access for visualising the implications of analytical activities, making use of a wide range of visualisation styles and metaphors including targets, graphs, dials, and charts of various kinds. At the heart of TRAiDE is an information management capability provided by Salamander’s Mood® product [6]. Mood has been chosen for this central role as it offers the best available match to the principles above, moreover it has the following additional attributes:

- It is MODAF compatible
- It is widely available and used within the MOD.

A key aspect of TRAiDE’s inclusiveness is achieved through basing the core information management on MODAF. This enables standardised interoperability with information structures provided or generated from a range of other systems, including design tools.

Using TRAiDE for capability visualisation and trading

Military Capability is delivered by combining a balance of the eight Defence Lines of Development (DLoDs). Providing representative views of this multi-dimensional reality has confounded decision makers to date, and the development of TRAiDE has invested effort in defining techniques whereby it is possible to capture and present what is undoubtedly a complicated picture in ways which provide a sufficiency of information, but which don’t devalue its integrity. An example of this is the “Bullseye Chart”, a simple example of which is shown opposite. This visualises the current status of capability as a balance of factors, and can be developed outwards to arbitrary degree to satisfy a range of reporting requirements.



In addition to these aspects other perspectives come into play such as Industry, health and experimentation not to mention the socio-political issues. The net result is a complex number of interdependent factors which have to be considered when deciding on the “best fit” options to take forward. These options are not absolute, but there is an essential process of tuning and elimination which

can take place at a relatively high level of abstraction, thus reducing the total amount of work needed to deliver a few good options and enabling a subsequent detailed quantitative analysis to be pursued with a manageable number of alternatives.

In this way the “*optioneering*” process can be efficiently and successively focussed by increasing the levels of detail in a controlled way, finally saving the most specific and numerically integral option comparisons to the stage where the plausible number has been dramatically reduced.

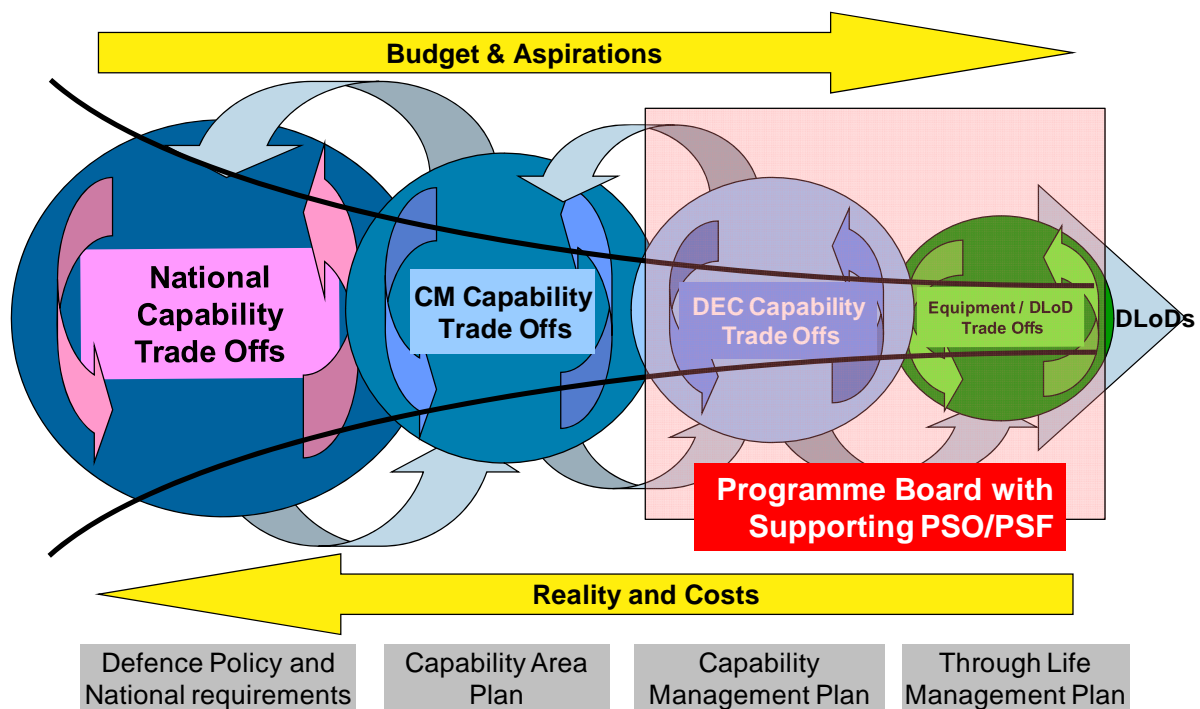
Trades complicate the *optioneering* process which must by necessity become highly interactive, making it rather like “pushing the plasticine”, as illustrated in the figure above. The juggling of unlike parameters requires a sharp skill to make sense of the consequences; moreover the user must be able to identify, visualise and assimilate the results quickly in an intuitive manner. This is where *TRAI*DE scores particularly highly by providing the user with views that give insights and results that form the basis of demonstrable evidence.

The DLoDs have no common currency it is therefore impossible to automate the comparison process. By keeping the examination level as high as possible for as long as possible it is practical to make the models work efficiently and the comparisons quickly. Military judgement remains the assessment rationale, the difference between this approach and more *laissez faire* methods is that for each option comparison the data is revaluated, controlled and used to provide a backbone of evidence; decisions thus become traceable and *relatively* quantifiable.

Applying TRAI

Supporting the introduction of Programme Boards

The delivery of military capability depends on the bringing together of a number of projects, each of which comprises specific DLoD elements. The UK MoD has now embarked on the roll-out of TLCM Phase 4 which is the bringing together of a number of these projects under a “programme board” construct based upon MSP² principles (see reference [5]).

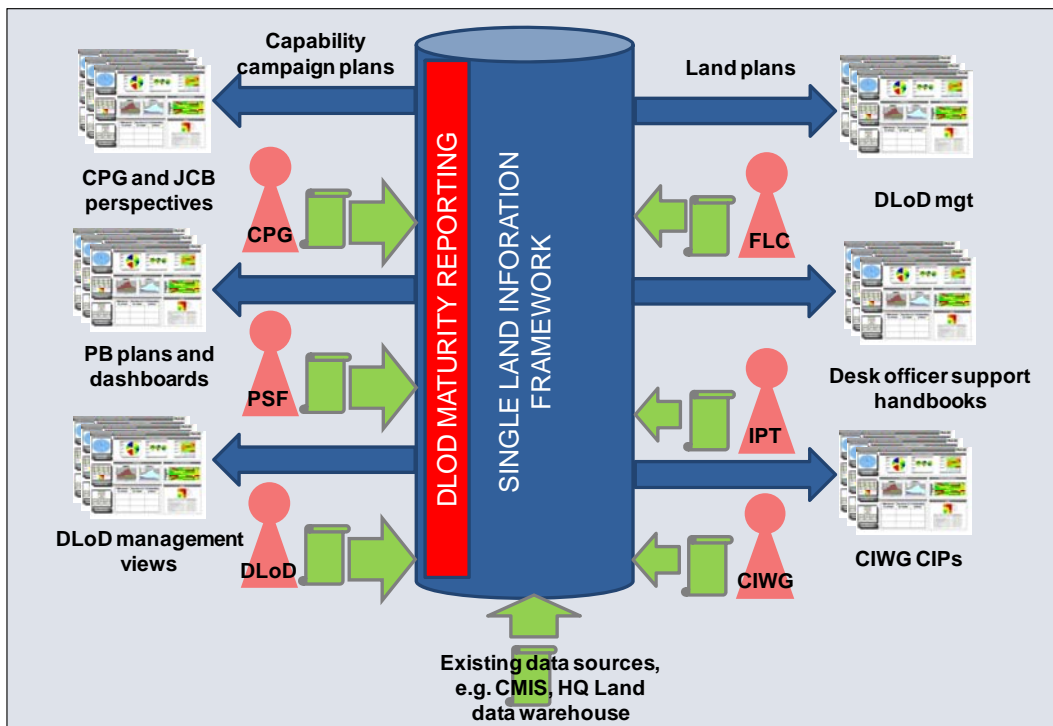


² Managing Successful programmes, UK Office of Government Commerce, http://www.ogc.gov.uk/guidance_managing_successful_projects.asp

The figure above shows the Programme Board construct superimposed over the trade space, adding a vital structure and embracing a number of otherwise separate “stovepipes”. In order to achieve maximum benefit from this initiative, the information and linkages that provide a basis for more confident and effective decision making, including the coherent use of linked information to aid the process of “optioneering”, significant background work must be undertaken to improve the availability, structure, type and format of the relevant data and its sources.

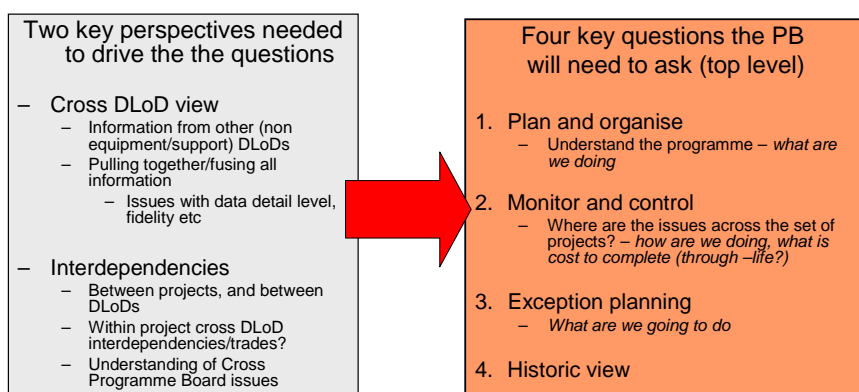
The vision to be achieved is illustrated by the figure below, which relates to the MOD’s Land Environment but which is readily generalised. The essence is a single common, managed information model across which are provided a range of views appropriate to the diverse stakeholder groups, operating at differing levels and making decisions in differing situations.

Vision – information and visualisations



Achieving this vision will require Programme Boards to address a range of key questions about data, required visualisations, and the analysis needed to support decision making.

Programme Boards constitute the primary body by which trades will be undertaken. In particular they will trade DLoDs at the level above individual projects. In working with Programme Boards in the early stages of their development it has been possible to examine the types of trade, the way the information is presented for decision purposes and the measurements associated.



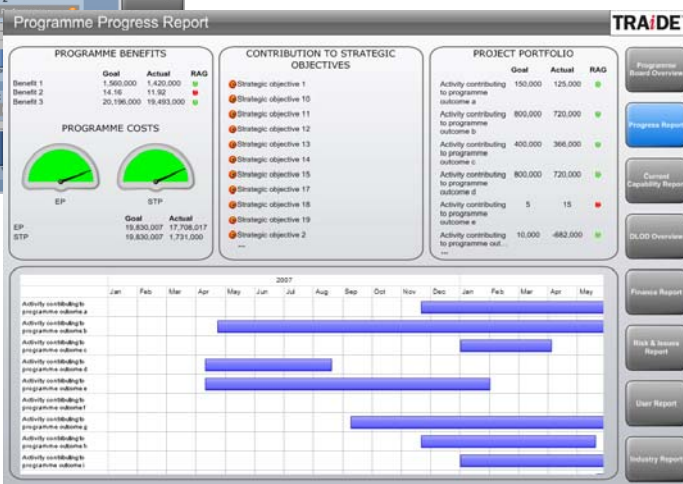
Other visualisations used to inform decision making

The figures below illustrates the application of the Capability Bullseye along-side a range of other visualisations, all generated dynamically from the same common, integrated information model.



Many of these visualisations will be familiar from other contexts. The originality comes from the use of such approaches as alternative windows into common information to support a diverse and ever-changing range of decision requirements.

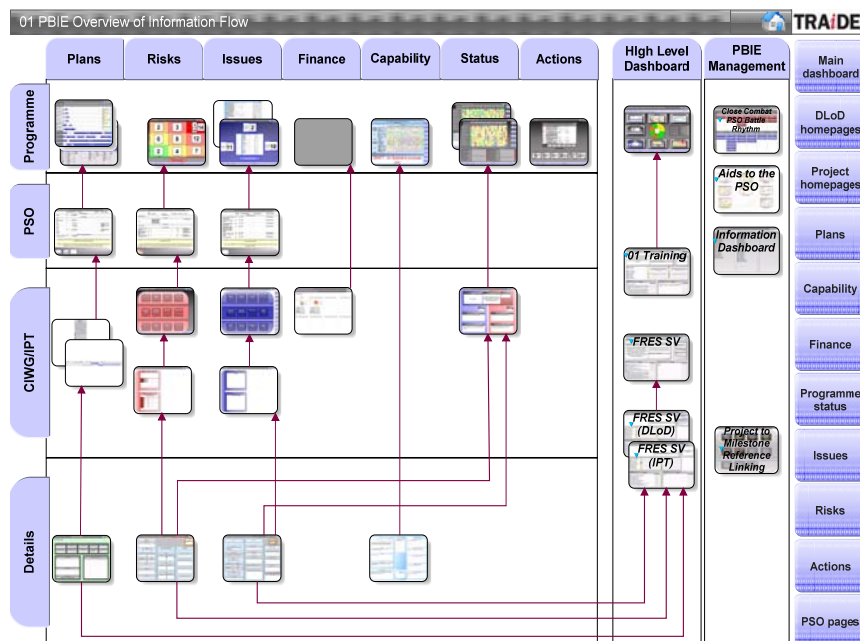
The visualisations needed have been derived from analysis of user communities' requirements, which differ in respect of both information types /connections and also level of abstraction. As an example of the latter, the risks of interest to a project decision maker are not necessary applicable to a programme role, and additional programme risks may exist beyond those applicable to specific projects. The TRAiDE approach to Programme Board decision support acknowledges and addresses this need with a mechanism for selective escalation of information.



An example of TRAiDE Applied to a Specific Programme Board

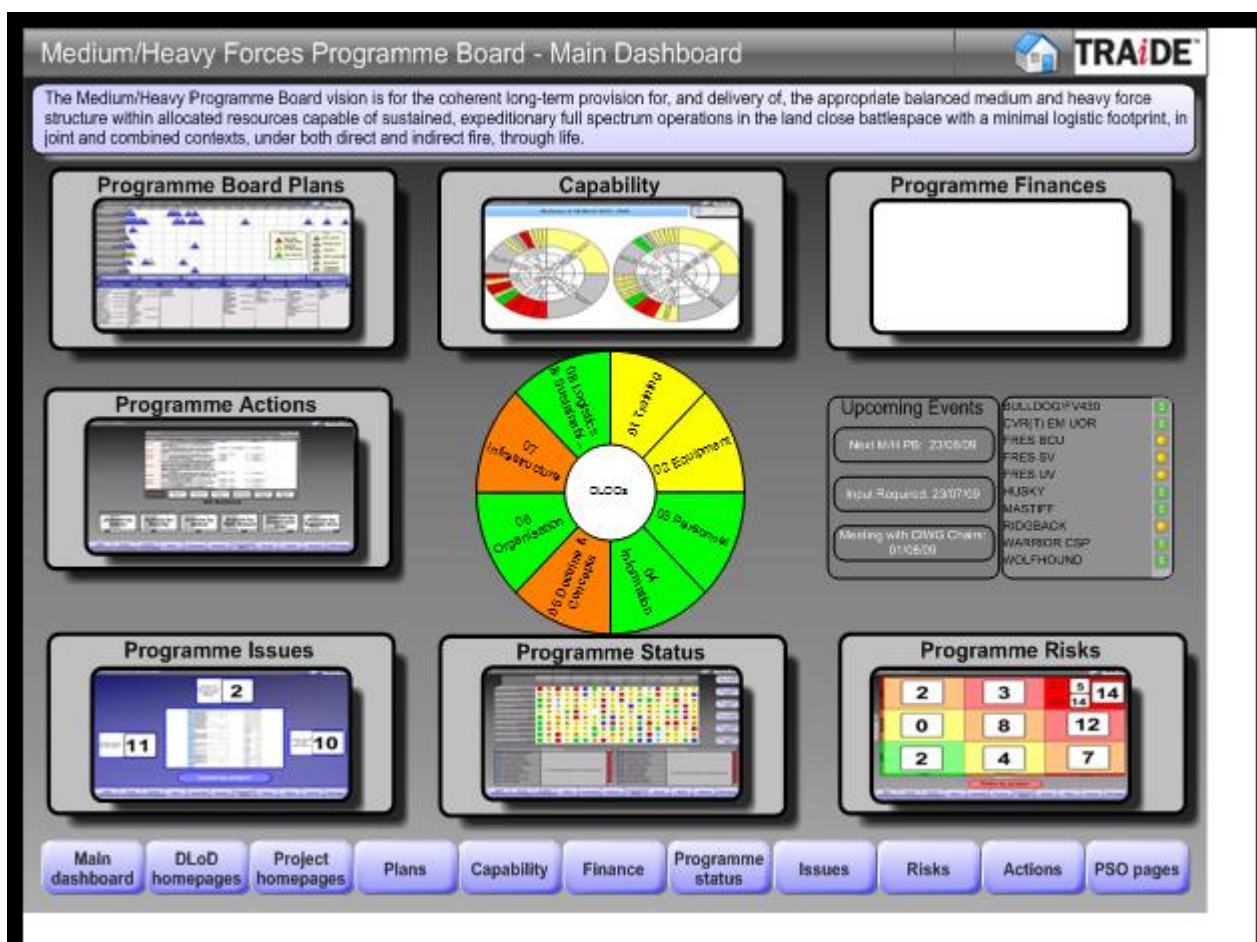
During early 2009, a project within MOD applied TRAiDE to create a Programme Board Information Environment for a specific MOD Programme – Medium / Heavy Forces.

Consistent with the methodology, an information map of user communities and information requirements was developed as a mechanism to drive information needs and environment configuration. The



map constructed continues to serve as a valuable administrative and control aspect of the live environment (it is itself one of the views). The information mapping and synchronisation activity is absolutely critical to success. What is also critical is the acknowledgement that the introduction of an environment of this type must be viewed and managed as a change project, not a technical development: existing processes for information management and reporting may be changed radically; furthermore, the availability of the new views may also have a radical effect on decision making and intervention. As an example, a regular quarterly / monthly reporting and review cycle that traditionally works against historical data is likely to be superseded by a much more proactive management process following the introduction of an environment that shows current performance and trends, with analysis support to explore options for immediate intervention.

The high-level dashboard – essentially providing a portal into the full set of available information – is illustrated below (the content is indicative to illustrate styles).



The environment was created in three months by a team working closely with the Programme Support Function, and yielded a “working demonstrator” – a system driven from live data, and addressing real requirements, which is usable over existing infrastructure, and which also provides a live demonstration of concept and potential. All of the elements on the dashboard can be “drilled into” to explore ever greater detail and connectivity, to support the understanding and decision-making needs of the user communities in this domain, from Director-level capability planning through to implementation teams.

User feedback from this application has been extremely positive, primarily focusing on improved “business efficiency” in decision making. The following sample of quotes illustrates this well, received from a range of users across the communities affected:

- The benefits of this work are consistency, acceleration and efficiency
- this will help to manage better at the [implementation] level ... feed info up to the [Board] easier and with less effort and time ... create more accurate info and improve the operation of Boards
- using a dashboard will save up to 3 days [per reporting cycle] of my time
- This will drive improved decision consistency and reduce the time to prepare for board meetings
- This will alleviate some of the resource impact of the Programme Board approach

Summary and Conclusions

- In constructing a properly connected "dashboard" which draws on information from its base source, an important first step is to map the essential information flows and usage requirements.
 - In order to maintain the integrity of the dashboard the base data must be of sufficient quality and be managed in respect of ownership and currency.
 - The mapping process identifies and synchronised these sources and the required usage. The data can then be grouped and aggregated in ways which deliver enhanced information, upon which good decisions can be better based.
- Improved decision making (better decisions, better decision process) across user communities is the key benefit of the visualisations generated, and where TRAiDE has proven to be such a success.
 - Dashboards which merely present "pictures" without the ability to subsequently, quickly and fully interrogate them are of limited value.
 - TRAiDE has demonstrably shown that fully linked, properly managed information represents a truly effective aid to better decisions.
 - It is these fundamental aspects of sound information management and high quality intuitive visualisations (as in the bullseye) which have undoubtedly proven a winning formula with the customer fraternity.
- A clear consequence of this approach however is that it highlights the weaknesses in the extant data management, sources and processes - this problem, which almost certainly will have given rise to dubious decisions in the past, has to be resolved, and the techniques we have described here address this important aspect.

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