

Operational Analysis:



Should We Bother?

By Wing Commander Simon Young RAF

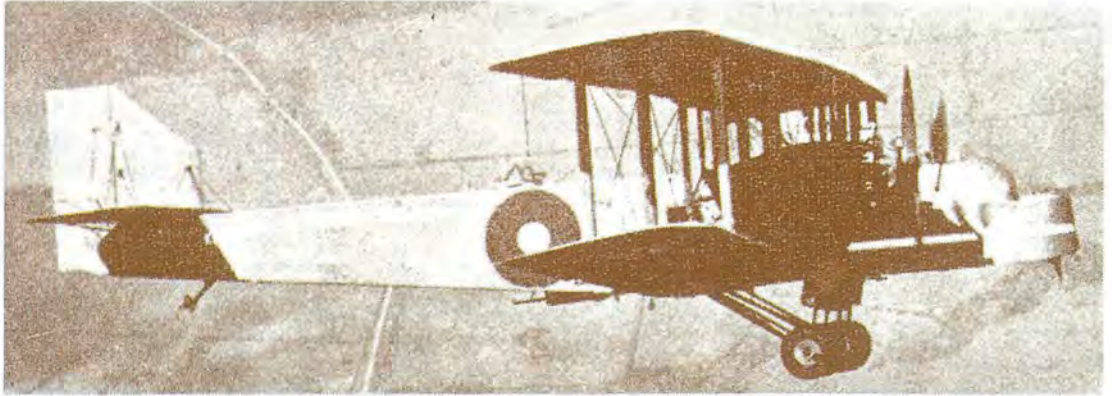
"The scientific study of Imperial resources, the coordination of the ever-varying facts upon which Imperial rule rests, the calculation of forces required, and the broad plans necessary to sustain the burden of empire, have, until quite recently, found no place in our system of government".¹

This comment from a report by the Esher committee in 1904 was, perhaps, the first official recognition that there was, or should be, anything scientific about the conduct of war. Although the report was referring to the newly created General Staff, any inclination of scientific endeavour within that body soon died and the conduct of the First World War can scarcely be described as scientific. Since that war, scientists have demonstrated that they can significantly contribute to the formulation of campaign objectives, tactics, force structures, as well as the design and development of new weapons. As a result, operational research, or now referred to as operational analysis (OA),² has become a mainstream event and a key component in the day to day running of the Ministry of Defence. However, just as government and the military have learned to accept scientific guidance, civilian industries have also adapted similarly. Industry³ now places great premium on conducting its own scientific research not only to shape its future product lines but also to formulate future business strategies and provide evidence to the management board and shareholders that sound rationale is being applied to business.

The situation now exists where the MoD increasingly relies on operational analysis as a means of underpinning human judgement in respect of the shaping of future defence policy, determining future force mixes, evaluating balance of investment (BOI) issues and deciding on future defence equipment programmes. However, as indicated above, the benefits of OA are not exclusive to the MoD. Defence industries in particular further utilise OA as a means of understanding the factors that shape global defence issues as well as tailoring their products to satisfy the MoD's requirements. Industry's growing dependence on OA is driven as much by the need to remain competitive in an increasingly aggressive market, as much as the desire to 'second guess' the MoD's equipment needs.

Given this symbiosis between the MoD and the defence Industry, this article examines their current relationship regarding the conduct of operational analysis, and explores the factors that will influence the evolution of OA and the MoD's future relationship with Industry in this context. In doing so, the genesis of OA is discussed before looking in more depth into the MoD and Defence Industry's individual requirements for OA. The current relationship between the MoD and Industry is then analysed which leads to a discussion on how their future relationship might develop. The article then concludes by drawing the analysis together to determine the most likely course for the MoD and Industry in the future. Whilst the analysis is predicated on aircraft procurement and future air system issues, the arguments forwarded are equally as valid to the land and maritime environments. The following analysis is primarily based on first-hand information gathered from OA experts and practitioners within the MoD and Industry.

RAF Heavy Bomber, Handley Page Hinaidi

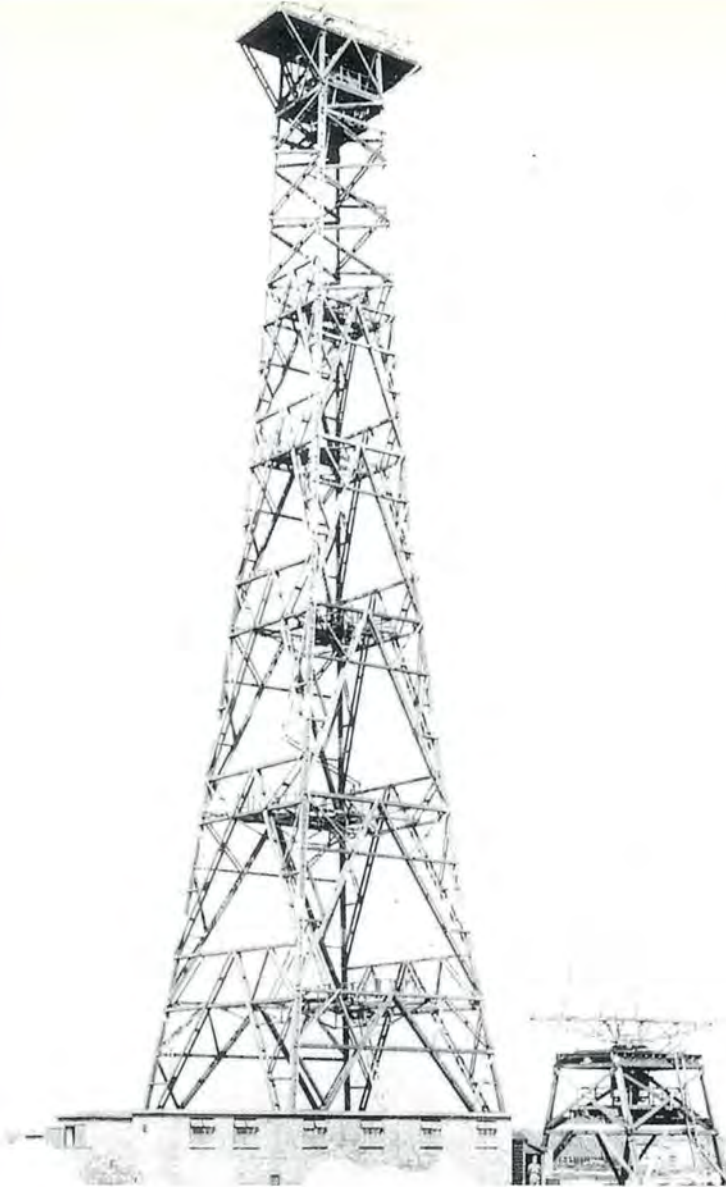


After the First World War the ultimate weapon perceived during the 20s and 30s was the bomber aircraft

THE BIRTH OF OPERATIONAL ANALYSIS

The advent of the Industrial Revolution brought with it an increasing need for industrialists and managers to understand the interaction between man and machine and how productivity was affected by that interaction. The result of the analysis leading to such understanding became known as 'method study' whereby engineers and chemists examined the relationship between product, process and machine (with the operator included).⁴ However, regarding military affairs, it wasn't until the early 20th Century that scientific analysis was applied to the art of war. In 1916, the scientist Lanchester introduced 'The Lanchester Equations' as the first method of scientifically analysing warfare. Essentially his equations stated that the rate of attrition of each side in a battle is proportional to the size of the opposing force that remains.⁵ Lanchester's equations were thought as the equivalent of the law of supply and demand in economics. However, in practice it was difficult to use the equations to tell a commander anything he did not know already and this 'top-down' approach produced nothing of military value at the time. After the First World War the ultimate weapon perceived during the 20s and 30s was the bomber aircraft. Indeed, early air power theorists such as Douhet expounded the belief that "the bomber will always get through".⁶ As the risk of a new war grew, the Government established a Committee for the Scientific Survey of Air Defence whose purpose was to determine an appropriate and effective counter to this new terror. Despite a large number of proposals for inventions to counter the threat of the bomber aircraft, government technical and financial resources would only allow one solution to be developed. Eventually the Committee selected a system of aircraft detection by the reflection of radio waves, which by means of integrating with a suitable fighter direction organisation would enable fighters to intercept intruding aircraft. This was the birth of radar and as a result of this successful innovation, a research establishment was set up at Bawdsey Manor on the Suffolk coast.

...the Committee selected a system of aircraft detection by the reflection of radio waves, which by means of integrating with a suitable fighter direction organisation would enable fighters to intercept intruding aircraft



The chain of radar stations resulting from this new technology was situated along the south and east coasts of Britain. However, trials revealed large discrepancies between the performances of different radar stations and scientists from Bawdsey Manor were tasked to investigate. It was during this investigation, it is argued, that Operational Research (the forebear of operational analysis) was born. In the course of their work, the scientists were not content with merely examining the electrical circuits and antennas of the radar systems but insisted on evaluating the different techniques used by operators to detect targets and combine the aircraft plots into tracks, which was principally a manual process. This evaluation revealed just how the operators were affecting the overall results of the radar stations. Such was the value of this work that the then Commander-in-Chief Fighter Command, Air Marshal Sir Hugh Dowding, asked the research establishment to provide a team to undertake further evaluation tasks on a permanent basis.⁷ On the outbreak of war, the team formed an Operational Research Section within Dowding's headquarters and by 1941 additional Sections had been formed at other Commands. These operational research teams are the origins of the Operational Analysis Element that exists within the Air Warfare Centre today.

The success of these operational research teams during the Second World War can be attributed to a 'bottom-up' approach. The scientists not only understood the physics of the technical systems involved but were also able to observe and quantify directly the performance of the human operators. These building blocks allowed the teams to use their scientific and mathematical tools to produce descriptions of high-level systems, such as a complete radar station. This in turn gave insights into how the systems and operators would perform and how they could be improved, insights which could not be arrived at by military judgement alone. Once the Second World War

had started, the scientists were able to analyse combat operations in a similar way, starting with the accounts of individual missions and combining them to draw out trends which would not have been apparent without the use of statistical techniques. Scientific analysis also extended to cover other aspects of air operations such as the generation of aircraft. For example, a study

A further example of the utility of operational analysis during the Second World War is the way in which the success rate of air-launched attacks against the German submarines conducting a surface transit in the Bay of Biscay was dramatically improved

recommended that the existing aircraft serviceability targets within Bomber Command should be replaced by a flying-hours target system which, after trials, resulted in a doubling of the flying hours achieved per aircraft.⁸ A further example of the utility of operational analysis during the Second World War is the way in which the success rate of air-launched attacks against the German submarines conducting a surface transit in the Bay of Biscay was dramatically improved. As a direct



consequence of analysing the records from each engagement and predicting submarine evasion tactics, an OA team was able to recommend that the pre-set detonation setting for depth charges be reduced from 100 ft to 30 feet, which resulted in a higher attrition rate of the German submarines.⁹

After WWII, during the first months of peace, the OA teams were used to assess the overall operational effectiveness of the Allies, most notably assessing bombing methodologies and accuracy, and evaluating whether targets selected during the strategic bombing campaign were indeed strategic. However, not long after the cessation of hostilities, the Operational Research Sections were considerably downsized and many OA practitioners found their way into industry. This transfer of analytical capability from the military arena to the civilian world of commerce arose not only from the pragmatism of ex-military analysts needing employment, but also the realisation by Industry that it too could benefit from a more scientific approach to its business processes as a means of improving efficiencies, effectiveness and, ultimately, profits. Yet, despite the worth of OA having been demonstrably proven throughout WWII, the Government adopted a 'laissez-faire' attitude to operational analysis during the post-war years and it is this period and the current day that are next discussed.

...despite the worth of OA having been demonstrably proven throughout WWII, the Government adopted a 'laissez-faire' attitude to operational analysis during the post-war years...

MOD AND THE USE OF OPERATIONAL ANALYSIS

Despite OA's illustrious birth during World War Two, the MoD's use of operational analysis became erratic during the 1950s, 1960s and 1970s. This can be partly attributed to a marked decline in the number of combat operations that could be analysed, with the notable exceptions of the Korean War and the Suez crisis. Moreover, as the size of the armed forces was significantly reduced post WWII, it was all too easy to question the need and funding for the operational analyst.

Subsequently, the MoD readily reverted back to the use of military judgement when deciding balance of investment and future equipment issues. Indeed, the MoD was subjected to a series of defence reviews in the 1950s and 1960s, which seemed to be guided more by political imperatives rather than reasoned judgement underpinned by credible operational analysis. For example, the Sandys defence review was conducted in a two-month period between January and April 1957 largely by Sandys himself, and a very small number of civil servants. Additionally, the driving force behind the review was to examine ways of discharging Britain's military commitments more economically, absorbing less manpower.¹⁰ These two aspects of the Sandys review suggest that there was little operational analysis underpinning the reasoning for and the outcome of the review itself; rather the review was driven simply by personal and political judgement.



...current British Defence Doctrine outlines the importance that operational analysis plays in the maintenance of military capability

The use of operational analysis regained favour as the workings of government and the use of taxpayers' money generally became more visible to the general public. This was perhaps inevitable after several debacles such as the AEW Nimrod shown here

Moving into the late 1970s and early 1980s, the use of operational analysis regained favour as the workings of government and the use of taxpayers' money generally became more visible to the general public. This was inevitable, perhaps, after several debacles such as the AEW Nimrod. The situation now exists where operational analysis is used by the MoD in virtually all areas of policymaking, balance of investment issues, and future equipment programmes. Indeed, current British Defence Doctrine outlines the importance that operational analysis plays in the maintenance of military capability. The Doctrine explains how actual conflict provides the definitive measure of military capability, although a complete and objective measure requires qualification, scientific and historical analysis, and military assessment. In peacetime, however, the yardstick is less clear. Methods that can be employed to obtain a measure of military capability are exercises, simulation, operational audit, and operational analysis.¹¹

At this point, it is worth briefly defining what operational analysis is. The 'Purple Book'¹² provides the following definition: "*operational analysis is the application of scientifically-based quantitative analysis techniques to military operational aspects varying from analysis of individual weapon systems to whole battle and strategic scenarios.*" A simpler definition though, might be that OA is a scientific approach to assisting in the mechanics of choice. In broad terms, there are two generic classes of operational analysis: the analysis of an event that has already occurred, or the

assessment of the possible outcome of a future event. The first type of analysis involves transforming the factual events and outcomes of an exercise or operation into quantifiable data for statistical and intellectual analysis, whereas, the second class of analysis involves the prediction of a future event or exercise utilising models designed to replicate real life as close as possible.

As briefly mentioned in the introduction, the MoD utilises OA to help decide on issues regarding the planning for and shaping of future force structures. This involves assessing the current military capability and comparing it against current and projected defence planning assumptions. This will highlight gaps and inadequacies in the current and planned force levels and equipment. Typically, operational analysis conducted for this purpose is known as high-level analysis. Here the emphasis is placed on the utility of campaign-level modelling which involves broad generic data being processed in order to produce results to inform high-level decision making. This level of analysis, it must be stressed, does not require data which is intricately defined. The results, or

...OA is also used extensively to help define the operational requirement for future equipment as well as to help define the characteristics required of the equipment itself

perhaps a better term would be the output, of this level of modelling must be subjected to a large degree of intellectual analysis before any meaningful deductions could be made. This appears to be a particular area of concern where, due to time and financial constraints, the intellectual process is not given fair and correct consideration and the raw output from high-level modelling alone is used often to inform or guide the decision maker. There is, therefore, the distinct possibility that important decisions regarding future policies, force levels and structures can be misinformed, or indeed even flawed without proper and full engagement in the intellectual analysis process.

Regarding the MoD's defence equipment programme, OA is also used extensively to help define the operational requirement for future equipment as well as to help define the characteristics required of the equipment itself. Here, in contrast to the high-level modelling required for high-level decision making, lower-level analysis is commonly used. Data used for all modelling can be of extreme detail and subjected to models that are specifically designed to produce unambiguous results. For example, this level of analysis could involve determining the effectiveness of a specific missile warhead against a specific target aircraft in a specifically detailed environment. This level of analysis does not tend to

require the detailed level of intellectual analysis that high-level modelling does and, as already mentioned, the output from this analysis is far less ambiguous than that derived from high-level modelling. Additionally, the output from low-level modelling can be utilised to shape and validate assumptions and algorithms being used in high-level models. But it must be stressed that the validity of any output from any modelling process is wholly dependent upon the fidelity and validity of the input data; the old adage "garbage in equals garbage out" is extremely pertinent in the world of modelling and analysis.

The agencies within the MoD that either require operational analysis to be conducted or seek to use the output of operational analysis are many and can be simplistically identified as follows: the Central Staffs, including the Operational Requirement Directorates, and numerous steering and management groups; the single Services themselves; the scientific community, including the scientists supporting single Services and Central Staffs; and finally, technical and cost scrutineers. Regarding the use of operational analysis in support of operational requirement definitions, there is specific guidance on project sponsorship given in 'The Purple Book'.¹³ Additionally, OA is vital in the conduct of a Combined Operational Effectiveness and Investment Appraisal (COEIA), which is a key tool used in the procurement process to assist in equipment selection. As already stated above, during the 1960s and 1970s, the MoD's use of operational analysis to underpin defence equipment procurement decisions was sporadic. This frequently led to chronic disagreements with the Treasury, which was always suspicious of the Services' unsupported military judgement that they really needed the sophisticated (and costly) equipment which was specified in their Staff Requirements. Even when military judgement was derived systematically to ensure an impartial consensus, the Treasury could not always be convinced that equipment procurements proposed by the MoD represented good value for money.¹⁴ Before the COEIA procedure was introduced, the MoD used investment appraisal procedures specified in a Treasury guide entitled 'Economic Appraisal in Central Government – A Technical Guide for Government Departments'. This Treasury guide did not refer to operational analysis and it wasn't until the 1991 Buckley Report¹⁵ that substantial changes to the decision-making machinery within equipment procurement procedures were made. One major aspect of the Buckley Report was the introduction of the COEIA, which is loosely based on the US Cost and Operational Effectiveness Analysis concept, which is now known as an Analysis of Alternatives. Specific guidelines now exist for the conduct of a COEIA but are restricted from release to commercial entities.¹⁶ The MoD currently prohibits releasing to Industry the precise performance and cost criteria against which equipment will be judged during the COEIA process. Additionally, the MoD is equally reticent about informing competing companies on how their individual equipment compared in the COEIA, although losing companies are individually debriefed by the MoD but without reference to the performance of their competitors.

The operational analysis and the scientific research studies are generally undertaken on behalf of the MoD by the Centre for Defence Analysis (CDA) and the Defence Research Agency (DRA). Both of these organisations are divisions of the Defence Evaluation and Research Agency (DERA) which was formed in 1995 to be the MoD's principal supplier of impartial advice on defence technology and equipment. CDA also conducts war-gaming on behalf of agencies such as the Air Warfare Centre, which might require operational analysis to validate specific tactics or changes to the specification of extant military equipment in response to an ongoing operation. This paper does not address itself to this particular use of operational analysis in the same detail as OA used to support the equipment procurement process and force-mix and policy-making decisions. However, many of the arguments within this paper are as valid for OA conducted in support of war-gaming.

INDUSTRY AND THE USE OF OPERATIONAL ANALYSIS

Having determined that the MoD uses operational analysis primarily to inform the decision making process, whether that be related to policy-making or equipment procurement, it is perhaps no surprise to learn that Industry embraces OA for very much the same reasons, albeit with the focus ultimately on revenue and profits. Within defence industries globally, the major contractors, such as British Aerospace, Lockheed Marietta and Boeing, all have an indigenous operational analysis capability. In the case of the US 'giants', their in-house OA teams are very much the envy of many foreign governments due to the extent of resources and energy expended on operational analysis. Even in the UK though, BAe Military Aircraft Division employs 30-40 people to conduct operational analysis to underpin its business across a variety of military product areas. One particular quotation often used by Industry when 'advertising' its OA capabilities, is a historic definition of operational research:

[operational research is] numerical thinking about operations, with the aim of formulating conclusions which, if applied to operations, may give a profitable return for a given expenditure of effort.¹⁷

Perhaps the attraction of this quotation to Industry is that it makes direct reference to profitable return in relation to expenditure of effort. Nevertheless, just as the MoD's use of operational analysis has evolved, so has Industry's. The era of the Cold War allowed a relatively stable and 'cosy' relationship to develop between MoD and the UK defence industry, as there was a long-standing and clearly identified Soviet threat, together with a firm UK commitment to NATO to counter that threat. This meant that it was comparatively easy to identify the technologies required to counter Soviet military equipment, although the MoD was always sensitive in allowing Industry to have access to intelligence assessments on the threat capabilities. Moreover, because of the perception of Soviet military might, governments supported large defence budgets, acknowledging that within reason they had to develop and buy sophisticated and costly equipment. This perhaps bred some complacency within some defence industries that felt that there would always be a steady demand for their products, which would be developed in response to very specific and continuing customer demands. Since 1990 – 1991, however, the threat is far less evident and it is extremely difficult to pinpoint how and where the threat might manifest itself. On top of this, the UK government remains firmly committed to NATO but the

Even in the UK though, BAe Military Aircraft Division employs 30-40 people to conduct operational analysis to underpin its business across a variety of military product areas



...the evolving role of NATO, especially when engaged on operations under the auspices of the UN, further confuses the situation for both the MoD and Industry

evolving role of NATO, especially when engaged on operations under the auspices of the UN, further confuses the situation for both the MoD and Industry. The UN finds itself being increasingly urged to undertake humanitarian and peacekeeping operations in a variety of 'hotspots' around the world. NATO provides the military (and sometimes political) framework that allows the UN credibly to undertake such operations. However, the NATO members can only offer 'legacy' military equipment with which to conduct an operation. Frequently, these legacy systems are found wanting and UN and NATO forces are having to 'make-do' in many instances. Industry has not been slow to notice this and has identified the potential for developing new equipment suited to these new markets.

A further complication to Industry's relationship with the MoD is that the collapse of the FSU has brought significant reductions in Government defence expenditure. For example, the UK Government reduced its defence budget from 4.0% of GDP in 1990 to 3.1% of GDP in 1995. In real terms this relates to a decrease of approximately £4 – £5 billion. The projected defence expenditure for 2002/3 reveals even more 'trimming' ahead with spending estimated to be approximately £16 billion, which represents just 2.1% of GDP. A similar trend can be seen across Europe with an average decrease of nearly 25% in government defence expenditure.¹⁸ Subsequently, Industry is having to rationalise and realign in the face of declining market volumes, decreasing government defence expenditure and increased competition. Hence, all these factors combine to make operational analysis an essential component of Industry's business processes, particularly as it strives to gain that vital edge over its competitors.

In simple terms, Industry now conducts OA to identify new product opportunities, to define those products to match a customer's requirements, and to provide evidence to the management board (and the shareholders if applicable) of why certain business strategies and product lines are being developed. In doing so, defence contractors are employing operational analysis teams not only to identify potential regions of conflict or unrest but also to determine the countries most likely to take an interest in those situations. The teams then examine the known military equipment holdings of those interested countries to identify any potential shortcomings in military capability. This exercise effectively creates a potential requirement for new or modified military equipment. Operational analysis is then further applied to see how any existing company products can be tailored to meet that requirement or whether a new equipment should be developed. All of this activity is being pursued with cost-effectiveness very much in mind. Not only must any new or modified product be cost-effective for a customer to purchase and own, but also the design, development and production methods must be cost-effective to the company. Much of Industry's operational analysis is conducted on its own initiative, as market forces will not allow companies to be passive in the quest for new business. However, one spin-off aspect of large defence contractors developing a credible indigenous OA capability, is that smaller governments, who have neither the experience nor budget to run equivalent OA teams, will employ these Industry OA teams to help define their national defence requirements.

The tools available for Industry to conduct its OA processes differ little from those generally used by the UK and the US governments. There are several commercially available analytical models common to both government and Industry use. Some of these models are fairly generic, allowing specific detail and algorithms to be incorporated according to the customers' requirements. However, company or national sensitivities and secrets can often preclude this approach and models specific to purpose are created 'in-house' as required. Furthermore, common to either approach is the need for skilled analysts to actually undertake the modelling and intellectual processes of OA. Qualified people are required to create the modelling environments and data sets, as well as conduct the critical analysis of the modelling results. Of course, this all costs money, which as far as Industry is concerned must be recouped from increased sales and profits, and as far as MoD is concerned must be budgeted for in the usual way by means of the LTC process. This issue of resources is one of particular interest and is analysed in further detail later on.

THE CURRENT MOD AND INDUSTRY OA RELATIONSHIP

As previously indicated, the MoD has various guidelines which have to be followed when formulating Staff targets and Requirements, and defining Concepts of Analysis in support of COEIAs. Understandably, the distribution of some of these guidelines is limited to government agencies only, and even then distribution and access can be severely restricted due to the security classification of the material and guidance contained within. However, regardless of the classification of the material, some guidelines exist on the extent to which Industry can be involved in the OA process in support of MoD business. In general though, the MoD prefers the High Level Studies division within CDA (DERA) to conduct sensitive analysis on future force-mix, balance of investment and policy issues, whereas Industry involvement is likely to be inappropriate on 2 possible counts.

Firstly, by involving a specific commercial organisation in the OA process, MoD may have to make available extremely sensitive military and political information and plans. This may lead opponents to government and that commercial organisation to argue that undue advantage is being given by MoD, or that Industry is being allowed to incorrectly influence government future policy. That is not to say that independent non-government 'OA houses' are not involved in such work today. Indeed, companies such as BAe SEMA and CORDA do undertake some operational analysis related to future policy and balance of investment issues, but MoD ensures that these companies are fully accredited by rigorous scrutiny of their security clearances together with their modelling and analysis capabilities. Even if companies pass this scrutiny, however, the MoD insists on sufficient 'firewalls' being erected within the company to prevent improper 'leakage' to subsidiaries of that company or its parent. Additionally, the MoD is likely to submit only part of the required analysis to an external agency so that the agency does not gain access to the 'full picture'.

The second point of possible contention occurs when the Company involved in the OA process is directly related to, or even an integral part of, a major defence equipment manufacturer. Here, involvement in the MoD's high-level management and decision making might be seen to give a Company unfair insight into future defence equipment requirements. In the current climate of probity, and with MoD's competitive procurement policy to ensure best value for money on behalf of the taxpayer, it is highly unlikely that external OA 'houses', such as BAe Military Aircraft Division's OA team, will be allowed to participate in conducting OA in support of high-level MoD management issues. However, it should be remembered that OA involves not just modelling but also the intellectual process of analysing the output from the modelling. It is in this particular practice that the MoD might well consult with Industry in order to ensure that all aspects of an issue are thoroughly examined and accounted for.

To date the MoD's history of accurately defining operational requirements can best be described as inglorious. Those requirements that arise from equipment or mission effectiveness shortfalls during a particular operation or crisis are easy to meet, but are only really relevant to that specific situation. The definition of future operational requirements, however, should be based on a well-founded perception of a future military capability shortfall. This may be as a direct result of a specific item of equipment becoming life expired and therefore needing to be replaced. Alternatively, current military capability might not counter an evolving or perceived future threat. These 2 examples raise an interesting issue of whether future operational requirements should be threat based, as they are today, or whether they should be capability based. This latter approach calls for requirement definitions, and subsequent equipment procurements, to be based on pragmatism rather than the inexact science of predicting the future.¹⁹ Returning to the past, however, operational requirement definitions have not always been derived with the use of operational analysis. As already stated, the Treasury was often in conflict with the MoD about the latter's 'wish list' for new defence equipment, which was costly and predicated on a specific threat. Furthermore, the Treasury frequently accused the MoD that it was purely subjective military judgement that was underpinning the need for the new defence equipment as well as defining the performance specification of that new equipment. Certainly, that accusation can not be made today. MoD guidelines, such as the Purple Book²⁰ and the Equipment Approvals Committee Procedures and Dossier Guidelines,²¹ clearly indicate that operational requirements must be defined through the process of OA and any subsequent equipment programme should be underpinned with supporting evidence from that process.

Traditionally, only government analysis agencies, such as the Defence Operational Analysis Centre (now known as CDA), were allowed to participate in operational analysis in support of requirement definitions. Industry was kept at arm's length, as there was very much an adversarial approach to business between MoD and Industry; Industry, as the supplier, had no place in advising or influencing the MoD, as the customer, in what it wanted or needed. However, the MoD now allows greater Industry participation, as far as security clearances will allow, in the requirement definition process. MoD recognises that best value can be achieved by inviting Industry to help analyse the future threat and conflict environment so that the MoD's needs can be more clearly understood. In return, the MoD is given easier and wider access to Industry's R&D effort and is, therefore, more readily able to understand the limits and applicability of future technologies relevant to its needs. This partnership approach not only aids the MoD to avoid defining operational requirements that can not be technically satisfied but also helps to identify where operational requirements can be relaxed or traded-off in the interests of cost-saving. This successful practice is examined further during the discussion on the future relationship between MoD and Industry.

When the COEIA procedure was introduced, there was some concern in the Services and the defence industry that it was primarily a bureaucratic device to delay new equipment projects, and that it would disrupt the harmony of collaborative projects with allies who use different methods of equipment selection.²² However, it is now accepted that a well-organised COEIA need not necessarily take longer than former equipment selection procedures, and it actually tackles a wider range of equipment alternatives. Operational analysis conducted in support of the COEIA tends to be at a much lower and more detailed level than that used, for example, in force-mix studies. Currently COEIA OA studies use a range of combat models developed at CDA and elsewhere. These studies evaluate explicitly and consistently the overall effectiveness of the equipment's option considered, where effectiveness depends on the option's success relative to an enemy's current equipment while an equipment option's performance is an absolute and enduring set of characteristics. The modelling employs future combat environments derived for and endorsed by the Studies Assumption Group (SAG). This is currently a sensitive issue between MoD and Industry as the SAG scenarios are classified and not available for release to non-government agencies. This is because the Defence Intelligence Service (DIS) participates in postulating future political regimes and regional hotspots, which may lead to areas of tension and conflict. DIS also provide technical intelligence assessments of future enemy equipment specification and performance.

However, the scenarios and modelling conducted for the COEIA are threat-based and the issue of capability or threat based procurement is relevant once again. A further moot point between MoD and Industry is Industry's access to, or even participation in, the formulation of the Concept of Analysis (CoA) for the COEIA. The CoA provides the specific analytical framework within which the COEIA will be conducted. The CoA will outline a variety of factors, which include: exactly which SAG scenarios will be modelled and to what degree those scenarios can be varied; which models will be used and the hierarchy of those models; the level of fidelity that modelling data must conform to; which equipment options will be modelled; and, perhaps most importantly, the Measures of Effectiveness that will be used to determine equipment performance and operational effectiveness.

By allowing Industry access to the CoA process, the following 2 points of contention arise: firstly, Industry may gain unfair and improper access to a competitor's product data; and secondly, Industry may 'tailor' the specification and performance of its proposed equipment to satisfy the modelling and operational analysis process itself, rather than to meet the operational requirement. There are, however, counter arguments to this which will be explored later when discussing the future relationship between Industry and the MoD. Nevertheless, it is perhaps inevitable that the COEIA is an area of disquiet between the defence industry and MoD. This is because the MoD requires the COEIA to remain a credible and impartial means of assessing the operational cost-effectiveness of a particular equipment or range of equipment in the event of a procurement competition. The need for impartiality is perhaps obvious but in order to be credible, the formulation of the COEIA, and its CoA, are likely to need a degree of input from the competing companies themselves, especially concerning clear and robust data-sets for the equipment options to be assessed. Furthermore, the MoD's requirement for limited Industrial input into the COEIA will have to be balanced against Industry's desire to know as precisely as possible which MOE criteria its product will be measured against during the COEIA, so that it can determine an appropriate specification and data-set which will maximise its chance of winning the 'COEIA competition', and, in all likelihood, the contract for the new equipment. This dilemma is likely to remain an issue regardless of which direction any future relationship between the MoD and Industry takes.

FUTURE COOPERATION BETWEEN MOD AND INDUSTRY

The ongoing Strategic Defence Review is considering the issue of smart procurement and, whatever the outcome, it is most unlikely that the MoD's requirements for operational analysis will diminish. However, although the process of smart procurement has yet to be precisely defined, the overall aim has been publicly declared as faster, cheaper, better procurement. This simple ideal hides the complexity of the problem though. It is worth remembering that the MoD Procurement

...although the process of smart procurement has yet to be precisely defined, the overall aim has been publicly declared as faster, cheaper, better procurement

Executive (PE) was initially established in 1971 with similar objectives in mind. As already stated, the MoD's track record in defence equipment procurement during the 1950s and 1960s is somewhat chequered, and the introduction of the PE was to ensure that equipment purchased for the 3 Services achieved the required performance, was delivered at the right time and provided best value for money to the MoD and the taxpayers.²³ Whilst the PE may have successfully achieved its objectives in some procurement programmes, enough projects failed and there is obviously the need to improve and adapt the PE's business to the pressures of managing defence in tomorrow's environment. The Chief of Defence Procurement (CDP) has outlined several main factors that will

...many of the advances in IT technologies are originated by civilian industries, many of which are not directly related to defence

influence the definition of the smart procurement process.²⁴ CDP acknowledges that the challenges the Armed Forces will have to face in the future are much less predictable and will require increased flexibility and utility from defence equipment. Once again, this touches on the issue of whether future operational requirements, leading to future defence equipment procurements, should be threat-based or capability based. Either way, however, operational analysis will remain an important and central tool in helping to define those operational requirements and then the characteristics of the equipment intended to meet the requirements.

Regarding the design and specification of future equipment, CDP also acknowledges that the technologies underpinning future defence equipment are advancing at an ever-increasing pace. This is particularly so within the fields of IT and communications. With the

MoD's initiative to ensure that all current and future defence equipment conforms to and complements the 'digitisation of the battlefield' concept, it is safe to assume that most, if not all, future equipment will have a large IT-related technical content. This is typified by the Joint Command Systems Initiative which aims to create a framework of cost-effective and efficient integrated global communications and information systems to support future UK military operations.²⁵ Moreover, many of the advances in IT technologies are originated by civilian industries, many of which are not directly related to defence. These IT industries are reacting to the demands of global customers, whether they be multinational conglomerates, the international businessman, or the ordinary person 'in the street'. Additionally, the products that are released to the public are generally derived from operational analysis, or market analysis, as some companies prefer to call it. The difference between this form of commercial analysis and that traditionally undertaken on behalf of the MoD, is that IT companies can validate their analysis more readily, thereby rapidly improving their OA capabilities with a commensurate knock-on effect to their products. After all, the companies can analyse market needs (or even shape demand if the public is unaware of new technologies), design new products, and sell those products within very short time-scales, often a case of months compared to the many years normally associated with defence equipment programmes.

It could be argued that some industries have an 'operational' analysis process that is more anticipatory and reactive than that of the MoD...

Contrastingly, the majority of the analytical tools used by the MoD can only be validated by actual operational experience (i.e. war) whereas many industries are able to validate their analysis frequently because their products are used every day, and for the purpose they were designed for. It could be argued, therefore, that some industries have an 'operational' analysis process that is more anticipatory and reactive than that of the MoD, and this might suggest that Industry's OA capability is more in tune with the new business environment that smart procurement is attempting to enter. Furthermore, there may be lessons within this industry process that will allow operational

analysis in support of future smart defence procurement to be conducted in time-scales compatible with advanced-technology industries. This may contribute to the aims of faster, cheaper (less time in the procurement process) and better procurement.

Given that operational analysis will remain important in the future process of smart procurement, it is necessary to examine the issue of resources, in terms of both manpower and budgets, and from an Industry and MoD perspective. As previously described, the MoD's defence budget is likely to continue decreasing. This will inevitably lead to various pressures not least of which will be to ensure that smart procurement achieves its aims and any new defence equipment has longevity of in-service life and is flexible in its utility to satisfy a broad spectrum of future scenarios. However, this trend towards characteristics of 'long-life' and 'super-utility' will place further pressures on the requirement definition and procurement processes and this will inevitably impact on the need for operational analysis. If the MoD is going to place greater emphasis on ensuring new equipment really does give outstanding value for money, then it will want to ensure 2 factors occur. Firstly that the operational requirement is irrefutably defined and, secondly, that the performance characteristics of the equipment designed to satisfy that operational requirement are not too limited or excessive, and equally not too specific to a particular scenario. Both of these definition tasks will require extensive and robust operational analysis to be undertaken.

However, the principal driver for this trend toward requirement and equipment definition is the reality of a declining defence budget. Moreover, this budget not only has to fund the whole-life costs of future defence equipment but also the operational analysis underpinning the need for and characteristics of that equipment. Unfortunately, if the MoD's current OA funding situation is taken as an indicator, then future funding is in danger of becoming insufficient. For obvious reasons, exact details of current levels of MoD funding for OA are classified; however, OA is frequently the first in the 'firing line' when harsh budget trimming is required. This is true whether the OA is part of the Applied Research Package or whether the OA is being funded within a specific project funding-line and pressure is being applied to identify cost-savings within that project. As a result, a potential dichotomy exists between the rising cost of OA, due to the increasing reliance of the MoD on OA to underwrite any future capability and equipment requirement, and the decreasing defence budget and project funds.

...OA is frequently the first in the 'firing line' when harsh budget trimming is required

It is not just future funding of OA that requires examination, however. Currently, the MoD employs CDA to undertake its OA in whatever guise. CDA can subcontract out some elements of analysis to external OA houses, within the limitations described earlier. However, CDA, as part of DERA, now has to operate within the context of an agency, where it has to charge customers for its work, including a profit element as defined in DERA's agency charter. DERA and CDA constantly review their working practices in the continuing effort to provide best practice (including best value) to the customer. This constant adaptation includes making the workforce more efficient by identifying and re-employing spare capacity as necessary, and improving extant analysis models to be more suitable to a wider range of applications. The former measure generally requires no further expenditure whereas the latter does. However, operational analysis is not just about pure modelling alone. The intellectual process of examining the modelling output and then analysing the impact of factors that could not be modelled is, some argue, of greater value than the modelling process itself. But regardless of whether it is modelling or the intellectual analysis itself that is being conducted, both activities require suitably skilled and qualified staff. It is here that a potential

...there will still be a significant defence budget and a need for defence equipment, unless there is an unprecedented change in future Government Foreign, Security and Defence Policies

problem exists. Currently, CDA does not undertake any OA on behalf of non-governmental commercial bodies. Indeed, it is estimated that only 2-4% of work conducted by CDA is in support of government departments other than the MoD. Therefore, unless CDA is able to expand its customer base significantly outside the MoD circle, it is likely to face an ever-decreasing requirement for its services. It is no coincidence that CDA is not restricted by Civil Service recruitment and employment practices and engages its analysts on 'rolling' contracts. This gives the flexibility to increase, or more likely, decrease its work force according to demand.

OA in support of COEIAs, however, is likely to remain government-only business and will require a core capability to be retained at CDA. Therefore, CDA and the MoD have 3 basic alternatives for the future. Firstly, CDA can reduce its workforce to a level where it can undertake core COEIA activities only. This would leave the MoD poorly placed for impartial OA in support of high-level management issues, as the envisaged level of COEIA activity would account for all available CDA personnel. Secondly, CDA could retain sufficient manpower to cope with all of MoD's OA requirements, very similar to the current situation. However, this approach will require a considerable commitment from the MoD to fund OA, possibly at the expense of future equipment programmes themselves. Lastly, CDA may be given more latitude within DERA's charter to become more commercial and actively pursue business from Industry. This would allow CDA to retain sufficient resources to conduct the MoD's total OA requirements but may cause friction with Industry. This tension may arise where CDA is contracted by Industry to undertake some commercial OA which requires a dedicated level of manpower, and CDA is then requested by the MoD to undertake short-notice high-priority OA in support of a major crisis. In this case, CDA would have to determine the correct balance of satisfying the Government's requirements against commercial imperatives and incentives, especially if CDA is dependent in any way on commercial revenue from Industry.

To return to the problem of suitably qualified analysts, as the MoD's need for quantity of OA diminishes in response to declining budgets and reducing volume of equipment programmes, Industry will likely adapt its business practices accordingly. Industry has 2 possible approaches to the situation. Firstly, it can let market forces reign and potentially merge or downsize as it competes for smaller volumes of defence business. Secondly, it can 'convert' away from defence equipment to more commercial and civil-use product lines if required. However, either approach is likely to require the foundation of credible OA. In relation to future defence equipment markets, although the volume of business will decline, there will still be a significant defence budget and a need for defence equipment, unless there is an unprecedented change in future Government Foreign, Security and Defence Policies. Therefore, Industry will need to be more focused on understanding the customers' requirement and the geopolitical environment that drives that requirement. This understanding will best be derived from some form of operational analysis and is likely to be a natural evolution of the OA conducted by Industry today.

This argument for OA within Industry is equally valid, if not more, when considering the issue of defence conversion. In this instance, a company will require very careful analysis of new markets and customers' requirements if it is to successfully change from supplying government defence departments to servicing the civilian markets. Accordingly, Industry's requirement for appropriately skilled and qualified analysts could increase regardless of the approach it takes, which, whilst complementing CDA's possible future need to 'downsize', could lead to a reversal of the current



balance of OA capability between government and industry. Therefore, the MoD could find itself in a position where CDA is only capable of undertaking core COEIA and high-level analysis and where Industry has the lower-level systems analysis capability vital in helping define operational requirements and determining equipment characteristics. Of course, it may not necessarily be Industry itself that takes up the lower-level OA mantle; independent OA houses may also expand to provide the capacity and level of OA that future Industry and government will require. If this were to be the case, then suitable safeguards would need to be in place to protect national and commercial sensitivities. However, this option may be more acceptable to MoD rather than have to contract to Industry, especially manufacturing companies, to conduct OA in support of national defence issues. The overriding caveat to this postulation though, is that operational analysis conducted in support of national defence policy, force-mix and BOI issues (the high-level defence management matters) is best left to MoD agencies for reasons of probity and security as previously outlined in this paper. This will, in all likelihood, probably underwrite the continuing need for CDA.

Taking any of the possible outcomes as postulated above, however, the MoD and Industry might find themselves in a position of confrontational stance where they both require operational analysis in support of their core businesses, yet find themselves competing for the scarce resources of manpower. Moreover, long-standing suspicions and prejudices between the 2 entities will remain counter-productive to satisfying their mutual requirements. To remedy this, both sides will have to change their current perceptions of each other, the processes by which each conducts its OA, and forge partnerships for the future that are mutually beneficial whilst respecting commercial and national sensitivities. Dealing with perceptions first, the MoD has often seen Industry's desire to make profits from defence equipment programmes as an affront to and incompatible with the Government's desire to obtain best value for money for the taxpayer. However, without reasonable profits, Industry cannot survive, maintain research and development programmes, expand if necessary, and remain

Traditionally, the FAF have had to accept Dassault's latest product which has been developed with export potential as a primary design driver rather than a genuine desire to meet national operational requirements



competitive in the market place. Equally though, Industry has viewed the MoD with equal suspicion and it can be argued that Industry's deft contracting expertise often mocked the MoD's naive perceptions that it had entered into a 'watertight' contract which would deliver a product on-time, on-cost and at best value for money. It is now appreciated on both sides that this situation is unhealthy and untenable and, perhaps, is acknowledged by the MoD's smart procurement concept and Industry's upbeat response to this initiative. The changes in perceptions and attitudes likely to be required are subjective, just as those perceptions and attitudes are themselves. However, accepting a partnership approach to business will be an acceptable and practicable start to modifying attitudes. Essentially, Industry must resist the temptation to 'milk' every contract and MoD must accept that profit making is an acceptable and essential element of business.

Turning to the issue of future OA processes, it is worth exploring how foreign defence industries and government defence departments interact in the conduct of OA. Regarding the European dimension, the relationships between industries and governments in France and Germany are easiest to explain for the following reasons: firstly, there is currently very scant information on the complexity and practicalities of OA interaction in those countries; and secondly, experts within the MoD and UK Industry are unable to provide any detail on these relationships. In light of the depth of OA understanding that the UK government and Industry has in respect of their counterparts in the USA, this would suggest that the French and Germans have very little interaction between Industry and UK Government OA practitioners, if they conduct OA at all. Indeed, what little experience UK experts have with their European counterparts suggests that the French are unused to OA as described in this paper. For example, in the French military aircraft environment, the French Air Force (FAF) have generally been given 'Hobson's choice' when deciding upon a new aircraft. Traditionally, the FAF have had to accept Dassault's latest product which has been developed with export potential as a primary design driver rather than a genuine desire to meet national operational

requirements. Further evidence of this has been French Air Staff surprise to the OA process being pursued in support of the UK Future Offensive Air System programme. Here, the MoD and Industry are forging a new relationship in which both partners are pro-active in the OA process. This involves the MoD engaging Industry in the operational requirements definition process at a much earlier stage than in the past, and Industry giving the MoD greater visibility of its design, development and manufacturing capabilities and costing mechanisms.

Turning now to the US, the UK has enjoyed a long and productive relationship with the Department of Defence (DoD) regarding OA matters. The MoD and DoD enjoy annual exchange visits between OA teams from all 3 environments of sea, land and air. This has allowed the MoD to understand in reasonable depth how the US military operational analysis teams interact with Industry. Not surprisingly, the US are 'asset-rich' in the OA environment and are able to accommodate government and Industry needs in a variety of ways. Principally though, the US Industry devotes incredible resources to promote indigenous and independent OA capabilities. However, much of this capability purposely imitates the capabilities within government OA agencies so constant comparison and cross-referencing can occur as operational requirements and equipment specifications are defined. There is considerable effort made, and money spent, to develop models that replicate real life as close as possible. Also, the US places great emphasis on integrating the models to give a total campaign modelling capability that will cope with low and high-level issues in a single run of the integrated model suite. This suggests that the US place more reliance on the output of the modelling itself rather than the intellectual process of analysis. However, this might simply be because they can afford to develop, integrate and validate their models to such an extent



that the modelling output is refined and robust enough to make the intellectual process nugatory. Overall, however, there is little that the US and Europe can offer as templates for the future OA relationship between MoD and Industry: Europe appears to be behind the UK's OA capabilities and the US OA process is based on a level of resources that the UK can never hope to match.

Nevertheless, there are aspects of the current UK OA process that are relevant to the future. As previously mentioned, the MoD will want to retain a minimum core OA capability that can examine the nationally sensitive high-level management issues as well a lower-level OA capability for independently conducting COEIAs. However, common to both levels of capability is the MoD's technical and cost scrutineers within the Central Staff. These specialists currently act as 'honest brokers' who ensure that Concepts of Analysis for COEIAs are not biased towards a particular solution or situation. They also ensure that the data being subjected to OA is as fair and robust as possible, as well as ensuring that the models to be used during a COEIA are suitable, capable of producing appropriate output and, wherever possible, validated against operational data or trial

Both in the US and the UK, large defence contractors have devoted considerable resources into creating 'virtual' worlds in which equipment can be progressed from the drawing board to the reality of production...



experience. Projecting forward, the role of the scrutineer could become even more pertinent should the MoD wish to, or even have to, contract out more of its low-level systems OA due to future lack of CDA capacity. In this situation, Industry would have to make its OA process available for independent scrutiny by the MoD specialists and react according to any criticism or additional requirement. However, by adopting this new role, the MoD could be assured that the output from Industry OA in support of MoD issues would be unbiased and robust and credible enough to inform the decision making process.

Considering all the above arguments, and assuming that OA does remain pertinent and important to both the MoD and Industry, mutual interests will be best served by adopting a partnership approach. As already explained, this is probably only practicable for lower-level OA conducted in support of defining future operational requirements, determining the optimum specification of subsequent defence equipment, and determining the principal drivers of new technologies such as those being researched within the Applied and Corporate Research Packages. The MoD acknowledges that there is a need to retain particular UK-based defence industrial capabilities in relation to certain key areas. Additionally, the MoD recognises the importance of indigenous defence industries to European economies and welcomes any moves by UK industry to improve its competitive position by building on new relationships both within Europe and the US. However, the MoD expects UK industry to take the initiative in this process.²⁶ Moreover, the MoD, together with the Department of Trade and Industry and representatives from the UK Defence Industry, now participates in the National Defence Industries Council working group in order to promote future understanding between government and Industry on defence needs and commercial and industrial concerns. Furthermore, CDP urges in his smart procurement objectives that the MoD and Industry become more interactive in the way they work. This includes Industry becoming more involved in the procurement process at an earlier stage and by exploiting modern IT systems and tools to permit improved planning, estimating and predicting.²⁷

It may transpire, however, that due to commercial imperatives and the need to remain competitive, Industry has the best modern IT and OA tools that would allow such exploitation. A good example here is the trend towards the use of synthetic environments during the development of equipment. Both in the US and the UK, large defence contractors have devoted considerable resources into creating 'virtual' worlds in which equipment can be progressed from the drawing board to the reality of production; a 'cradle to grave' process. The aim is to minimise time and material wastage in the design and development stages of new equipment. This is achieved by allowing designers and engineers to see how proposed changes will affect the performance characteristics of the equipment and then incorporate the preferred changes into the final design. The virtual environment also allows the manufacturing process to be simulated so that the first 'metal-cut' or carbon fibre moulding is right first time. Additionally, a synthetic environment negates the need for costly hardware prototyping and leads to a reduction in the time to develop a concept into reality. Ultimately, this process allows very cost-effective development and manufacture of products, which can then be passed on to the customer in the way of cost-effective ownership and operation of that equipment. However, the cost of establishing such environments is expensive and, although Industry can justify it through increasing its competitiveness and reducing overall cost of ownership to the customer, it is unlikely that the MoD and CDA could afford to create such an environment. Therefore, this development could make the partnership approach to OA more attractive to the MoD. Early involvement of Industry within Integrated Product Teams (IPT), in line with CDP's

initiative, is likely to reap considerable mutual benefits for both the Government and Industry; Industry invests the money to reduce R&D time and risks, and the MoD gets its defence equipment better, sooner and cheaper.

So, having analysed all the above arguments and factors, what does the future hold for the MoD, Industry and their relationship in the context of their need for operational analysis and how they will conduct it? Dealing with Industry first, OA is likely to be vital in assisting Industry to adjust to the future way of defence management post the Strategic Defence Review. As the MoD strives for faster, cheaper and better defence procurement, Industry not only has to participate willingly, and profitably, in this initiative but also has to face the challenge of rationalisation within Europe. In both these activities, Industry will find OA invaluable in both helping to understand the MoD's requirements and shaping its own business strategy. Accordingly, Industry might be willing to expand its OA capabilities in order to achieve the competitive edge over its rivals and remain a profitable concern in the future of declining defence budgets. However, this approach will require Industry and the MoD to be less confrontational in their relationship and adopt a more pro-active partnership approach to sharing OA capabilities and outputs.

...if the MoD becomes more reliant on OA then the proportion of OA required to underpin the MoD's business will increase accordingly

Turning to the MoD, there are 3 distinct yet inter-related challenges facing it. Firstly, the trend towards increased transparency and accountability in Government business is likely to intensify the MoD's requirement for OA. Future governments are most likely to continue the intense scrutiny of public spending in an effort to meet their policy and electoral obligations in the most cost-effective way. If current and past trends are indicative, future defence budgets will be the first to be subjected to Ministerial and Treasury examination. However, the need for the MoD to provide 'fit-for-purpose' forces to satisfy the Government's security and defence policies will not diminish. Accordingly, the MoD faces a future where it must justify to Ministers and the taxpayers that it is undertaking its business in the most cost-effective manner, matching carefully defined force structures with adequately defined defence equipment. It is in these definitions that operational analysis will remain paramount and, given the issue of increasing accountability, the MoD might find itself becoming increasingly reliant on OA to underpin its business. The second challenge facing the MoD relates to the cost of OA. Quite simply, if the MoD becomes more reliant on OA then the proportion of OA required to underpin the MoD's business will increase accordingly. This factor is elaborated on below. Following on from this, the cost to the MoD of conducting OA will also rise and this potentially escalating cost flies in the face of declining defence budgets. The MoD will then have to balance the need to pay for OA, without which it will not prove the need for any new force structures or equipment, and the need to preserve valuable funds to pay for future forces and new defence equipment.

The third challenge confronting the MoD is the role that CDA will play in the future. The MoD's quest for fewer defence systems to equip smaller forces means that the total amount of OA to be conducted by CDA will decline, yet far more emphasis will be placed on the quality and fidelity of that OA. Potentially, CDA faces a future where its current level of highly skilled analysts is required to undertake a declining level of analysis. CDA can tackle this in one of 3 ways. Firstly, and most unlikely, is that CDA can steadily reduce its workforce in line with the MoD's input to such a level where it undertakes the MoD's core OA only. In this instance, CDA will be well placed to undertake high-level OA for BOI and force-mix issues but might be less comfortable when it comes to undertaking intensive COEIA low-level modelling. Additionally, CDA might not have the manpower to cope with surge demands from the MoD, say in time of crisis or when several COEIAs coincide. The second option for CDA is to remain just as it is and shape its work force to meet the demand. However, one drawback with this approach is that CDA might find itself in competition with Industry for the skilled analysts to undertake OA. Also, this option is dependent on the MoD remaining the predominant source for OA work and, because of the reasons outlined above, this may leave CDA in a state of steady decline as the MoD funding for OA reduces. The last option, and perhaps the most pragmatic, to be considered is the situation where CDA greatly increases its customer base for its OA skills. Here, CDA might undertake operational analysis not just for Government departments other than the MoD, say for the Foreign Office, but also conduct OA on behalf of Industry. This approach would allow CDA to maintain its status with the MoD whilst engaging in enough contracted work to sustain a credible level of skilled analysts to undertake both high and low-level OA. However, this alternative would need sufficient safeguards not only to protect both the MoD and Industry's interests but also to ensure that priorities were established and adhered to by all parties.

Nevertheless, it is the partnership approach that is likely to satisfy all the parties' mutual needs; Industry would have access to a highly capable OA facility without having to accept the overheads of creating its own alternative; CDA would remain a global centre of OA excellence, capable of undertaking a wide range of OA tasks; and the MoD would still have impartial OA to underpin all its high-level and COEIA-related issues. Industry and the MoD will continue to need operational analysis to inform and shape their business strategies and whether the SDR acts a catalyst, or whether declining defence budgets and global defence equipment markets force the issue, they will both have to adapt to the many and varied challenges that lie ahead. The solution, perhaps, is for Industry and the MoD to engage in a new era of partnership, a solution obvious to many but conspicuous by its absence in the past.

NOTES

- 1 R C Wheeler, 'Operational Analysis: What It Is And How It Came About', *Air Clues*, April 1994, p.132.
- 2 Operational research (OR) is hereinafter referred to as operational analysis (OA). This avoids confusing the OR abbreviation with that of Operational Requirements.
- 3 Throughout this paper, Industry refers to UK defence industries and companies, whether they be manufacturers, suppliers or prime contractors.
- 4 P Rivett, *Concepts of Operational Research* (London: C A Watts & Co Ltd, 1968), p.4.
- 5 R C Wheeler, *Op Cit*, p.132.
- 6 E Warner, 'Douhet, Mitchell, Seversky: Theories of Air Warfare', in *Makers of Modern Strategy*, ed by E M Earle (Princeton: Princeton University Press, 1943), p.494.
- 7 R C Wheeler, *Op Cit*, p.133.
- 8 *Idem*.
- 9 P Rivett, *Op Cit*, p.11.

- 10 T Dodd, *Defence Reviews: Past, Present? and Future?* (Unpublished House of Commons Library Research Paper No 93/91, 18 October 1993), p.4-5.
- 11 United Kingdom Joint Warfare Publication 0-01, *British Defence Doctrine* (London: MOD CS(M)G, 1996), p.6.23-6.24.
- 12 Deputy Chief of the Defence Staff (Systems), *Procedures for Project Sponsorship of Staff targets and Requirements, Part 1 Policy and General* (Unpublished), p.25.
- 13 *Ibid*, Chapter 2.
- 14 D Kirkpatrick, 'Choose Your Weapon: Combined Operational Effectiveness and Investment Appraisal (COEIA) and its Role in UK Defence Procurement', *Whitehall Papers 36* (London: RUSI Whitehall Paper Series, 1996) p.5.
- 15 Report of the EPC Efficiency Scrutiny (Unpublished MoD report, May 1991).
- 16 Ministry of Defence RP(Systems), *Equipment Approvals Committee Procedures and Dossier Guidelines* (Unpublished, May 1996), p.E-1 – E-4.
- 17 Sir Isaac Newton 1694.
- 18 JSCSC Foundation Phase UK Foreign and Defence Policy Essential Reader, *Britain in the 21st Century: Rethinking Defence and Foreign Policy: What do we need the armed forces for?* (Unpublished, M Chambers), p.28.
- 19 A previous RAF ASC Research Paper (Sqn Ldr R McAlpine) covers this issue in great depth and advocates capability-based procurement rather than counter-threat-based procurement.
- 20 Deputy Chief of the Defence Staff (Systems), *Procedures for Project Sponsorship of Staff targets and Requirements, Part 1 Policy and General* (Unpublished), p.2-8.
- 21 Ministry of Defence RP(Systems), *Equipment Approvals Committee Procedures and Dossier Guidelines* (Unpublished, May 1996), p.5-2.
- 22 D Kirkpatrick, *Op Cit*, p.55.
- 23 *Ibid*, p.4.
- 24 Briefing by Sir Robert Walmsley KCB Chief of Defence Procurement, *Smart Procurement* (Unpublished MoD Press Release 2 Oct 97).
- 25 United Kingdom Ministry of Defence, *Statement of the Defence Estimates 1996* (London: HMSO, July 1996), p.54.
- 26 *Ibid*, p.65.
- 27 Briefing by Sir Robert Walmsley KCB Chief of Defence Procurement, *Op Cit*.

This article has been republished online with Open Access.

Ministry of Defence © Crown Copyright 2023. The full printed text of this article is licensed under the Open Government Licence v3.0. To view this licence, visit <https://www.nationalarchives.gov.uk/doc/open-government-licence/>. Where we have identified any third-party copyright information or otherwise reserved rights, you will need to obtain permission from the copyright holders concerned. For all other imagery and graphics in this article, or for any other enquires regarding this publication, please contact: Director of Defence Studies (RAF), Cormorant Building (Room 119), Shrivenham, Swindon, Wiltshire SN6 8LA.

 **ROYAL
AIR FORCE**
**Centre for Air and
Space Power Studies**

OGL