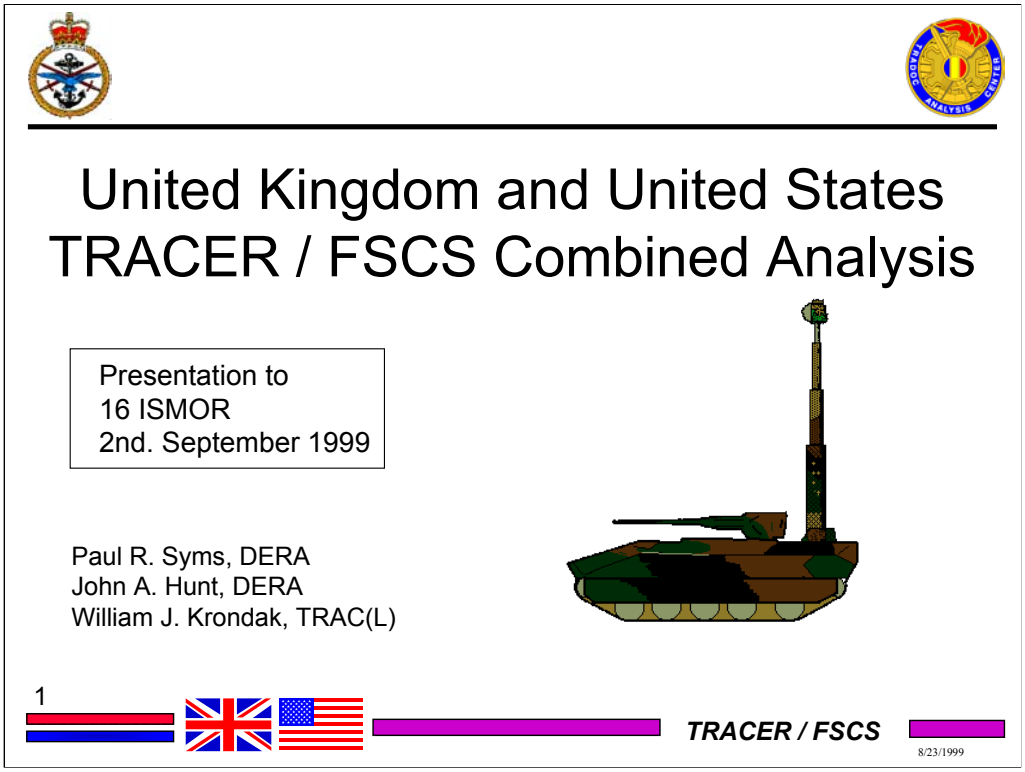

UK/US TRACER/FSCS Combined Analysis

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John A. Hunt
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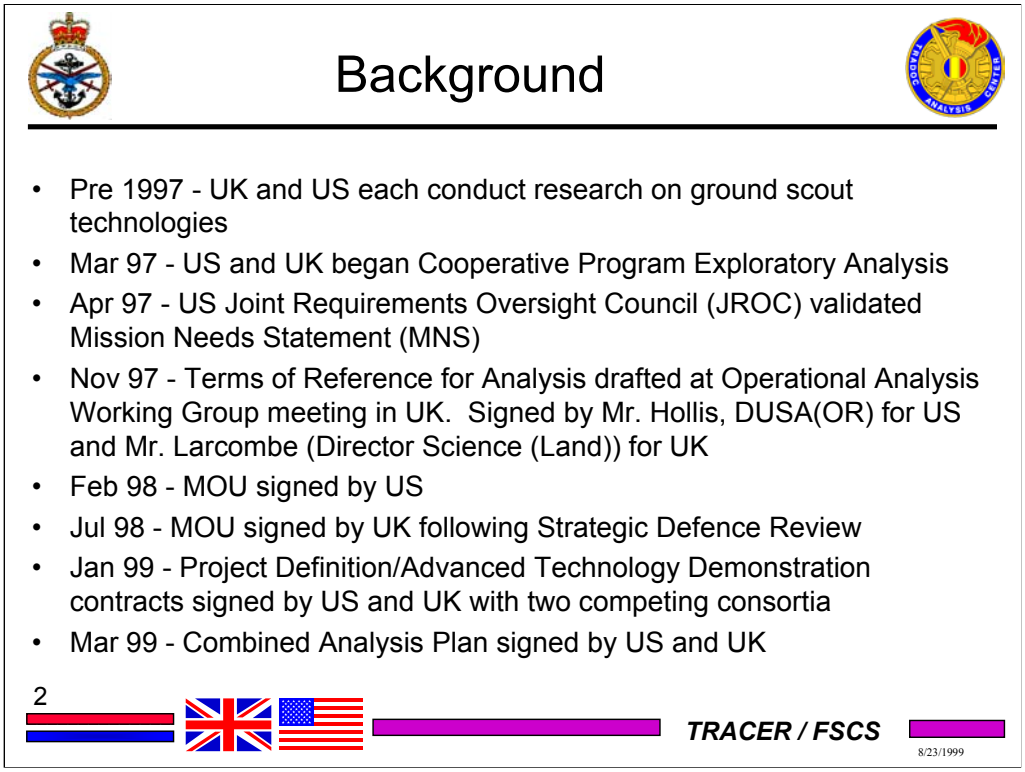
Abstract:
The armies of both the United Kingdom and the United States have recognized their need for replacement of the Combat Vehicle Reconnaissance (Tracked) (CVR(T)), the High Mobility Multi-purpose Wheeled Vehicle (HMMWV) scout, and the Cavalry Fighting Vehicle (CFV) scout. The UK conducted studies on a development effort known as the Tactical Reconnaissance Armoured Combat Equipment Requirement (TRACER) while the US Joint Requirements Oversight Council approved a Mission Needs Statement for a Future Scout and Cavalry System (FSCS). The UK and US signed a memorandum of understanding in July 1998 to accomplish a cooperative Project Definition/Advanced Technology Demonstration phase to meet the requirements.

To support this effort, the UK Director Science (Land) and the US Deputy Undersecretary of the Army (Operations Research) signed Terms of Reference for a combined analysis to underpin the programmatic and acquisition decisions by the UK and US. Analysts from both countries established an operational analysis working group and prepared a Combined Analysis Plan (CAP). The CAP was signed in March 1999.

This paper outlines the combined analytic approach. Included are the following:

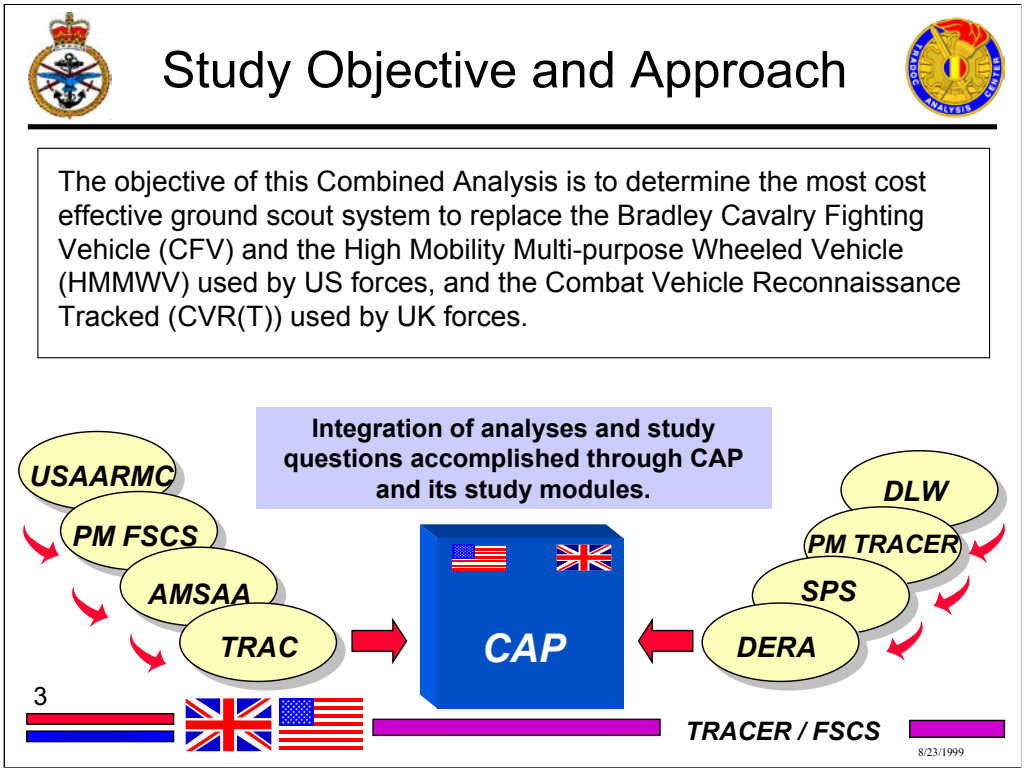
a. The settings and scenarios, to include cooperatively developed common and shared scenarios;
b. The technical analysis, including the innovative Integrated Systems Measures approach; and
c. The operational effectiveness analysis, to include discussion of the various models and how to achieve a truly combined analysis that will support both nations' decisions.



1. Introduction. Many countries in the European and North Atlantic community recognize that they must cooperate to develop and produce affordable and interoperable military systems for their future security needs. In the area of ground-based surveillance and reconnaissance, the United Kingdom (UK) and the United States (US) recently began a cooperative Project Definition (PD) and Advanced Technology Demonstration (ATD) phase to build a new manned ground scout vehicle. A combined UK and US government analysis effort will parallel the PD/ATD phase and inform the government leaders regarding the development decisions at the end of the phase.

2. Background.

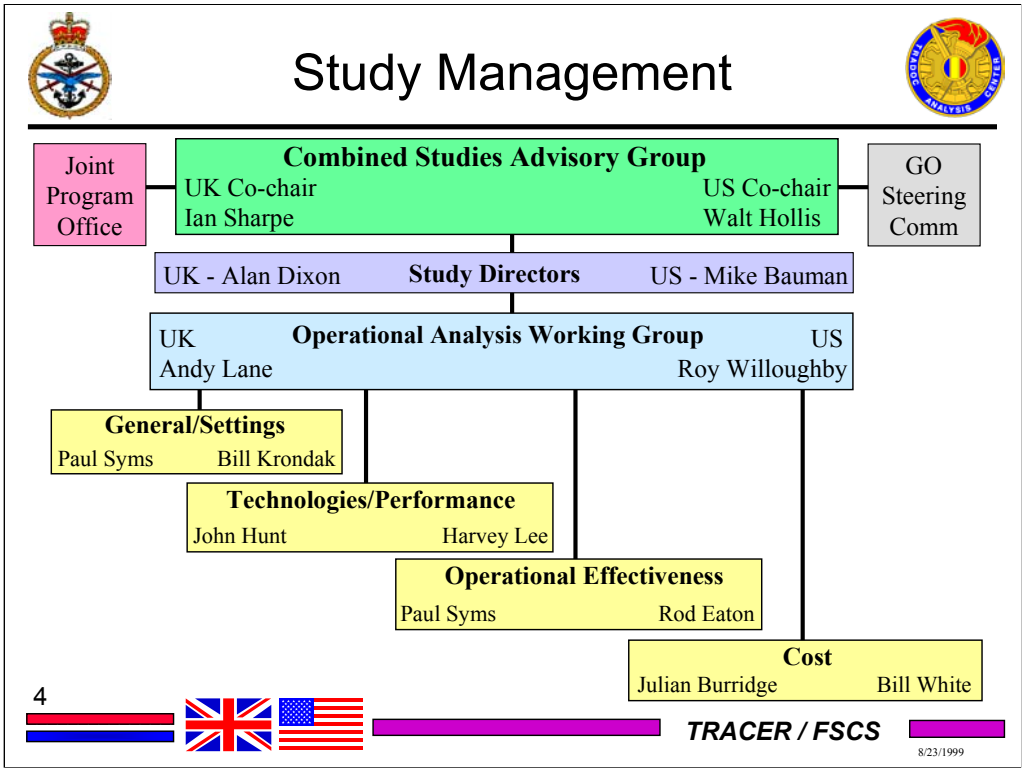
2.1. Both UK and US military leaders recognized that a ground scout provided certain capabilities that could not be met by aerial surveillance and reconnaissance platforms or by other intelligence means. The existing systems, the UK's Combat Vehicle Reconnaissance (Tracked) (CVR(T)) and the US High-Mobility Multi-purpose Wheeled Vehicle (HMMWV) and Bradley Cavalry Fighting Vehicles (CFV) were effective but aging. They did not have the platforms to incorporate the new technology becoming available through research and development. Thus, both nations sought to develop a replacement for the existing systems. After extensive research, the countries investigated whether a cooperative development was feasible. The chart shown here illustrates the steps taken to create a cooperative development program as well as a combined analysis. Note that the combined analysis terms of reference were drawn up in anticipation of the signing of the Memorandum of Understanding for cooperative development and highlight the excellent working relationship between analysts in the UK and US.



2.2. The PD/ATD phase lasts 42 months. The two competing consortia are Team Lancer and SIKA International. Team Lancer is GEC-Marconi and Alvis Vehicles of the UK teamed with Raytheon and United Defense of the US. SIKA International includes British Aerospace and Vickers Defence Systems of the UK teamed with Lockheed Martin and General Dynamics of the US. Both teams will work to create what they believe to be the systems that best meet the requirements specified in the Combined Operational Requirements Document (CORD) developed by the UK and US user communities. They will build and test an integrated demonstrator vehicle.

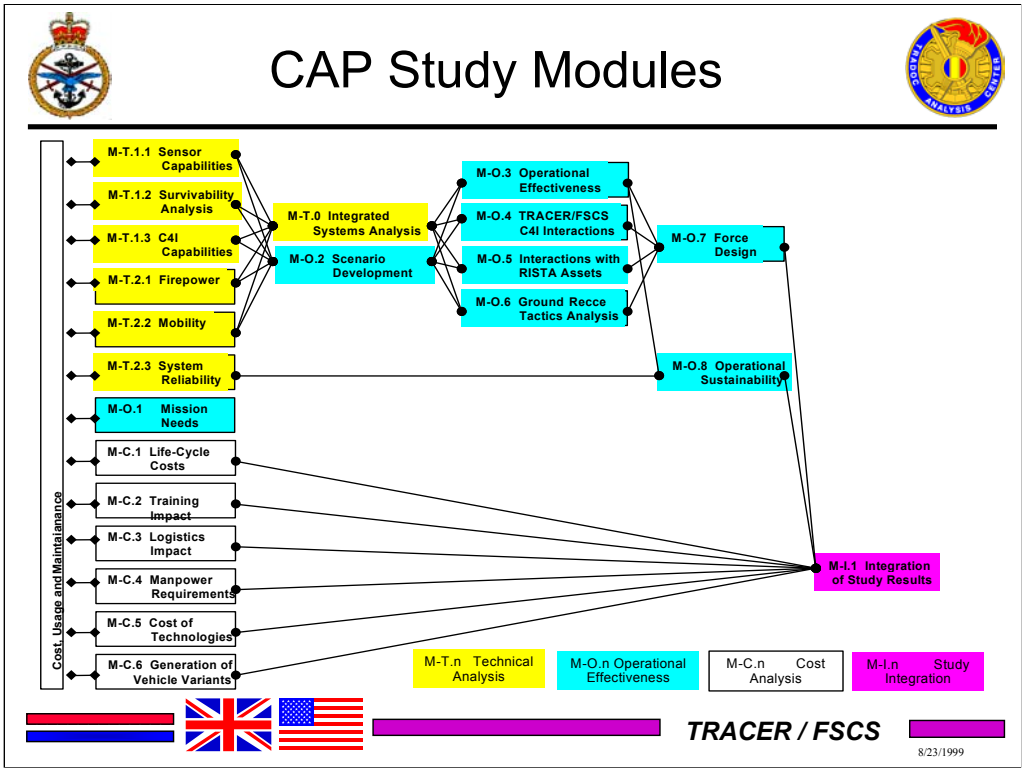
3. Study objective. The government analysis conducted in the combined analysis program by UK and US analysts will help to make national authorities "informed customers" regarding the proposals from the industry consortia. The specific study objective (shown in the chart above) is to determine the most cost effective ground scout system to replace the HMMWV, Bradley CFV and CVR(T).

4. Study approach. The study approach was developed through creation of the Combined Analysis Plan (CAP). The CAP included input from agencies shown on the chart above. They included the US Army Armor Center (USAARMC), Project Manager Future Scout and Cavalry System (PM FSCS), US Army Materiel Systems Analysis Activity (AMSAA), and US Army Training and Doctrine Command Analysis Center (TRAC). United Kingdom contributors included the Directorate of Land Warfare (DLW), Project Manager TRACER, Specialist Procurement Services (SPS) and the Defence Evaluation and Research Agency (DERA) which includes the Centre for Defense Analysis (CDA).



4.1. Study management. The chart above describes the combined study management structure. Note that the Joint Program Office and a General Officer Steering Committee provide input to the Combined Study Advisory Group. The co-study directors are Mr. Alan Dixon of the Directorate Science (Land) (DSc(L)) and Mr. Mike Bauman of TRAC. The operational analysis working group (OAWG) comprises four sub-groups working under the leadership of Mr. Andy Lane of DSc(L) and Mr. Roy Willoughby of TRAC.

4.2 Study modules. The study approach used a hierarchical structure of questions derived from the study objective. The questions were then gathered into logical groupings related to General/Setting, Technologies/Performance, Operational Effectiveness, Cost and Integration. The analysis working group then created and assigned a series of study modules that would address the questions. As each module is completed, its output will be used as input to answer the hierarchical structure of questions. The study modules are being addressed in a time schedule broken in segments. This provides management a tool to help allocate resources and assess progress.



4.3. Scope of the study modules. The Combined Analysis Plan (CAP) consists of 21 separate study modules which are divided into Technical, Operational Effectiveness, Cost and Integration. The relationships between them are indicated by the lines.

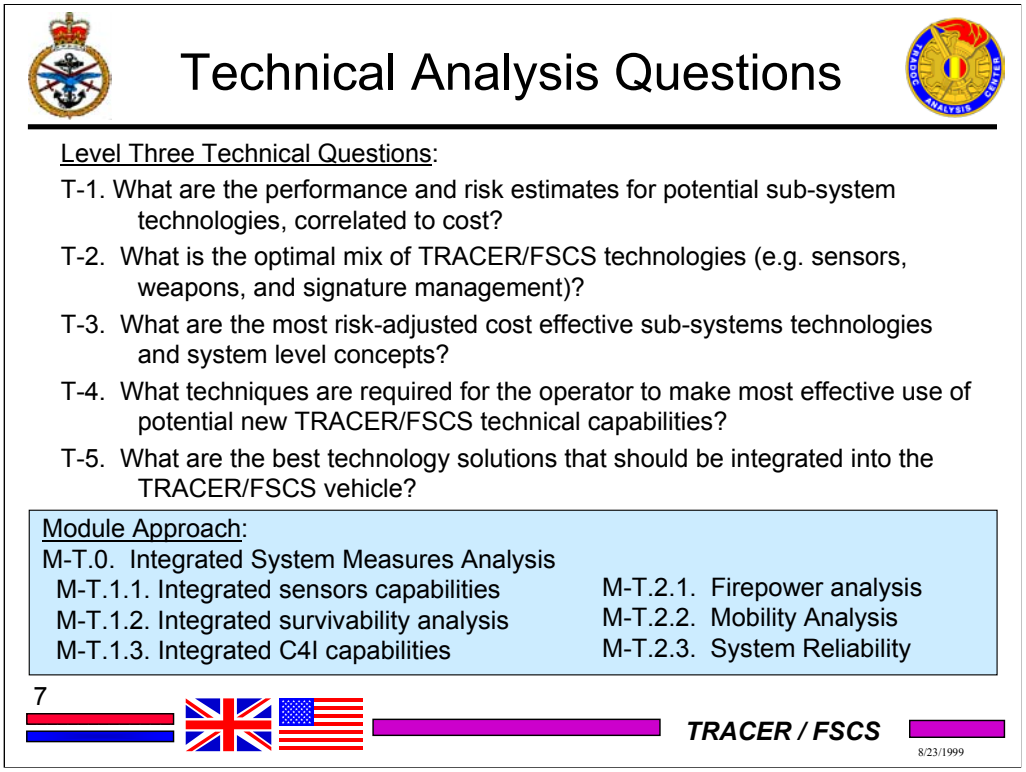
Critical Study Questions

Level One Question:
What are the cost and effectiveness values of TRACER/FSCS options?

Level Two Questions:

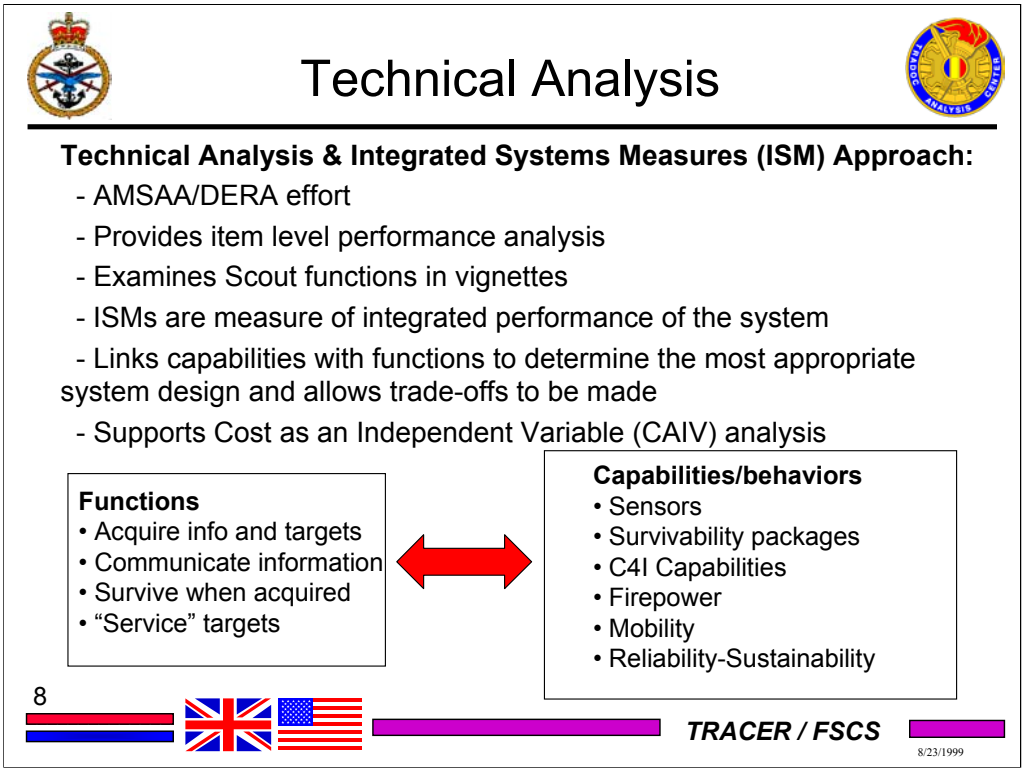
General (G)	What are the settings to be used?
Technical (T)	What are the integrated system performance, cost and risk estimates for each alternative?
Operations (O)	What is the operational effectiveness of each alternative?
Cost (C)	What is the cost of each alternative?

5. Critical study questions. The chart above shows the top level question related to the study objective and the level two sub-questions. In the following sections, the level three questions assigned to each sub-group will be shown and the analytic tools and methods highlighted.



6. Technical Analysis.

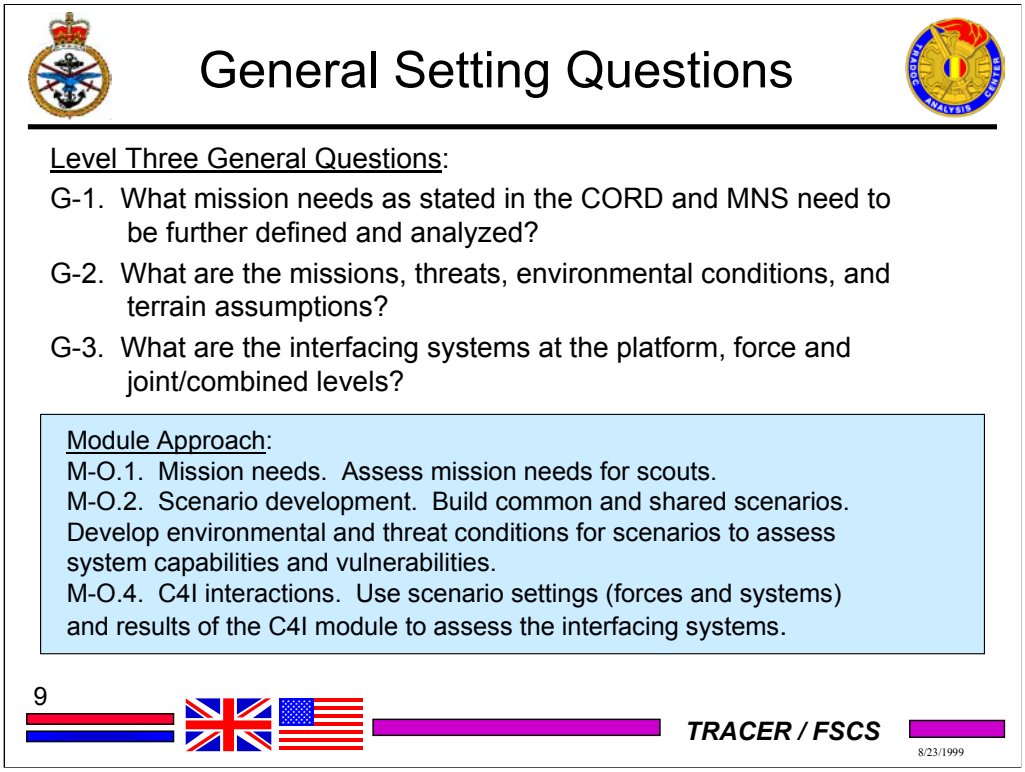
6.1 Technical questions and modules. The questions for the technical analysis are shown in the chart above. The analysts then developed modules to address the questions. Because of the expected resource requirements associated with module fulfillment and because some of the questions had already been addressed extensively in the prior research and analysis, the OAWG prioritized the modules. Priority one modules are shown on the left. Priority two modules are shown on the right. Several unique issues arose and were addressed by the technical analysis working group. Among them was the issue of survivability. The question arose "What constitutes a scout kill?" The analysts agreed that more than the traditional mobility kill, firepower kill, or catastrophic kill assessments were needed. The reason was that the scout is supposed to provide information about the battlefield to its higher headquarters and adjacent units. Thus the analysts developed a scheme to include sensor kills and communications kills in scout survivability.
A second unique issue was how to address logically the many system and subsystem capabilities that had to be examined to enable assessment of the existing and proposed future concepts. The UK proposed an approach called integrated systems measures (ISMs).



6.2. Technical analysis and integrated systems measures. AMSAA and DERA agreed to use an integrated technical analysis and integrated systems measures (ISM) approach for this analysis. The technical analysis feeds the operational effectiveness (OE) analysis with technical data, and the ISMs and cost analysis with cost-performance data.

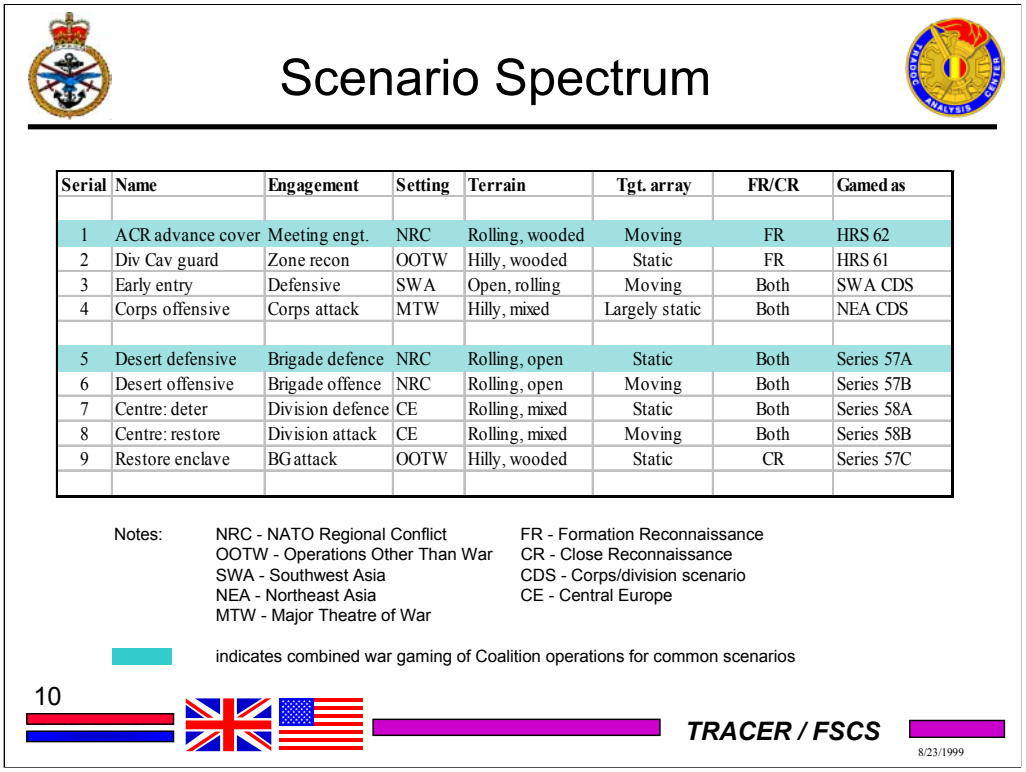
6.2.1. The technical analysis provides item level analysis of the components of the new scout system. It will assess the relative capabilities of a variety of sensors, survivability suites, command, control, communications, and computer packages, armament, as well as mobility and reliability concepts. It will do this using a variety of engineering level models and high resolution combat models. The technical analysis and ISM will support use of cost as an independent variable (CAIV) analysis.

6.2.2. The ISMs are high level measures of the behavior or function of a system. ISM measures what a system is supposed to do to meet the mission requirements placed upon it by military commanders. It is not a demand on the form of the system or implementation of a solution. For example, survivability is a behavior, while armor capable of defeating a given threat is demand on the form of the system and does not allow the government or industry to meet the survivability requirement using an alternative technology or approach. Taking the integrated approach, survivability is dependent on a variety of things other than just armour; these include sensor range, mobility, vehicle profile, weapons, and sensor countermeasures. ISMs differentiate between measures, metrics, and the subsequent requirements: for example, "speed" is a measure, 30 km/h is a metric, and "vehicle speed shall be at least 30 km/h" is a requirement. ISM analysis will support modification of the requirements based on tradeoffs during the study.



7. General Setting.

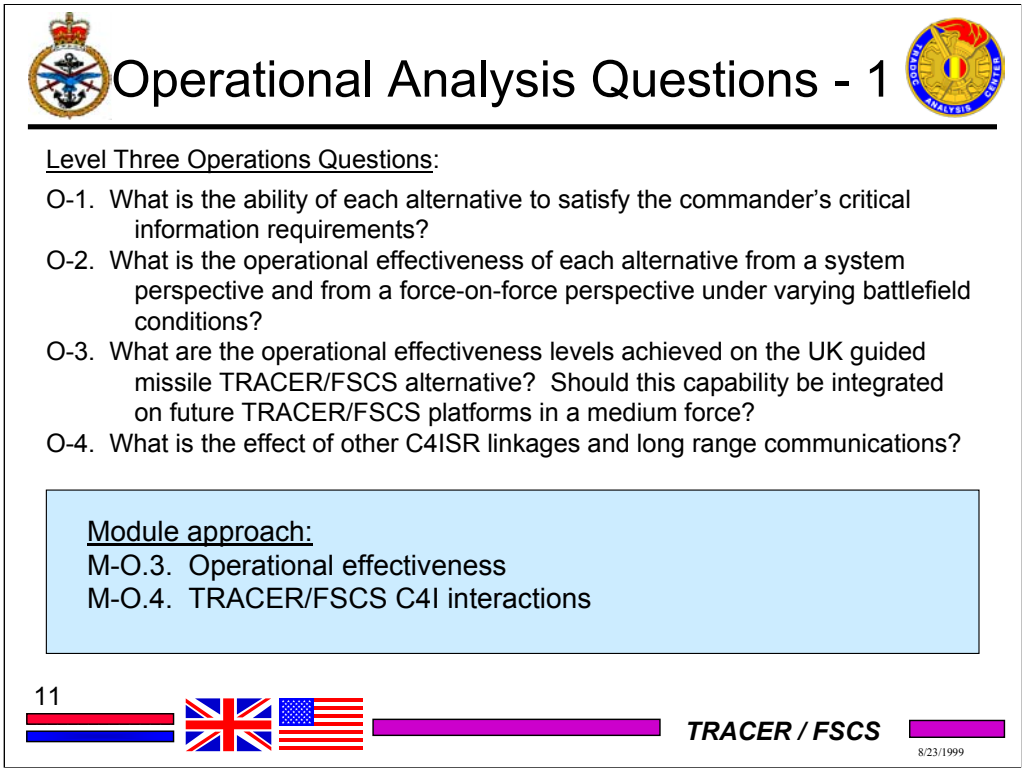
7.1. Setting questions and modules. What settings to use in the operational analysis composed the level two question for this group. The level three questions shown on the next chart are being addressed through appropriate modules that define the missions, scenarios and environmental conditions under which the alternatives are to be examined. The mission needs question is being addressed through a review of existing doctrine and scout requirements. The issues to be explored in the module include mobility requirements to assess the need for tracks or wheels, the survivability requirements, and the armament requirements. To satisfactorily answer the second question on threat, environment and terrain issues, the operational analysis working group (OAWG)concluded that a number of scenarios and combat simulations would have to be used. Some of the scenarios are common scenarios, that is, both the US and UK will use the same scenario in their own simulations. Other scenarios are shared. Shared scenarios will be used in a combat simulation by one of the nation's analysts and then the results shared with the other nation's analysts and used to fulfill the study module requirements and answer the critical study questions. The question on system interfaces will be addressed through evaluation of the scenarios that use a variety of units (formation reconnaissance, battlegroup scouts, armored cavalry regiments, division cavalry, etc.), as well as a variety of joint and combined environments that will bring to bear a wide variety of supporting and cooperating sensor and weapon systems. All these will have to be integrated through command and control systems to achieve the full joint and combined operations capability.



7.2. Scenario spectrum. The scenario spectrum proposed for use and currently under development includes a wide range of settings. It includes major regional conflicts as well as operations other than war. The terrains range from hilly, mixed terrain that is very restrictive for mobility and line of sight to open desert terrain. The missions range from attacks and defensive operations to zone reconnaissance operations in an operations other than war environment. One of the unique accomplishments of this study has been the development of common scenarios. The UK analysts and military gamers assisted the US in the development of a common scenario at TRAC White Sands Missile Range in 1998. The US assisted the UK in the development of a common scenario at DERA Fort Halstead in early 1999.

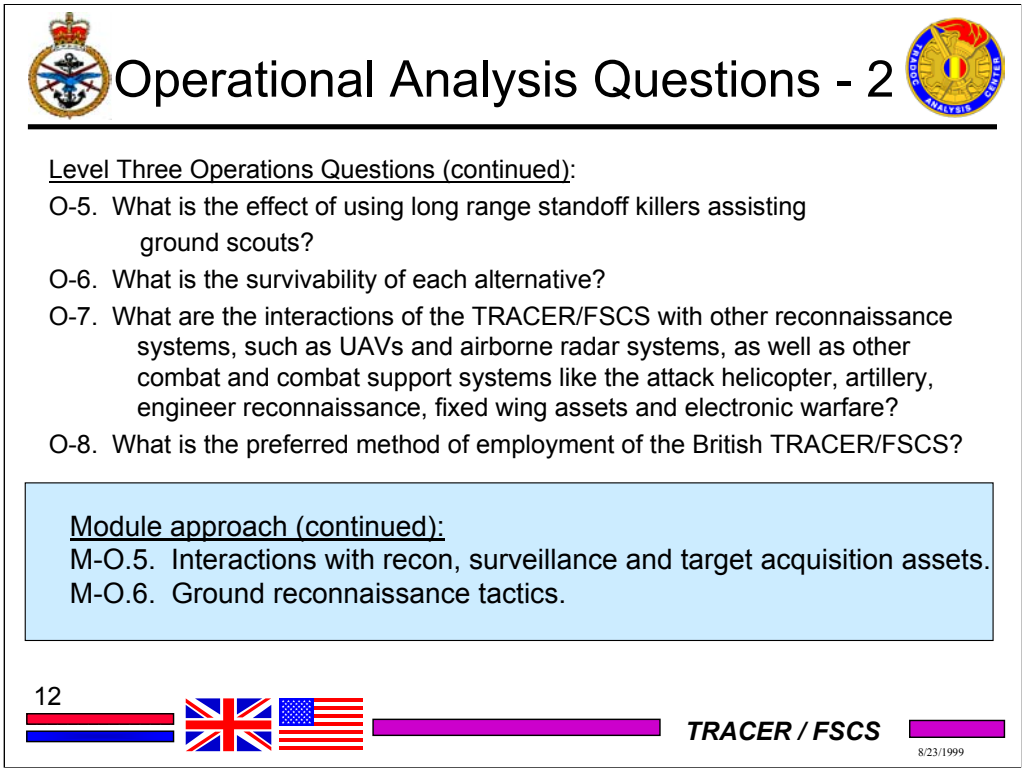
7.2.1. For certain scenarios, the weather and threat environments will be altered to conduct excursions. For example, one scenario excursion will include falling snow to examine mobility and sensor capabilities, and another excursion will include precipitation and heavy fog. Environmental conditions such as high winds and ‘hot and high’ atmospheres, both of which could limit the use of unmanned aerial vehicles (UAVs), will also be considered.

7.2.2. Threat excursions will include improved conventional weapons, the use of chemical weapons, and sensor counter-measures.



8. Operational effectiveness analysis.

8.1. Operational effectiveness questions and modules. The questions to be addressed by the operational effectiveness analysis are shown on the chart above and continued on the next chart. Four modules have been developed to address the questions. Two are shown on this chart. Note that the first question relates to how the scout system will satisfy the commander's critical information requirements. When the commander and staff do a mission assessment for an upcoming operation, they determine what information they must gather to increase their chances for achieving success. Establishing a set of critical information requirements thus enables the intelligence staff and subordinate units to focus their reconnaissance and surveillance efforts. The second question will be addressed by combat simulations. The third question relates to the UK employment of specialist overwatch variants carrying long range guided weapons to engage targets identified by the scouts. The fourth question relates to how will the commander control and communicate with a scout if it is built with the capability to penetrate deep into enemy territory to gather information.



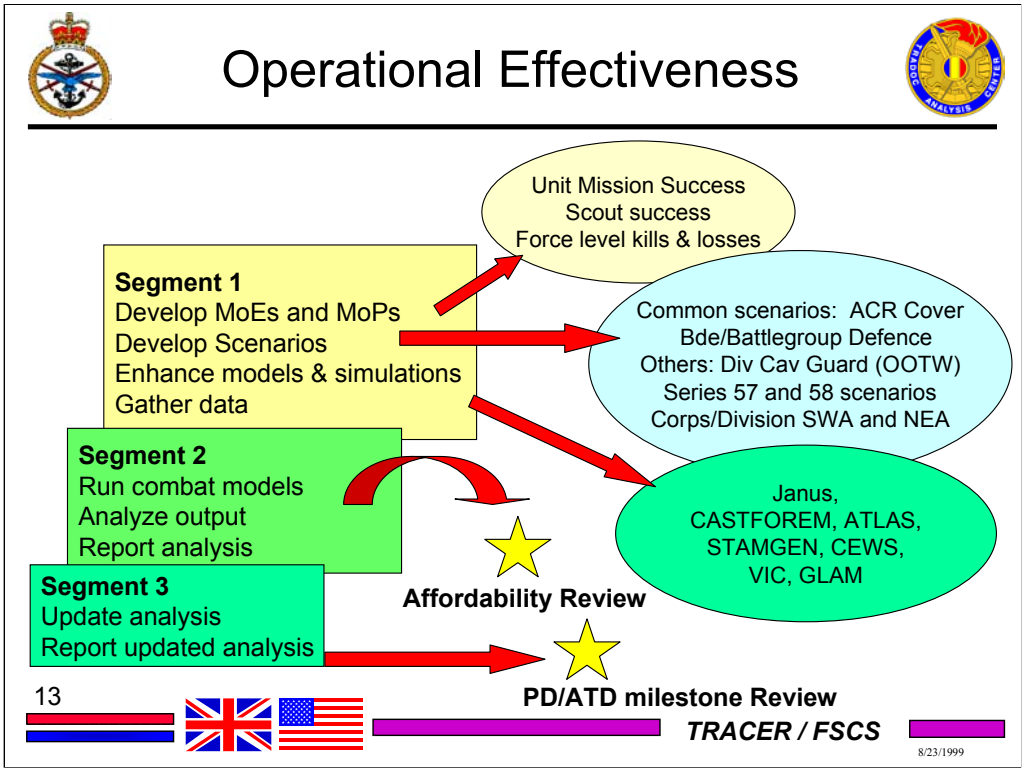
8.2. This chart continues the discussion of the operational analysis questions and modules.

8.2.1. Standoff killers refers to artillery and missile systems as well as helicopters armed with guided weapons that can be used in a 'fire and forget' mode.

8.2.2. Note the question regarding survivability. The operational effectiveness analysis will take the data and assessments from the technical analysis and the ISM and evaluate the resulting concepts in both high resolution force-on-force simulations as well as corps-level and division-level combat models.

8.2.3. The question on interactions is to determine the optimum mix of manned ground reconnaissance and other tactical reconnaissance systems, particularly UAVs, to achieve the reconnaissance aims, and ultimately, to achieve a successful battle outcome. This is driven by both nations' desires to procure a cost-effective and robust tactical reconnaissance capability.

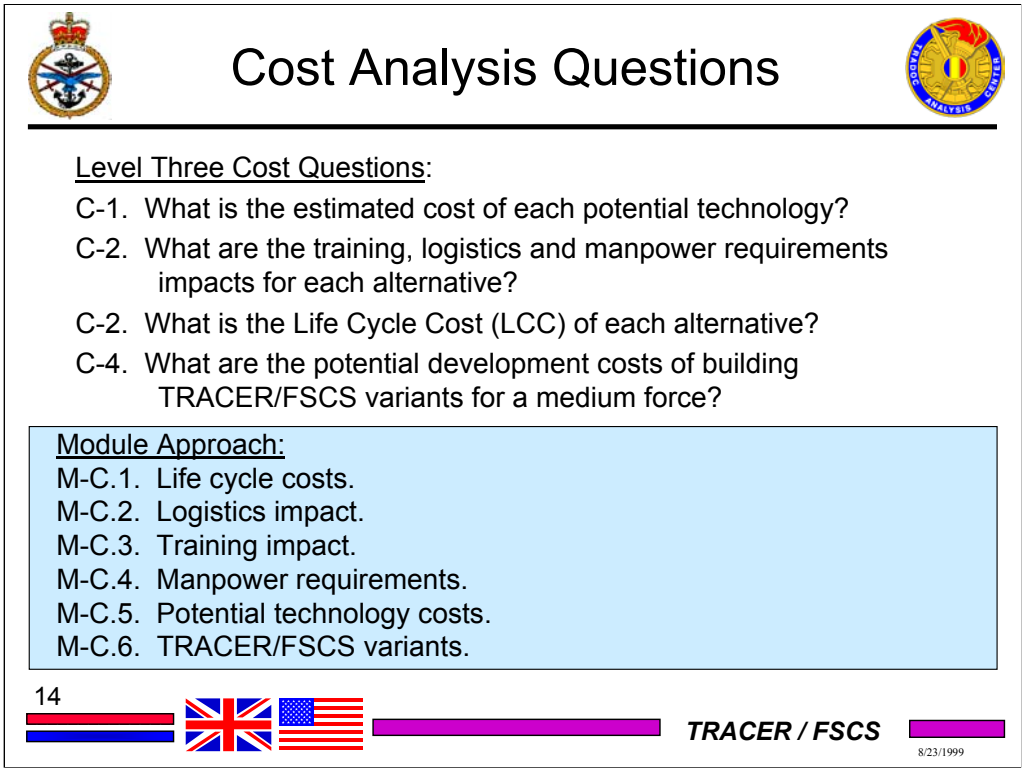
8.2.4. The question on preferred methods of employment is aimed particularly at the GW overwatch vehicle, and its use to counter enemy reconnaissance. It will be addressed primarily using the Janus wargame, possibly in combination with less detailed (but also less costly) manual wargaming.



8.3. Operational effectiveness analysis. The operational effectiveness (OE) analysis is divided into three segments. Each contributes to the following segment and builds on previous work.

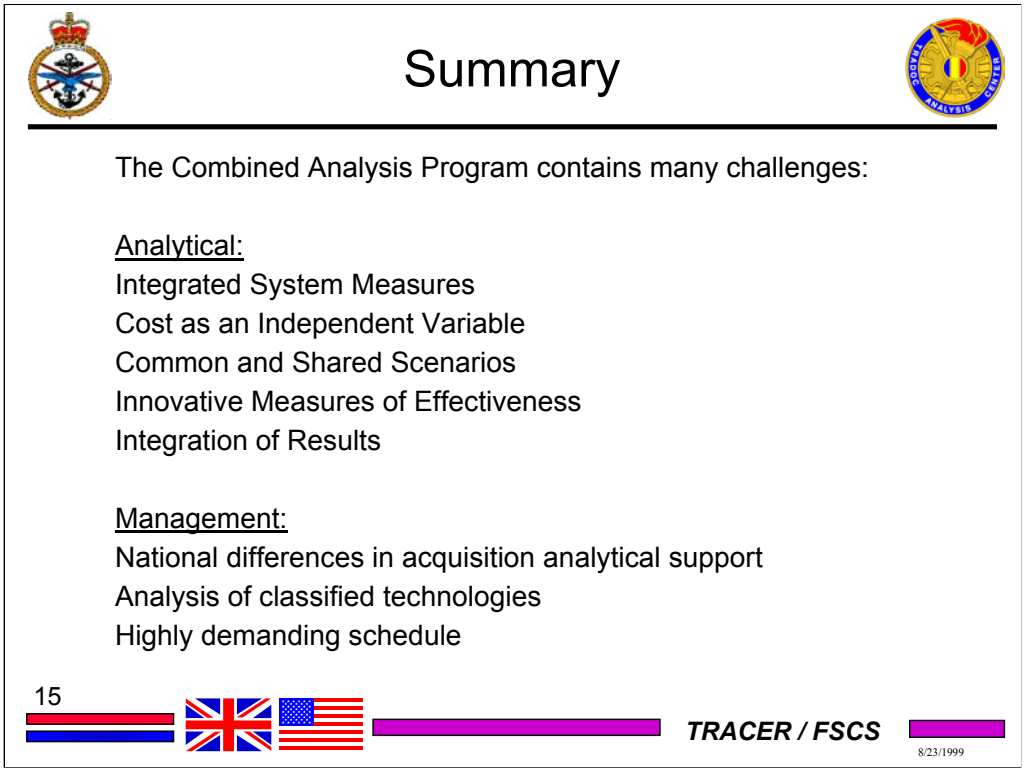
8.3.1. Segment one. During segment one, measures of effectiveness (MoEs) and measures of performance (MoPs) will be developed. These will use input from the technical analysis, and scenario input regarding the unit mission and scout mission. The critical information requirements mentioned earlier will feed the development of MoE and MoP. It should be noted that the analysis has to respond to the subtleties of reconnaissance and scouting, and traditional attrition based MoEs, such as loss-exchange ratio, are inappropriate. The development of MoEs to measure battle outcome is one of the greatest technical challenges of the programme. The models will also be enhanced to enable them better to represent new technologies and reconnaissance tactics. They will construct the scenarios designated by the General Settings sub-group and get the implementations approved. They will gather data from the technical analysis and from intelligence sources to load the combat models with the best data available. The models being used include brigade and battlegroup level interactive tools like Janus, and also the US Combined Arms and Support Task Force Evaluation Model (CAST-FOREM), the UK Analysis Tool for Land Systems (ATLAS), and corps and division-level simulations like Vector-in-Commander (VIC) and the UK Generic Land Aggregation Model (GLAM).

8.3.2. Segment two. During segment two, the analysts will run the scenarios in the models, assess the various alternative concepts for the ground scout, share the output with their counterparts, and develop reports and briefings to support a general officer Affordability Review in early 2001.

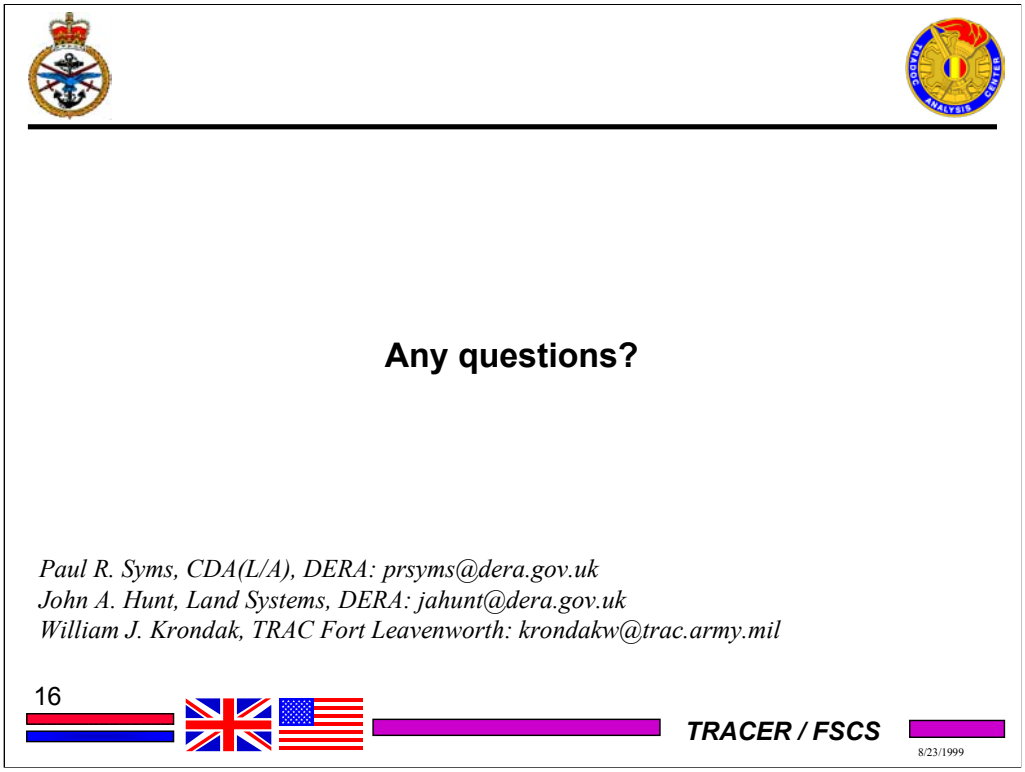


8.3.3. Segment three. Segment three will address any unanswered questions, update the analysis based on the emerging contractor proposals and provide the necessary information to inform the decision to move to the next phase in the development program. That decision will take place in mid-2002.

9. Cost analysis questions and approach. The chart above shows the cost questions and cost module approach. The costing method will include building a full life cycle cost estimate to include research, development, test, and evaluation (RDT&E), procurement, and operation and sustainability (O&S) cost for each alternative. In addition, the modules will include a training impact assessment, a logistics impact assessment, manpower requirements, and evaluation of the technology costs associated with the promising new technologies that may be applied to the scout system. The cost analysis will also include a module that assesses the costs of developing variants of the scout, particularly the UK guided weapon carrying variant.



10. Summary. The TRACER/FSCS combined analysis is an ambitious study but certainly one with high-level management and oversight. Several new or innovative methods are being used or explored. They include the integrated systems measures approach, the cost as an independent variable method, the common and shared scenarios, the development of non-traditional measures of effectiveness and performance, and finally the challenging integration of the results to meet the decision needs of the leaders in two independent nations. The challenge is great. We hope to be able to report out the results of this work to a future ISMOR.



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