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“Adapting C2 to the 21st Century”

Identifying And Assessing Appropriate System Architecture Options for Generic and Specific Mission Requirements

Cognitive and Social Issues / Organizational Issues /
C2 Metrics and Assessment

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1 Abstract

The aim of this paper is to describe work in progress on a project funded by the MoD Defence Technology Centre for Systems Integration and Integrated Systems for Defence: Autonomous and Semi-Autonomous Systems (SEAS DTC). The particular focus of the paper is a method for the development of a decision support system that shows how, for a particular instantiation of a Combat Search and Rescue (CSAR) scenario, the requirements for a CSAR mission can be assessed and the available assets measured in order to be able to select a system architecture that meets, at least in capability and attribute terms, what is required by the mission. The method is based upon the use of system attributes which are used to describe required capability, i.e. the so-called 'ilities'. Not only is there no consensus on a 'core' set of these system 'ilities' or attributes, many of them are not measurable directly and in this approach are interpreted in terms of other secondary attributes and contributing factors which are more easily measured, in order to generate evaluation techniques for various systems.

2 Introduction

This paper reports on work funded by the UK Systems Engineering for Autonomous Systems Defence Technology Centre (SEAS DTC). The SEAS DTC is operated by a UK industrial consortium and aims to research innovative technologies relevant to autonomous systems, at both whole-system and sub-system level and, through the adoption of Systems Engineering approaches, to facilitate pull-through of the technology into military capabilities.

The work reported in this paper contributes to the SEAS DTC project "Impact of Different Cultural Attribute Sets on S/AS Decision structures and interfaces". One thread of work within the project focuses on the impact of 'soft factors' relating to cultural values on communicating and implementing decisions and is described in more detail in Siemieniuch and Sinclair (2006) [15]. This paper reports on work carried out in Work Package 3 of the project, the aim of which is the development of a decision support system (DSS) that shows how, for a particular instantiation of a Combat Search and Rescue (CSAR) Scenario, the requirements for a CSAR mission can be assessed and the available assets measured in order to be able to select a system architecture that meets, at least in capability and attribute terms, what is required by the mission.

Decision-making during military operations, from the mission planning through to mission execution phases, has traditionally been done mainly by humans supported by a few notable automated decision-aid tools. These decision-aid tools have mainly been used for specialist applications such as mission planning, reactive defensive aids, carefree handling of aircraft, etc. Within the force structure it is increasingly likely that a much wider range of decisions will be made by lower ranks acting as autonomous units, or autonomous individuals, in order to enable shorter response times in the face of varying threats. This is partly the result of force transformation demands to achieve greater agility, enabled by concepts such as network centric warfare, and partly in response to the emerging asymmetric [1] and non-traditional warfare threats, both of which require fast response time and decentralised decision making.

With the continuing development of autonomous and semi-autonomous systems there are strong indications that military organisations will, in the future, field such systems where decision making is both human and machine based. It is already foreseen that military organisations will place an increasing reliance on such semi/autonomous systems (S/AS) for critical operational capabilities such as surveillance and communications. This trend can already be seen in, for example, the USA's increasing reliance on the Global Hawk autonomous platform for surveillance missions [2]. This has necessitated the development of decision-making strategies and algorithms to enable autonomy, both on board and between system platforms. Research to date has often focused on optimisation methods and learning methods, such as neural networks. However, all of these approaches have failed when trying to make a capability to enable autonomy. The factors contributing to a failed decision making attempt include limited processing speed and capacity to obtain an acceptable output from these methods, the complexity and multi-dimensionality of the problem, and the intrinsic architectural constraints of the system.

However, rather than focusing on 'Decision-making' within semi/ autonomous systems this research will address the issue of the provision of a Decision Support System that enables decision-making agents to assess mission requirements and then measure the available assets in order to provide the decision making agents with a set of system architecture options that meet, at least in capability and attribute terms what is required by the mission. These considerations fall under a particular branch of systems engineering, that of systems architecting.

2.1 Systems Architecting

A systems architecture refers to the structure of a system, much as a civil architect deals with the structure of the building. It is important to differentiate between a systems architecture and an actual system. By way of analogy, a cartographer's map is not the terrain, but rather is a useful abstraction for the purpose of navigation. A map is not concerned with detail such as individual blades of grass, or the number of windows in a building, rather it abstracts the features of the terrain up to a useful level of information for an observer, where the relative positioning of objects is more important than the physical appearance of them. A systems architecture deals with the overall functionality of the system at a level of abstraction that is useful to the architect. As Maier (2000) eloquently states, "Architecting deals largely with unmeasureables using non-quantitative tools and guidelines based on practical lessons learned; that is, architecting is an inductive process. At a more detailed level, engineering is concerned with quantifiable costs, architecting with qualitative worth" [12]. Qualitative worth implies that the level of detail required in individual subsystems is relative to the impact that they will have on the overall system towards the purpose of that system (and therefore ensuring client satisfaction).

From Maier (2000), "Systems architecting is a process driven by a client's purpose or purposes. If a system is to succeed it must satisfy a useful purpose at an affordable cost for an acceptable period of time" [12]. But what characteristics of a subsystem are important with respect to the function, cost and timeliness required for success? And how should these characteristics be measured? As discussed, at an architectural level it is the qualitative worth of a subsystem that is important, as opposed to the precise details. In this research we are not trying to establish an optimising methodology. Optimisation in general is best avoided, as due to the complexity inherent in systems designs it is probable that an "optimum" seldom, if ever, exists [12]. This is founded in the argument that no practical way may exist to obtain information critical to make a "best" decision among alternatives.

2.2 Mission Architectures

A military mission, simplistically, invariably involves achieving some objective in an environment where a friendly force and an enemy force exist (in competition with one another). In equally as simplistic terms, mission success for a friendly force could be thought of as requiring the friendly force to meet and exceed the capabilities of the enemy force and in so doing meet the mission's objectives. This "positioning for capability superiority" is similar in concept to the positioning for information superiority model proposed by Alberts, Garstka, and Stein [14], as shown in Figure 1.

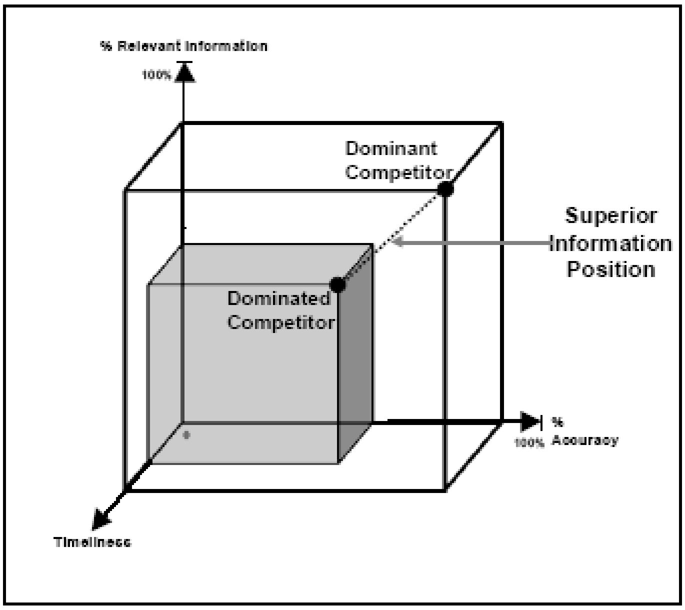

Figure 1: Positioning for Information Superiority. [14]

This model deals with gaining information superiority over an adversary, with three key metrics proposed: relevancy of information, accuracy of information and timeliness (of information). In simplistic terms, by outperforming the enemy for each of these metrics, information superiority is achieved. This doesn't provide an indication of likely success or failure, rather that a position of information superiority has been achieved and could therefore be exploited and translated into a tactical advantage.

This fits with Rechtin (1999), who defines such competition in architectural terms as, "an attempt by one system or organisation to equal or surpass others to gain something of value" [13]. In terms of this research the "something of value" would be defined in the mission's objectives. The idea that mission success could be enabled (as opposed to guaranteed) by considering competitive architectures in terms of qualitative capabilities is also lent credence by Rechtin (1999). On the subject of competitive systems Rechtin (1999) states, "Like economies and the art of war, it is primarily about relative levels between the competitors' capabilities rather than about their absolute values, sizable and important as the latter may be" [13]. This, in the context of military missions, would indicate that a higher level of abstraction will suffice for comparing competing systems, or comparing systems in the application of "what we need" against "what we've got".

3 Overview Of The Approach

To consider the issue of the provision of a Decision Support System that provides systems architecture options a number of steps were required. These are shown in Figure 2.

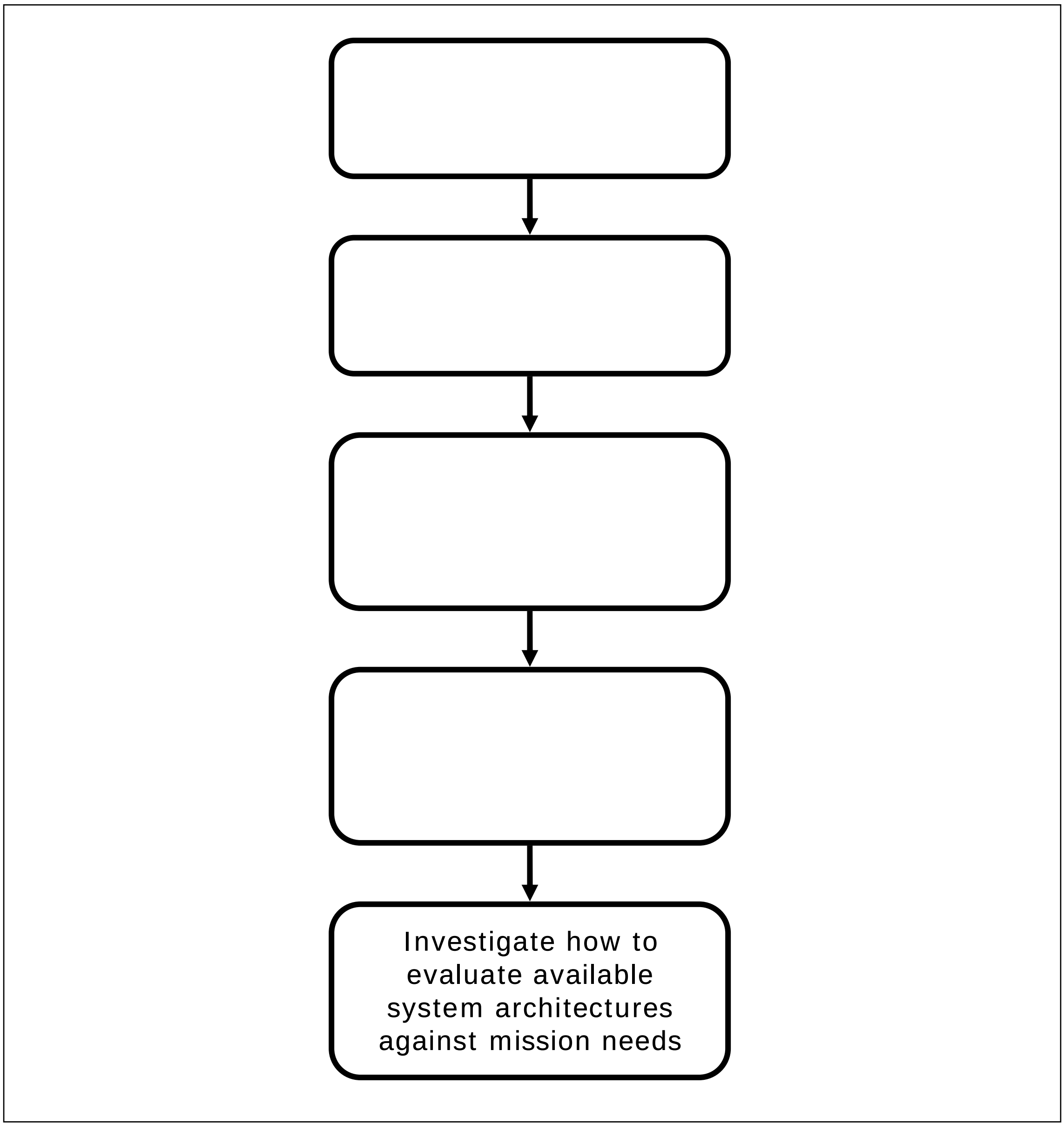

Figure 2: Overview Of Approach

This approach moves from gaining a functional understanding of a CSAR mission through to addressing how a particular mission and system can be characterised for evaluation purposes. A functional understanding was gained because it is solution independent and places an emphasis on required capabilities rather than platforms. The route followed to gaining this functional understanding, which was captured in a generic functional model, is shown in Figure 3.

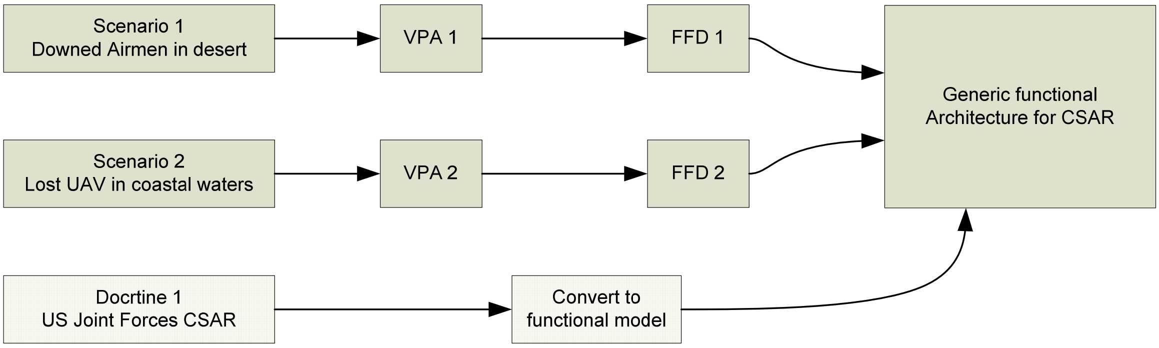

Figure 3: Approach Followed To Developing A Generic Functional Model

With a Generic Functional Model (GFM) for CSAR missions the next consideration was how the decision of what architecture to use for a particular mission could be supported. Decision making literature indicated that in time sensitive, risky environments the decision maker may not consider more than a couple of options at best. We concluded that the best way to support this decision would be to develop a decision support system that could present to the decision maker a number of architectural options which are functionally and characteristically suitable to conduct the mission. This in turn requires a methodology to assess available architectures against mission requirements, as shown in Figure 4.

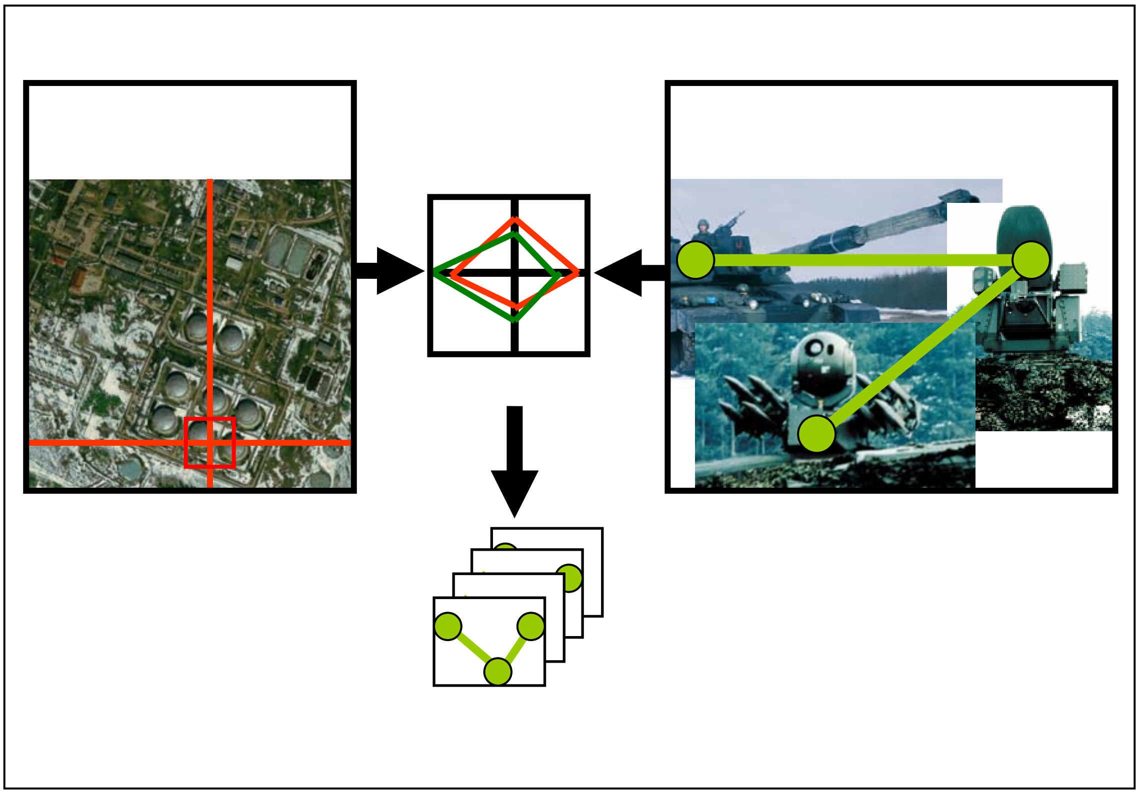

Figure 4: A Decision Support System

4 Development of the CSAR Generic Model

To consider how to support an effective decision making capability within an architecture a context was required. To ensure that the research would be valuable and applicable to the SEAS DTC a military mission was an obvious context to use. The majority of combat missions were deemed unsuitable due to security issues, especially with access to information. The Combat Search And Rescue (CSAR) mission was chosen as the initial context as there is a quantity of literature (including United States military doctrines) available within the public domain. An initial review of this literature indicated that the mission involved decision making in a variety of situations at various levels of authority, making it suitable for this research. CSAR is also an approved SEAS DTC vignette for research. Whilst the overall outcome of the research will be focused on CSAR, the less specific outcomes should be valid and applicable to a number of other mission types. There are a variety of CSAR definitions within the available literature, generally varying to some degree; a small selection of definitions is presented in Table 1.

Literature	**Definition**
Department of Defense Dictionary of Military and Associated Terms [3]	A specific task performed by rescue forces to effect the recovery of distressed personnel during war or military operations other than war.
Joint Doctrine Encyclopedia [7]	
Combat Search and Rescue [9]	CSAR is a specific task performed by rescue forces to effect the recovery of distressed personnel during major theatre war or military

	operations other than war (MOOTW).
Joint Tactics, Techniques, and Procedures for Combat Search and Rescue [8]	Combat search and rescue (CSAR) encompasses reporting, locating, identifying, recovering, and returning isolated personnel to the control of friendly forces in the face of actual or potential resistance.

Table 1: CSAR Definitions

Note that all of these definitions have a human focus. Due to the project focusing on S/AS, it seemed clear that the generic CSAR functional model would need to orchestrate CSAR missions consisting of both human and platform (non-human) targets. Therefore, the following definition was adapted from existing definitions for the context of this CSAR modelling work:

> "CSAR is a specific task performed by rescue forces to effect
> the recovery of assets isolated in hostile territory."

There is also a set of assumptions that accompany the above definition. These are as follows:

- "Hostile territory" refers to an area where opposing forces have the intent and capability to effectively oppose or react to recovery operations and/or threaten the isolated asset.
- The "territory" could include land, sea and littoral rescues, but space (as presently considered a demilitarised zone) and air (deemed unlikely) are excluded.
- An "asset" includes humans, platforms and data.
- "Isolated" refers to an asset when it becomes separated from its operational unit and is in danger of being captured.

4.1 Methodology

The research team had no previous experience of CSAR operations and so various analysis methods were used to help develop a greater understanding of CSAR. It was decided early on in the project that the team would disregard current literature until a self created view of CSAR had been established. This was to ensure that an appreciation of CSAR was gained without being constrained by existing ideas and approaches. It was not until the later stages that literature was used to verify the functional model created through this process.

To understand CSAR various analysis methods were used to build a visual representation of the mission, incorporating functional and non-functional requirements. This was achieved through the process depicted in Figure 5.

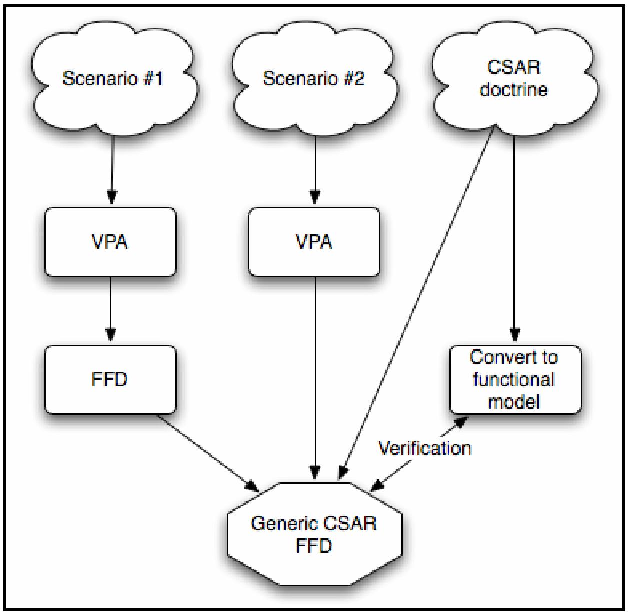

Figure 5: Process followed to create a Generic Functional Model.

The foundation of this process was the consideration of two very different CSAR scenarios, described in the following sections. These scenarios were analysed in turn using Viewpoint Analysis (VPA) to identify stakeholders, identify key mission requirements (non-functional requirements) and to create a functional, solution independent view of the scenario. The first scenario's functions, generated by the VPA, were then associated to each other to form a functional structure using Functional Flow Diagrams (FFD). This approach enabled an understanding, through visualisation, of how the CSAR system fitted together in terms of functions and their relationships.

The FFD's were decomposed down several levels of functionality until it became apparent that the desired level of detail had been achieved. This created a functional hierarchy for a CSAR mission with its associated non-functional constraints. This FFD was then re-examined with the second scenario's VPA to produce a second FFD encompassing both scenarios. From this a generic CSAR FFD, or Generic Functional Model (GFM), was developed which is applicable to a variety of CSAR missions. This was achieved by stripping out the mission specific language in each scenario to leave a set of generic stages which could cover multiple CSAR mission types. The GFM was verified functionally using available US CSAR doctrines.

4.1.1 Scenario 1: Downed Airmen Behind Enemy Lines

In this scenario a fighter aircraft has been hit by a surface to air missile over enemy territory in the desert. The pilot managed to eject and has landed in a hostile area. It is imperative that the pilot is found before she becomes captured by enemy forces and is used for propaganda purposes. A signal from the ejector seat beacon had been detected, limiting the initial search area to about 10km^2. The area where the ejector seat was detected was quite remote and there was unlikely to be any enemy forces in the immediate area until they could move troops in from nearby bases. This left a small time frame to rescue the pilot in before the enemy moved in. If the enemy did manage to quickly move a forward team into the area, it was likely to consist of lightly armoured vehicles and conscript soldiers. The downed aircraft had sensitive data and equipment on board that needed to be retrieved or destroyed. A diagram of this scenario is shown in Figure 6.

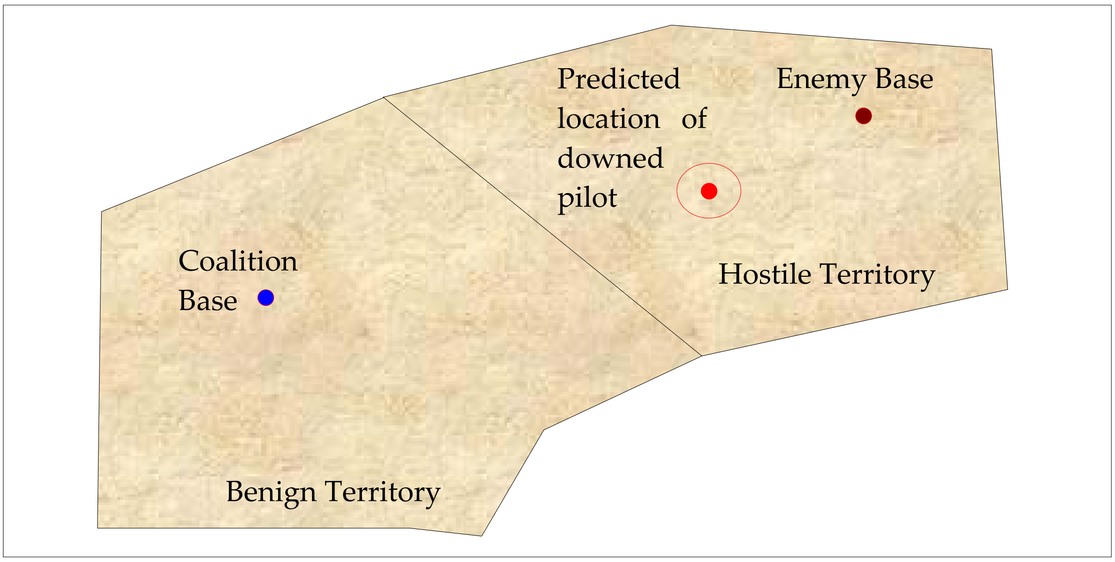

Figure 6: Scenario 1 map.

4.1.2 Scenario 2: Lost Unmanned Autonomous Vehicle

In this scenario communication had been lost with an unmanned, autonomous water borne vehicle in hostile coastal waters. It was presumed that the vehicle had broken down. The vehicle's last recorded position was known, but due to local currents the vehicle may well have drifted significantly from that position. If the vehicle was found by the enemy it could cause significant political problems, therefore it was important that the vehicle was either recovered or destroyed without being detected by hostile forces. The enemy had significant radar coverage and intelligence indicated that the enemy had coastal patrol boats in the vicinity. A diagram of this scenario is shown in Figure 7.

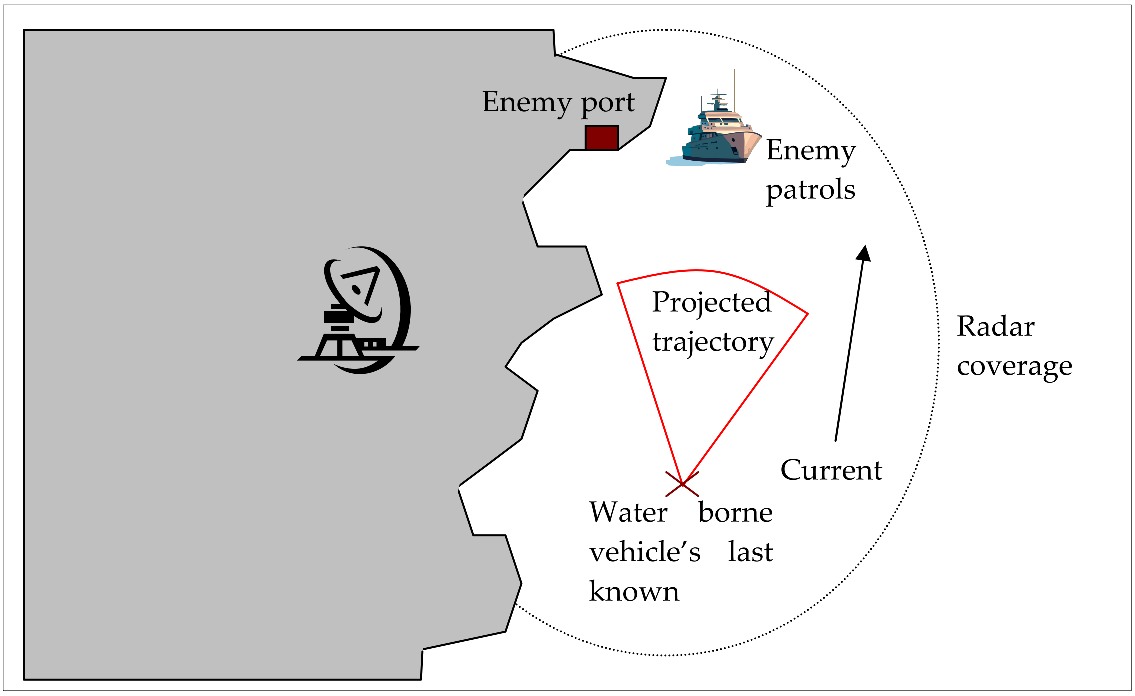

Figure 7: Scenario 2 map.

4.2 View Point Analysis

View Point Analysis (VPA) is a formulised brainstorming process through which a set of functional and non-functional requirements are generated [10]. VPA was used to brainstorm the key elements of a CSAR missions in terms of their functional and non-functional requirements. This approach helped to gain a holistic view of CSAR by considering the perspectives of each of the identified stakeholders in turn. The two CSAR example scenarios, as discussed previously, were used as a basis for the VPA and, due to the diverse nature of the two scenarios, helped produce a wide set of top level requirements. The two scenarios were intentionally left quite open, lacking the usual detail found in a real military operation, to help increase the scope of the top level requirements. The functional and non-functional requirements produced by the VPA were solution independent, i.e. they did not dictate how the scenario will be implemented in terms of equipment, but rather in terms of high-level functions such as 'engage with enemy' or 'detect distress signal'.

A number of key findings were made through undertaking VPA, including:

- A consideration of the wider strategic picture is required for CSAR. A CSAR mission can not be considered in isolation, there are always high level constraints such as international agreements.
- Common phases of CSAR were identified for both scenarios (which were later verified with US doctrine). Stripping out the mission specific language in each scenario left a set of generic stages which could cover multiple CSAR mission types.
- The scenarios highlighted common issues for both human and platform recovery. For example, the requirement to repair the unmanned asset in scenario 2 triggered an additional requirement to administer first aid to a human asset in scenario 1.

The top functional level of the CSAR mission is shown in Figure 8.

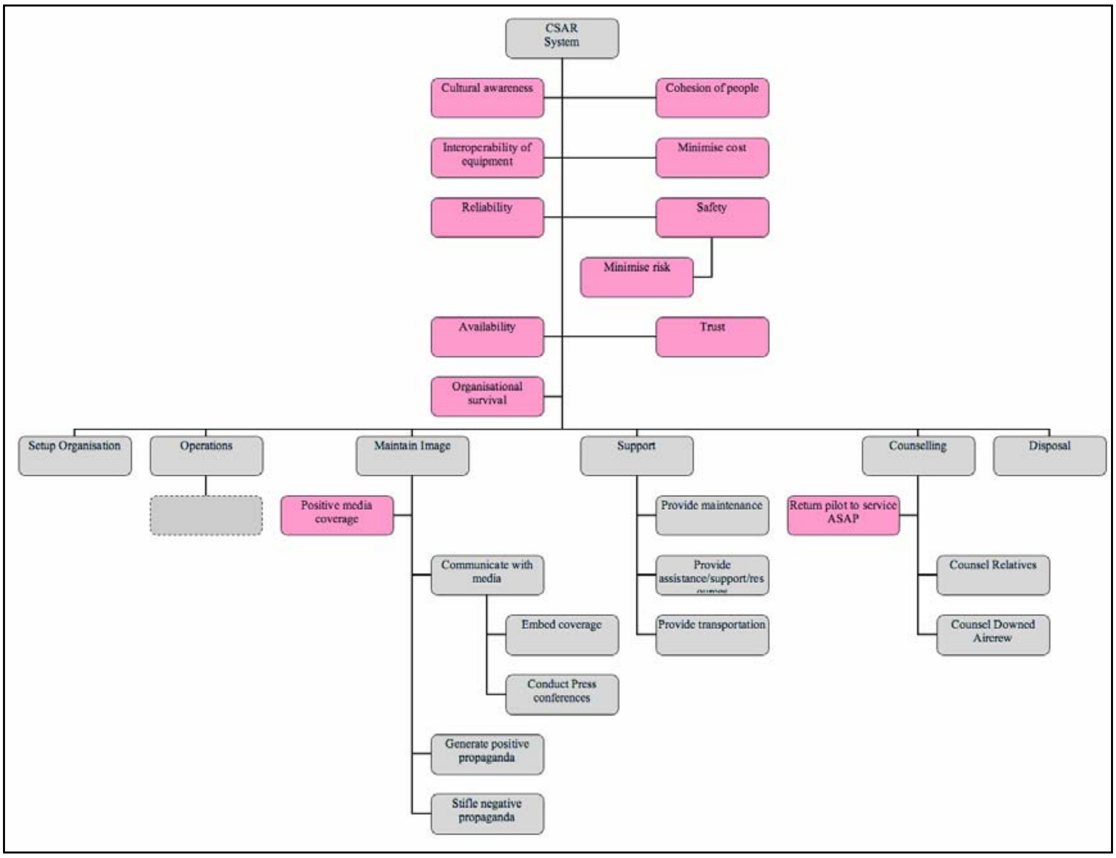

Figure 8: Scenario 1 CSAR mission overview VPA diagram.

Six key functions were identified for undertaking a CSAR mission, these were: Setup Organisation, Operations, Maintain Image, Support, Counselling and Disposal. To provide a focus and some bounding to our work the Operations function was selected for further detailing, as this was the function that actually "performed" the CSAR mission. The VPA diagram for Operations is too large to show in this paper, but provided a functional hierarchy for the Functional Flow Diagrams in the following section.

4.3 Functional Flow Diagrams

Functional Flow Diagrams (FFDs) are the product of a "top-down" structured functional modelling process and represent a system in terms of functions with inputs and outputs [11]. Producing FFDs allowed an understanding, through visualisation, of how the CSAR system fitted together in terms of functions and their relationships. An FFD diagrammatically represents functions (from the VPA) as ellipses with interlinking information flows. Each diagram is set at a particular functional level of the system, as determined by the hierarchy developed in the VPA. A functional ellipse can be explored in greater detail by creating a new FFD at a functional level below it. The process of producing FFDs helps to ensure consistency in the flows between functions and sub-functions.

Initially the FFDs for the first scenario were produced, based on the VPA for that scenario. This model iteratively evolved over time as the team's thinking matured, aided by the rapid methodology of FFDs. When this first set of FFD's was produced the team defined the areas of interest within the CSAR system, allowing certain functionality to be drilled-down several levels until a desired level of detail had been achieved (e.g. for clarification of what was involved with a particular function). These FFDs were then re-examined with the second scenario's VPA to produce a second FFD encompassing both scenarios. An example of one of the FFDs produced in shown in Figure 9.

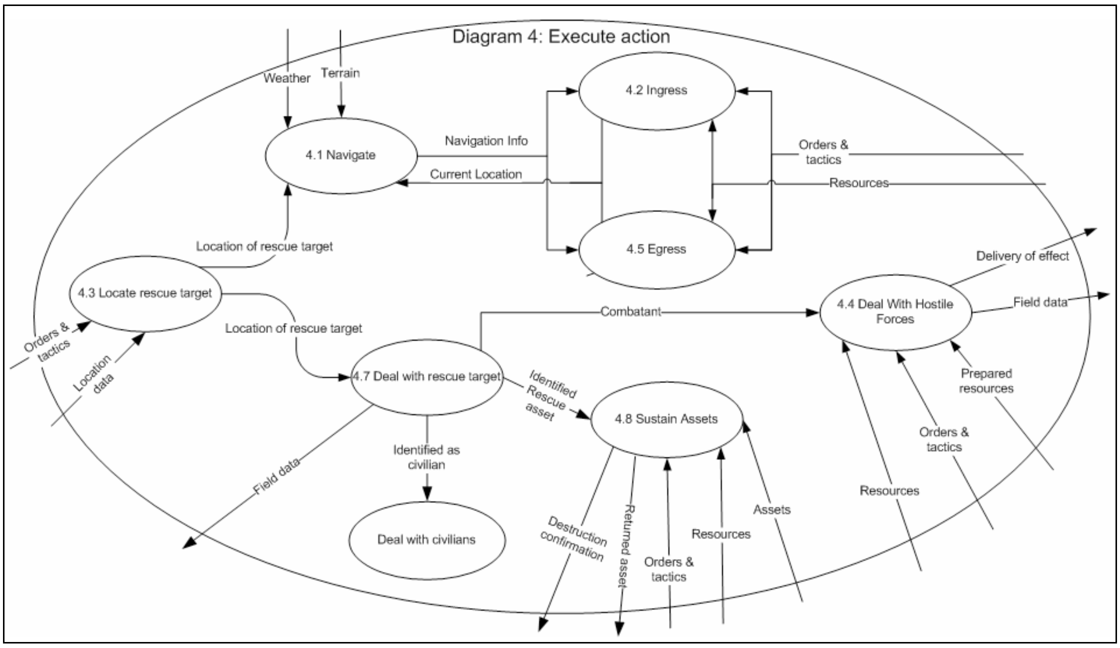

Figure 9: The Execute Action FFD.

The FFD at the highest functional level is called a context diagram, which shows the whole system and its interfaces with the environment. The FFD for both scenarios, showing the overall CSAR system, is shown in Figure 10.

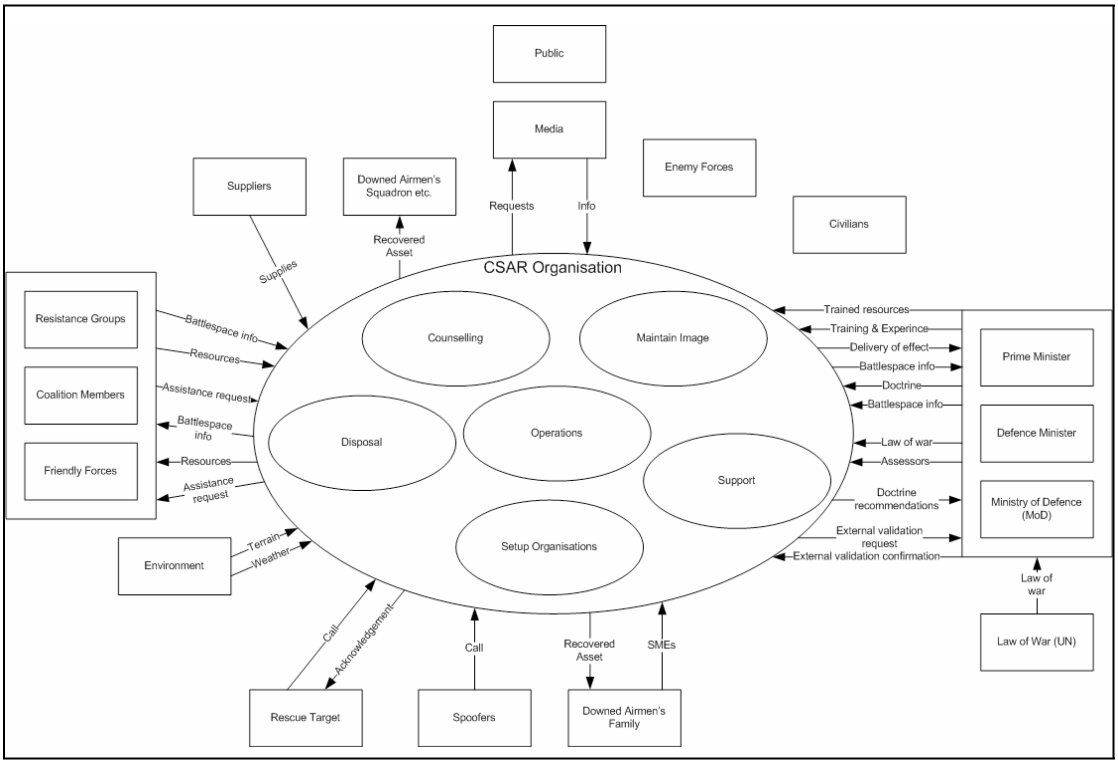

Figure 10: CSAR Context Diagram.

4.4 A Generic Functional Model

By looking at the two scenario specific functional models, we were able to develop a generic CSAR functional flow diagram or Generic Functional Model (GFM), applicable to a variety of CSAR missions. This was achieved by stripping out the mission specific language in each scenario to leave a set of generic stages which could cover multiple mission types. The GFM represents our current understanding of CSAR and will continue to mature as the research progresses. Whilst the model is generic at the higher common levels it should be noted that as the model becomes more detailed it becomes more mission specific. The FFDs generated for the different CSAR scenarios showed that whilst every CSAR mission is unique at the more detailed levels, there were clear commonalities at the higher levels of abstraction. The GFM captures these high level commonalities, enabling it to support the majority of CSAR missions and hence providing a starting point for the development of the architecture(s) to be used for a particular CSAR mission.

4.4.1 Verification Of The Generic Functional Model

Once the GFM reached a reasonable level of maturity, it was verified through functional analysis with the available DoD CSAR doctrines, a summary of the key Joint Operations doctrines are shown in Table 2.

Doctrine	Scope
Joint Tactics, Techniques, and Procedures for Combat Search and Rescue [8]	Describes the Fundamentals of Multinational Operations Reviews Multinational Command Relationships Discusses the Considerations During the Planning and Execution of Multinational Operations Covers Operational Considerations
Doctrine for Joint Combat Search and Rescue [5]	Describes Combat Search and Rescue (CSAR) Responsibilities and Command Relationships Explains CSAR Procedures and Methods Outlines Coordination and Planning Procedures Defines CSAR Intelligence and Support Requirements Details CSAR Capabilities of the Services and Special Operations Forces
Joint Doctrine for Evasion and Recovery [6]	Provides General Evasion and Recovery Considerations Covers the Moral, Legal, and Operational Guidelines for Evasion Discusses the Philosophy and Considerations of Recovery

Table 2: Relevant CSAR Doctrines used for verification.

This was to ensure that the GFM reflected the current military approach to the mission, which incorporated what had comprehensively been tried, tested and learnt in the field. Differences between the GFM and literature were identified and improvements were fused into the GFM to enhance its scope and functionality. This literature based verification will be built on by consultation with appropriate subject matters experts.

5 A Decision Support System

Using the context of CSAR missions we have considered decision-making processes for determining what architectures are appropriate for a particular mission. We have recognised that CSAR missions are typically reactive missions and are often time sensitive. We have helped with the planning of CSAR missions by capturing the functional requirements for conducting the majority of CSAR missions in the GFM. When a CSAR mission is initiated the GFM can be reduced to the functions required to conduct this particular mission. This in turn will start to suggest appropriate courses of action (COA) based around the functions needed to complete the mission. As a reactive mission and due to the time constraints and immediacy of CSAR operations it will not be possible to predict what assets are available for a particular mission save for the specialist, dedicated CSAR platforms. When a mission is initiated it will be necessary to determine what resources (platforms, people, supplies etc.) are available to the CSAR organisation. As stated previously, whilst the GFM provides an initial picture of what's required functionally to complete the mission it will be necessary to assess and modify this with respect to the particular requirements of this mission. This can then be interpreted in terms of the capability that the mission demands and leads to a consideration of how to characterise and assess available architectures against these demands. This balancing of considerations to output architectural options is shown in Figure 11.

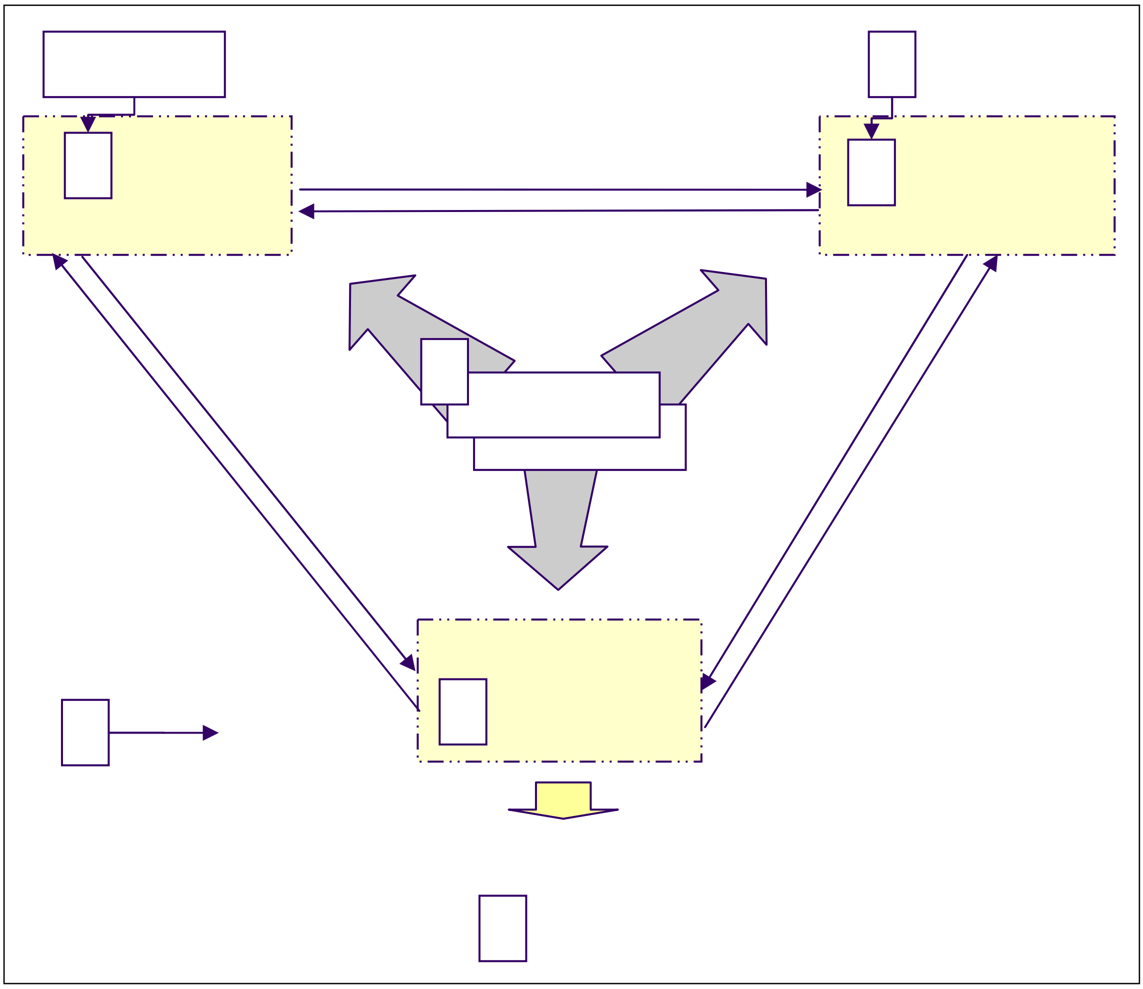

Figure 11: The Decision Support System

This decision is critical as a poor selection or structuring of the system's architecture could result in it being unable to meet, in functional terms, what is required by the mission. For the majority of CSAR missions this functional understanding has been captured in the developed GFM. However, a mission does not just require a system's architecture to be functionally fit for a particular mission. It also requires more qualitative capabilities, such as adaptability and interoperability, i.e. the so-called 'ilities'. These capabilities can be exhibited by a system's architecture and may be required by a mission. We can describe these required capabilities through 'system attributes', a proposed selection of which are shown in Table 3.

Attribute Name	**Attribute Description**
Availability	The quality of being functionally capable when

	needed.
Integrity	The quality of being whole and complete through adherence to and maintenance of a value set.
Interoperability	The ability of two or more systems to work together through exchanging information.

Table 3: Some Proposed Attributes

A system needs to achieve a set of goals. In order to achieve the goals it must demonstrate a set of attributes. An attribute is a high level (macro) characteristic or property of the system. An attribute is not normally measurable directly because of its scope or subjectivity. We propose that attributes can be measured through the interpretation of other secondary attributes and contributing factors which are more easily measured (through direct measurement or subjective assessment) in order to generate evaluation techniques for various systems. A set of proposed secondary attributes for the Interoperability attribute are shown in Table 4.

Secondary Attribute Name	Secondary Attribute Description
Adaptability	The degree to which a system can change in response to the environment.
Communication	The degree of language commonality
Confidence	The ability to be trusted by other systems.
Flexibility	The ability to employ multiple ways to achieve a function and to select between these based on the circumstances.
Integration	The degree of cultural and systems interfacing.
Resilience	The degree to which a system can recover from a perturbation in its environment.
Robustness	The degree of tolerance that a system has to continue functioning when subjected to perturbations in its environment.
Security	The ability to protect against the unauthorized use of and prevent unauthorized access to the systems and it's subsystems.
Situational Awareness	The knowledge of other systems in the environment
Timeliness	The ability to functionally achieve something within a predetermined or favourable timeframe.
Trustability	The ability to believe in the reliability, truth, ability of other systems.

Table 4: Some Proposed Secondary Attributes

A factor is a low level (micro) characteristic or property of a system, a number of which can be considered to contribute to a representation of an attribute. Many of these relevant factors are for 'soft' issues which are not necessarily measurable but for which rational subjective judgement can be applied. The approach does not separate out 'soft' from 'hard' issues – rather it recognises that the various attributes can be affected by factors from across the whole soft/hard spectrum. Some proposed factors for the Security secondary attribute are shown in Table 5.

Factor Name	Factor Description
Physical Security	The security of the physical system from theft and espionage.
Electronic Security	The security of the system from electronic influence and damage.
Data Security	The security of the data stored and used within the system.
Network Security	The security of internal and external network connections of the system.

Table 5: Some Proposed Factors

The CSAR mission is set in a number of scenarios such that the detailed objectives of each specific mission can vary from the initial generic set and can be identified for each application. This leads to an awareness that differing levels of capability can be defined for these specific missions: this is interpreted as variations in weightings applied to the set of appropriate attributes, secondary attributes and factors. The relationship between attributes, secondary attributes and factors are shown in Figure 12.

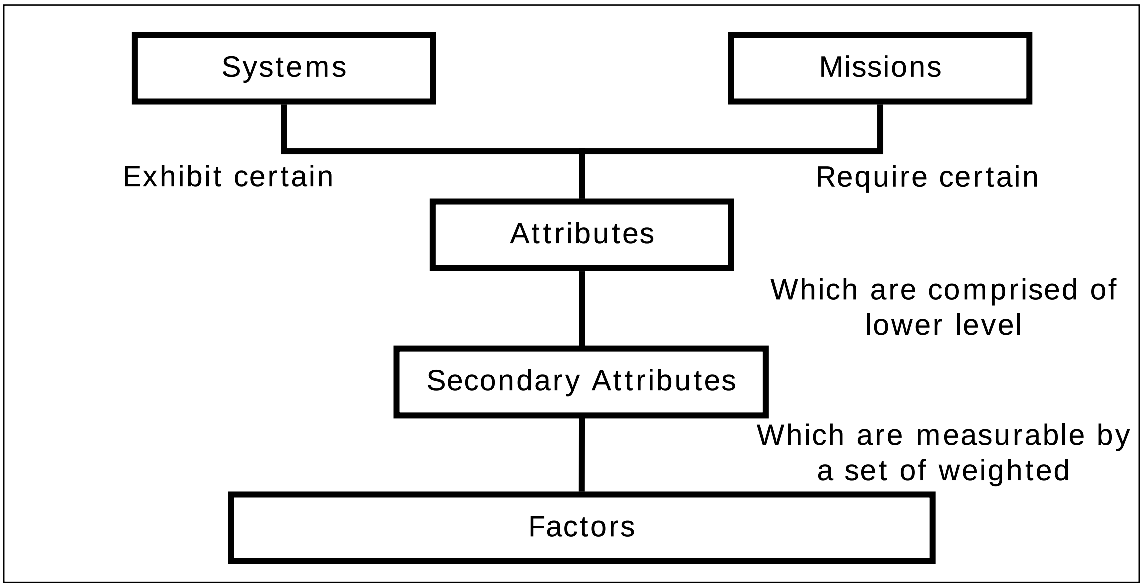

Figure 12: Relationship Of Terms

This approach characterises the 'demand' side of the assessment of suitable systems and the functionally based architectures which may underpin them. At any time, some given resources or assets are made available to carry out a particular CSAR mission. These assets may or may not have the skills and competencies needed to carry out a particular mission. For a particular CSAR mission architecture various combinations of assets can be brought together to form a system to carry out the specific mission. In order to assess the suitability of the available system alternatives, they can be assessed in terms of the same attributes and factors as used above. When matched against the mission 'demand' requirements an evaluation can be carried out to assess the suitability of a chosen system and to identify appropriate architectures to integrate available assets for a particular mission. Note that this assessment may indicate that the available assets are unsuitable to complete the mission with. Whilst this evaluation process won't give an indication of likely success it will show if an architecture is functionally and characteristically suited to conduct the mission.

It is likely that, during a specific mission, circumstances may change or objectives may be altered. This decision support system can be used at any stage of the mission, from planning to completion to re-assess the best use of assets in order accommodate changes in circumstances or mission objectives. At the moment we're considering how to support the decision of what system architecture to use before the mission starts and hence are only considering lead measurements. Lag measurements will be of use for during and post mission assessment but this is beyond the scope of our research at the moment.

6 Conclusions

We have shown the development of a Generic Functional Model (GFM) for Combat Search And Rescue (CSAR) missions. We have used this model to consider how to evaluate available architectural options against a particular mission's capability requirements. We have investigated how best to describe and measure capability through the use of systems attributes. These attributes have been recognised as being complex and difficult to measure directly and so we have introduced secondary-attributes and factors to better describe these attributes and allow the measurement of them through interpretation. Defining these characteristics and their relationship from attribute down to factor is work in progress and we will update this draft paper to reflect this work for our final submission.

7 References

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