On the Need for White Force Multipliers

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ABSTRACT

Synthetic training exercises, not unlike live exercises, require extensive planning, preparation and management in order to provide trainees with effective training experiences. These activities are performed by training facilitators, commonly known as the White Force. For many exercises, White Force personnel far outnumber the training audience, and the limited availability of White Force personnel places an upper-limit on exercise size, scope and fidelity. This paper examines the White Force activities in previous Australian synthetic training exercises, and builds the case for further development of White Force technologies and techniques. It is the premise of this work that developments leveraging White Force personnel will directly improve the cost effectiveness of synthetic training.

1.0   INTRODUCTION

Military training exercises require two kinds of people to be involved – trainees and facilitators.
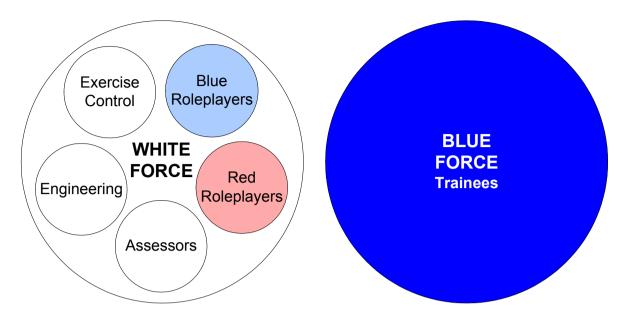
This report considers the specific role of people who facilitate distributed simulation exercises. An example of such an exercise would be the Black Skies exercise series that has been used by the Defence Science and Technology Organisation (DSTO) to research synthetic collective training tools, techniques and benefits. Exercise Black Skies 2010 included scenarios for training an Air Battlespace Management (ABM) team comprising five trainees. The training was facilitated by a large contingent of White Force personnel including two subject matter experts (SME) for scenario design and exercise control, two ABM assessors and eight simulation operators who managed computer-generated entities within each scenario [1]. The White Force outnumbered trainees by more than two to one and yet was considered necessary to provide the environmental complexity and interactivity that was required to effectively train the team.

The burden of facilitating collective training remains significant and expensive. Simulation exercises, similar to live exercises, require extensive planning, preparation and management in order to provide trainees with effective training experiences. It is the premise of this work that developments which leverage White Force personnel will directly improve the cost effectiveness of training.

2.0   WHO ARE THE WHITE FORCE?

The term White Force is commonly associated with military training exercises but may be interpreted differently depending on the country, service or domain context in which the term is used. DSTO's Aerospace Division have initiated an enabling research program to investigate how collective training using synthetic environments can be made more accessible by reducing exercise facilitation overheads. To that end, it is convenient for us to define the White Force as being the whole range of exercise participants that facilitate simulation-based exercises apart from the training audience themselves (Figure 1). This White Force definition has a broader scope than that which is used within most military training environments but it is reasonable and serves well to guide the scope of our research activities.

White Force: the whole range of exercise participants that facilitate simulation-based exercises apart from the training audience themselves

Figure 1 A scope definition for the White Force

Overlapping White Force definitions found in the literature include:

- a team of experts who facilitate training including exercise management, technical liaison and role players for both friendly and opposing forces [2]

- a team of experts who organise and run large-scale live training exercises [3]

- exercise management, and a team of operators who simulate other participating units [4]

- an umpiring force made up of programmers, controllers, and evaluators, who have access to a variety of truth data [5]

It is understood that other contexts have used the term White Force differently to describe opposing forces, safety observers, or civilian/non-combatant forces in a military exercise.

3.0 WHAT DO WHITE FORCES DO?

The activities undertaken by a White Force depend upon many factors including the scope of a particular exercise and the availability of relevant artefacts from previous exercises (Table 1).

Table 1 Some factors that influence White Force activities

Similarity to previous exercises	Exercise duration
Training paradigm	Technical constraints
Training audience diversity	Time constraints
Training objectives	Security constraints
Trainee skill level	Budget constraints
Number of trainees	Data availability
Stakeholder expectations	SME availability
Scenario complexity	Policy

Activity descriptions have been documented using Unified Modelling Language (UML) Use Case diagrams to characterise examples of White Force behaviour. UML Use Cases describe a sequence of actions that typically provide some result of measurable value [6]. Figure 2 below, for example, describes an actor or person with the role of Exercise Manager interacting with a Use Case named Control Scenario. That activity in turn makes use of other activity sets, or Use Cases, for managing exercise event triggers and monitoring events as they occur within scenarios.
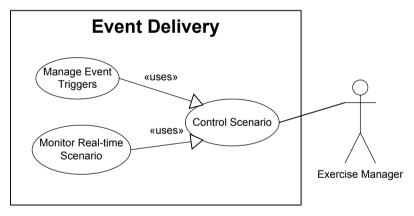

Figure 2 Example White Force Use Case

Utilising UML notation in this way, White Force activities for two simulated military air-operation exercises were captured and are summarised in Appendix A. White Force Use-Cases fell into three exercise life-cycle phases that we have named Event Preparation, Event Delivery and Post-Event Analysis. The Use Case diagrams and White Force SME interviews yielded the following list of White Force activities that commonly take place in support of an exercise.

EVENT PREPARATION

Identify constraints   The White Force identifies, tracks and deals with constraints that limit the employment of various synthetic environment assets for planned exercise scenarios. For example, if a participating simulator is only able to display a limited number of ground targets, then that technical constraint should be taken into account when assigning training missions to that entity.

Develop exercise plans and scenarios   The White Force should take into account all elements within the training audience and translate their training needs into exercise plans and scenarios. The planning process should map training objectives to scenario elements within the constraints of the synthetic environment.

Generate scenario-specific artefacts   The White Force may need to prepare a broad range of artefacts specific to each exercise scenario. The artefacts may include maps, operational data and other planning documents, tasking orders, check lists, assessment plans and briefing materials. Artefacts from previous exercises may be re-used if appropriate.

Prepare the synthetic environment   The synthetic environment will be prepared to meet exercise scenario requirements. This activity will include configuring simulations with the correct exercise data including entity visual and electronic orders of battle, terrain databases, and representation of military systems. Computer Generated Forces (CGF) applications will be configured to implement scenario plans. The SISO sponsored Distributed Simulation Engineering and Execution Process [7] captures several elements of this preparation process from a high level perspective. An engineering overlay should be applied to manage the federation configuration and ensure that it is fit for the purpose of the exercise.

Arrange event logistics   Administration tasks are beyond typical definitions of White Force but the activities remain necessary for facilitating distributed simulation exercises. Joining instructions should be prepared and issued. Long-haul distributed simulation may imply out-of-hours operation requiring catering and special security arrangements to be managed. White Force staffing may need to be managed.

EVENT DELIVERY

Control the scenario	The White Force will generally control scenarios during an exercise to meet training objectives. A typical large-scale White Force division of responsibility would be to have an Exercise Director responsible for overall exercise coordination and a Blue Force commander and Red Force commander to coordinate related role players. This team, which might collectively be called EXCON or Exercise Control, will generally monitor the tactical situation in real-time and control the training experience through various scenario manipulations.
Role-play unmanned scenario elements	Distributed simulation training scenarios often include roles that are not found amongst the training audience. Subject matter experts have typically been used to simulate roles that require verbal communication or complex decision making behaviour. Role-players may be used by the White Force to simulate friendly, opposing and neutral entity behaviours.
Control Computer Generated Forces (CGF)	Software may be used to simulate the behaviour of unmanned scenario elements either autonomously or more commonly semi-autonomously. Entities generated by such software applications are commonly referred to as constructive CGF or Semi-Automated Forces (SAF). It is common for a single role-player to control multiple SAF entities simultaneously.
Conduct familiarisation training	The White Force may lead new trainees and role-players through an induction process to familiarise them with systems that they are to use throughout an exercise. The systems may include CGF applications, simulation devices and tools for planning, briefing and after-action review.
Support mission planning, briefing and debrief	If the training objectives include planning elements then the White Force may need to provide a trainee planning environment that simulates aspects of real-world planning conditions. Similarly the White Force may need to support trainee briefing activities with products derived from the synthetic environment.
Troubleshoot / Monitor simulation system performance	Collective training exercises typically depend upon a complex synthetic environment that is comprised of a diverse assortment of simulation systems. Engineering staff within the White Force generally need to monitor simulation systems during the execution phase of current exercises so that technical issues can be addressed in a timely fashion to maintain training effectiveness.

Monitor trainee performance	The White Force will monitor each scenario to ensure that training objectives are being met. Trainee performance may be observed in order to assess proficiency and/or to enhance training via scenario tailoring and feedback.
Record observations	The White Force may wish to record observations during an exercise to inform either after-action review or post-exercise analysis. The observations may include subjective training assessments and training system performance data.
Implement dynamic scenario innovations	The White Force may choose to deviate from their scenario plans during an exercise. Dynamic scenario innovations may be required to address, for example, arising simulator issues or unanticipated trainee behaviour. The scope for such innovations is limited only by the imagination of the White Force and its ability to dynamically change or introduce new elements into the synthetic environment.
Manage audio/visual systems	The White Force may choose to exploit various audio/video streams during execution and after-action review phases of the exercise. The management of audio/visual systems will be very dependent on available technology. Tasks may include identifying relevant streams/events for display and management of display real-estate.

POST-EVENT ANALYSIS

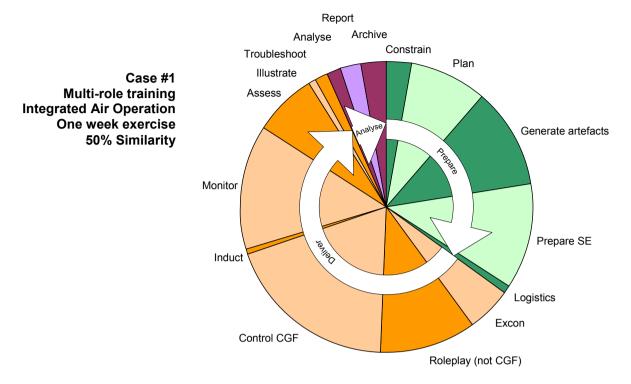| **Analyse event records**	Synthetic exercises can be a rich source of data regarding collective team behaviour. The data may also be analysed to identify opportunities to improve the system of training. White Force members may be required to undertake post-event data-analysis.
Make recommendations	It is particularly useful for the White Force to identify and report on lessons-learned during the course of an exercise, particularly if the exercise introduces new or modified features to the system of training.
Store exercise artefacts	Artefacts from an exercise may be stored for reference, further analysis and reuse in future exercises. Exercise artefacts may include recorded data, planning products, briefing materials, simulator configuration files and other documentation. The White Force may be tasked with managing these assets.

A White Force activity model was built using the preceding breakdown. The model was populated using estimates from observers and White Force participants for a range of simulation exercises. Figure 3 presents model results indicating the relative allocation of resources for different types of exercises.
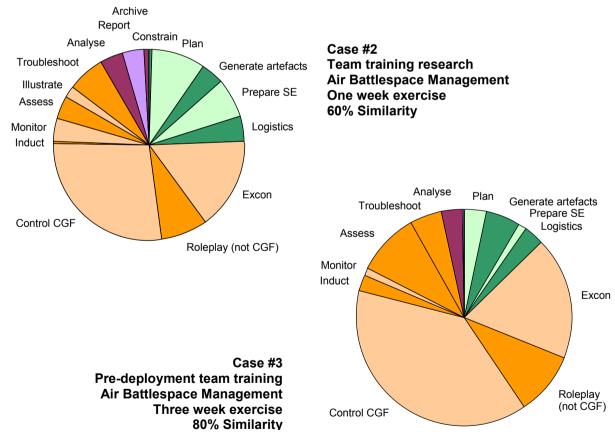
Figure 3 Relative White Force resource allocations – estimated, not measured

The model indicates that exercise similarity compared to previous exercises mostly impacted upon the preparation phase. Re-use of previously developed artefacts, such as scenarios, plans, configuration files and documentation dramatically reduced the exercise preparation time. Exercise delivery resources were mostly driven by the total size of the White Force and duration of the exercise. All of the examples presented in Figure 3 employed significant White Force cells to control Red and Blue constructive CGF. The need for post-event analysis varied considerably amongst the exercises. Exercises with a research or experimentation component consumed more post-event effort.

4.0   WHY DO WE NEED TO MULTIPLY THE WHITE FORCE?

Put simply, there is a need to multiply White Force capability because expert White Force staff are a limited resource who are critical for effective collective training.

Synthetic exercise best-practice advice, distilled from years of distributed training experience, advocates that exercises should be facilitated by a professional White Force comprised of experts in related military operational and technical domains. The US Distributed Training Operations Centre (DTOC) report that maintaining a trained persistent White Force was a key factor in making the Distributed Mission Operations (DMO) training model successful [8]. UK research similarly identified that the provision of a core White Force team, with current tactical experience and an understanding of the implications of distributed synthetic training, was a key element to the success of their Mission Training through Distributed Simulation (MTDS) system of training [2].

Maintaining a large persistent White Force with relevant expertise can be expensive. It is possible to extend the White Force for an exercise by drawing on front-line operators to act in a White Force capacity, but those resources are difficult to obtain during times of high operational tempo and operators assigned to White Force express reluctance to act as a training aid for other units. Sometimes the necessary combinations of expertise, operational knowledge and training abilities will not be available for an exercise. Effective White Force expertise is scarce.

Therefore, White Force people can easily become overloaded as they strive to generate a rich synthetic environment for the training audience. Extensive anecdotal evidence suggests that constructive entities, either automated or driven by White Force role-players, frequently exhibit unusual behaviour that detracts value from training exercises. Best et al [9] observe that communication bottlenecks can become a problem particularly when a single role-player controls multiple formations of synthetic entities. In the case of DSTO-sponsored Exercise Pacific Link 2, researchers observed unrealistic behaviour in the form of missed radio calls and slow verbal responses that affected the ability of trainees to engage with the scenario. Tracey et al [10] report on a subsequent exercise, Black Skies 2008, where trainees stated that they sometimes had to modify their behaviour to account for the unrealistic behaviour of entities within the synthetic environment. Trainees suggested that the complexity and fidelity of the synthetic environment fell short of real-world characteristics despite a comprehensive team of Red and Blue role-players. Researchers observed that, under high-workload conditions, role-players simplified their control strategies and shed certain tasks including maintaining entity situation awareness and communications tasks. It was concluded that these unfulfilled tasks reduced the realism of the training scenario.

There has been some hope that as the training community for an exercise grows more diverse there will be less need for the White Force to represent missing training elements within scenarios. While this is true to an extent, it is also true that diversity within a training community also introduces diverse training needs that are sometimes hard to reconcile. For example, a C2 element may have a need for combat aircraft to be in-scenario for a long period of time to build up their air picture, while air-combat elements would find that use of time very inefficient and would rather use their time for focussed air-combat training. Often the easiest way to resolve diverse training needs has been to meet incompatible training objectives with separate

scenario elements driven by the White Force – thus a larger and more diverse training audience can easily increase the White Force footprint. The DTOC, for example, found that adding a new training participant "often required an exponential increase in the amount of mission planning and White Force support" [8].

Bui and Taylor [11] make the case that as complexity continues to increase and simulation plays an increasingly important role in training, so too will the costs of failure and the burden upon White Forces increase. With White Force expertise being necessary, scarce and overloaded, it follows that technologies and techniques that enhance White Force capabilities are required in order to provide better access to improved training at reduced cost.

5.0   WHAT IS A WHITE FORCE MULTIPLIER?

We have coined the term 'White Force multiplier' to mean any technology or technique that leverages a given investment in White Force resources to provide improved White Force capability.

Best et al [9], for example, propose intelligent teamed agents with voice recognition and machine speech to reduce role-player manning requirements. McCall et al [12] call for improved scenario authoring tools, fully automated synthetic team-mates and automated performance assessment tools to reduce the overall requirement for White Force. Numerous similar suggestions may be found in the literature. Such proposals align well with the requirements for White Force effort as illustrated earlier in Figure 3.

A comprehensive exploration of the relationship between technology trends and White Force requirements will be reported on separately. However, our observations so far lead us to suggest that White Force multipliers should be sought to reduce effort required for the following general activities:

- Exercise preparation
- Exercise control
- Role-playing and management of synthetic forces
- System monitoring, and
- Trainee performance assessment.

6.0   CONCLUSION

The case has been made that professional White Force personnel are necessary to provide effective synthetic collective training, and that White Force limitations directly constrain the ability of an organisation to deliver timely cost-effective training experiences. We have found it useful therefore to define the simulation exercise White Force with a broad scope to identify opportunities for White Force multiplier research.

White Force activities have been identified for exercise preparation, exercise delivery and post-exercise analysis phases. Exercise resource requirements were observed to depend upon many variables. However, for all exercises considered, the most resource-intensive activity was the employment of role-players, with and without constructive entities, to deliver a synthetic training environment that adequately represented the training domain. We are particularly interested therefore in technologies that have potential to multiply the present capabilities of professional White Force role-players. Successful development of White Force multipliers throughout the exercise life-cycle should drastically reduce the cost and time required to facilitate synthetic collective training exercises.

7.0 ACKNOWLEDGEMENTS

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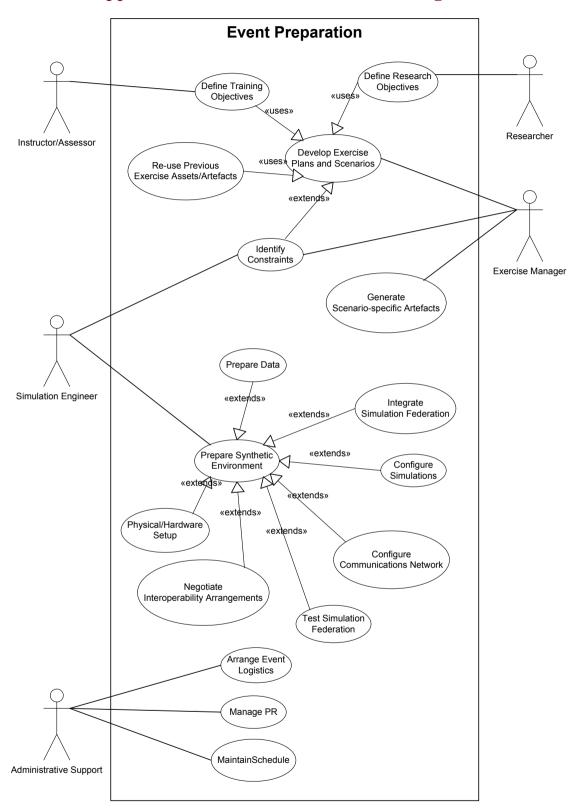# Appendix A – White Force Use Case Diagrams
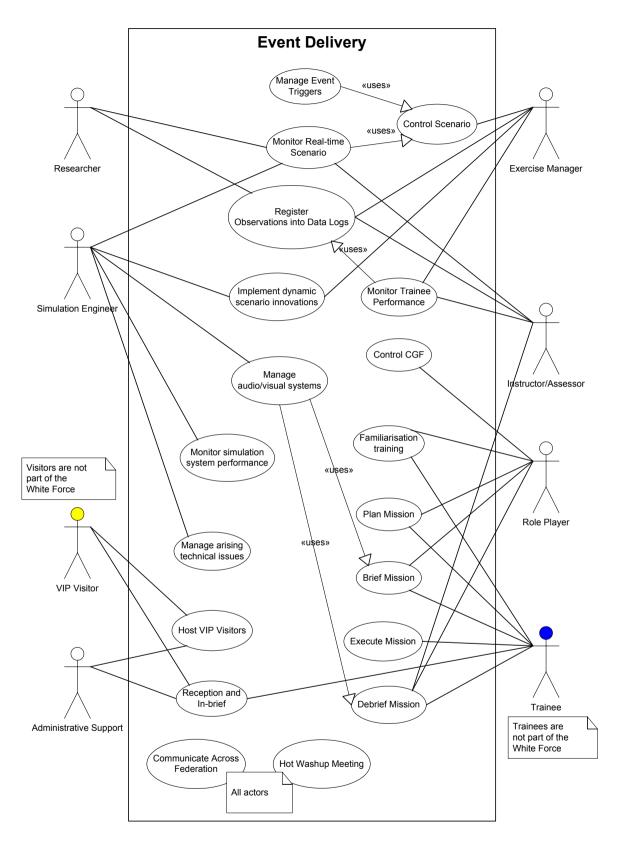

Figure A-1 Event Preparation Use Cases
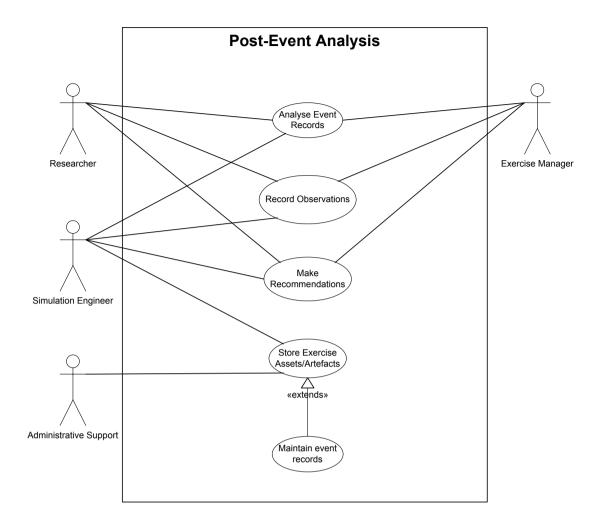
Figure A-2 Event Delivery Use Cases

Figure A-3 Post-Event Analysis Use Cases