Simulation Verification, Validation and Accreditation Guide

Australian Defence Simulation Office

Department of Defence, Canberra

Copyright Notice

The principle author, Darren Mc Farlane, would like to recognise the contributions made by the following Defence members. Your support is greatly appreciated.

Cliff White	John Loughhead	Tom Wickham	Rob Carpenter

Australian Government
Department of Defence

Foreword

The Verification, Validation and Accreditation Guide (VVAG) provides a source of initial information and advice in relation to formal confidence building in Defence Simulation in support of the nine applications areas cited in Defence Simulation Policy DIG (OPS) 42-1. The Guide also directs the reader to where more detailed information and advice can be found.

The VVAG is a living document and will be updated as required given changes in policy and guidance. Comments or further clarification on any aspect of the VVAG are welcomed. Please complete the evaluation form at the back of this document.

Cliff White
Director-General, Simulation
Australian Defence Simulation Office

Telephone: (02) 6265 2019
Facsimile: (02) 6265 2223
Email: cliff.white@defence.gov.au

Table of Contents

1 Introduction 1

1.1 Background 1
1.2 Purpose of the Verification, Validation and Accreditation Guide 2
1.3 Relationships to other Documents 3

2 Introduction to Simulation Verfication, Validation and Accreditation 4

2.1 Introduction to Simulation Accreditation 5
2.2 Introduction to Simulation Validation 6
2.3 Introduction to Simulation Verfication 7
2.4 Independent Simulation Verification and Validation 8
2.5 Configuration Management 8
2.6 Simulation Data 8
2.7 VV&A of Distributed Simulations 8

3 Simulation VV&A Process 10

3.1 Strategic Issues For Implementing a Simulation VV&A Process 10
3.2 Understanding the Simulation VV&A Process 12

4 VV&A Scope and Associated Cost 17

4.1 Estimating the Amount of VV&A to be Undertaken 17
4.2 Resourcing the VV&A Scope 20

5 Simulation VV&A Roles 22

6 Simulation VV&A Documentation 24

6.1 Accreditation Plan 24
6.2 Verification and Validation Plan 25
6.3 Verification and Validation Report 25
6.4 Accreditation Report 26

7 Relationship of Simulation VV&A to Other Defence Initiatives 27

7.1 Technical Regulatory Framework 27
7.2 Test and Evaluation Program 28
7.3 System V&V Program 28

8 VV&A Standards 30

8.1 Simulation Verification and Validation Standards 30
8.2 General Software Verification and Validation Standards 31

Annex A Abbreviations and Acronyms 32

Annex B Definition of Terms 33

Annex C Reference Documents 35

Annex D Simulation VV&A Support 36

Annex E DMSO VV&A Recommended Practices Guide Site Map 37

Annex F Simulation VV&A Examples 38

List of Figures

Figure 1-1: Relationships to other documents 3
Figure 2-1: The VV&A Processes 4
Figure 3-1: The Overall Problem Solving Process 13
Figure 3-2: The Accreditation Process 14
Figure 3-3: The V&V Process 15
Figure 4-1: Organisation Goal Analysis 18
Figure 4-2: Simulation Analysis 18
Figure 4-3: VV&A Investment Analysis 19
Figure 4-4: VV&A Resource Analysis 20
Figure 4-5: VV&A Resource and Schedule Estimation 21
Figure 6-1: Defence Simulation VV&A Documentation 24

List of Tables

Table 5-1: Typical responsibilities for VV&A of simulation 23

Amendment List

Serial	Amendment	Date Effected

1 INTRODUCTION

1.1 BACKGROUND

1. The Australian Defence Organisation looks increasingly to Simulation[1] as a way to help decision-makers take better account of the complexity, the dynamics and the uncertainties that pervade modern warfare and management. However, we must acquire, develop, manage, use and support simulation in an environment that ensures the overall credibility of simulation outcomes. The Defence Simulation Policy emphasises the need for careful analysis to determine whether simulation offers a suitable and viable solution for a particular use. One of the six criteria[2] by which an informed assessment needs to be made is the level and type of confidence building approaches that are required to establish simulation outcome credibility. The Defence Simulation Policy states[3]:

> **Confidence building approaches**—how is 'fitness for purpose' to be assessed to establish both the overall credibility of simulation outcomes and the necessary levels of user confidence in them?

2. The Defence simulation Verification, Validation and Accreditation (VV&A) policy[4] states:

> The common purpose of simulations is to gain knowledge or develop skills. Simulations must be relevant to the business processes that the knowledge and skills support. Confidence building approaches must therefore build the trust needed in the simulation to the extent that:
>
> a. The role of the simulation meets the end-users' needs within their business process cycles (ie, that it is doing the right things); and
>
> b. The fitness of the simulation to deliver outputs that all end-users and stakeholders have sufficient confidence in (ie, that it is doing those things right).
>
> Generally, confidence building approaches focus on process and independent evaluation of results. Informal approaches[5] might be adequate for less complex or less expensive simulations. The management of expectations is a key component of informal approaches to confidence building and the target outcome is of trust in the simulation by users and their stakeholders. In many cases, formal approaches will also be required. Formal approaches include standards that provide a regulatory and guidance framework and verification, validation and accreditation. These offer structured processes to identify potential problems before they arise. In all cases, it is only necessary to demonstrate the desired fitness for purpose in/of the simulation.

[1] As defined in DI(G) OPS 42-1, a **model** is a physical, mathematical or otherwise logical representation of a system, entity, phenomenon or process. A **simulation** is the implementation or exercise of a model over time.
[2] Refer to Reference A (paragraph 22) and Reference C.
[3] Paragraph 22e.
[4] Reference B.
[5] Informal approaches may take the form of involving a subject matter expert in the design and/or the evaluation, regular meetings with the user, allowing the user to 'free play' the simulation, or obtaining feedback from other users of the simulation.

1.2 PURPOSE OF THE VERIFICATION, VALIDATION AND ACCREDITATION GUIDE

The purpose of the Guide is to assist the Acquirers, Developers, Managers, Users, and Supporters of simulations in giving an understanding of the concepts of Verification, Validation and Accreditation for simulations and to provide guidance on its effective application in establishing the fitness for purpose of Australian Defence simulations. The Guide points to more detailed sources of advice and technical information as required.

3. The principle objective of the Guide is captured in the first strategy[6] to achieve the Defence Organisation vision for simulation:

> **Manage Simulations Effectively:** Simulations often represent a considerable investment in dollar and workforce terms. Effective management is necessary in order to secure and maintain the maximum advantage available from the investment. Defence will implement measures to increase the effectiveness of simulations through improvements in the management structure and processes for simulation requirement definition, acquisition, and implementation phases.

4. The purpose of the Verification, Validation and Accreditation Guide (VVAG) is to provide guidance for managing the VV&A process for Australian Defence simulations. In particular, the VVAG details the VV&A process, VV&A roles and VV&A activities to be undertaken as a formal approach to building confidence in simulation outcomes. By applying the guidelines contained within the VVAG, Defence and Industry personnel involved with acquiring, developing, managing, using, and supporting Defence simulations will be assured of operating within a common framework. This Guide offers an introductory overview, and readers are directed to sources of more information and advice in the text as may be required.

5. Readers should note that VV&A is a tailored process, and each project team must analyse their objectives for the application of simulation and develop their own VV&A approach based on this guidance. The decision to invest in VV&A, and the decision as to how much VV&A is required should be consistent with the impacts which the use of simulation is expected to have on Organisational outcomes.

6. The VVAG is one of the Defence Organisation policy initiatives that will help lead the simulation community to grow and realise Defence's formally approved vision:

Defence Vision for Simulation
Defence exploits simulation
to develop, train for, prepare for and test military options for Government
wherever it can enhance capability, save resources or reduce risk.

[6] Reference A (paragraph 25).

1.3 RELATIONSHIPS TO OTHER DOCUMENTS

7. The concept of simulation VV&A is introduced in the **Defence Simulation Proposal Guide** (Reference C). The Guide assists those involved in acquiring or developing a simulation to address the six criteria for simulation proposals as required by the Defence Simulation Policy. Simulation VV&A is one of the formal methods addressed in Chapter 9 - 'Confidence Building Approaches'. It is recommended that this chapter be read for an understanding of confidence building approaches.

8. The **Distributed Simulation Guide** (Reference D) provides guidance on the use of distributed simulation technologies for combining simulations. It provides specific VV&A guidance for distributed simulations.

9. The **Simulation Data Guide** (Reference E) provides guidance on buying, modifying and utilising data for simulations. Specific guidance is provided on verifying, validating and certifying data for simulation use.

10. The relationships of the above documents and other Defence documents are shown in Figure 1-1.

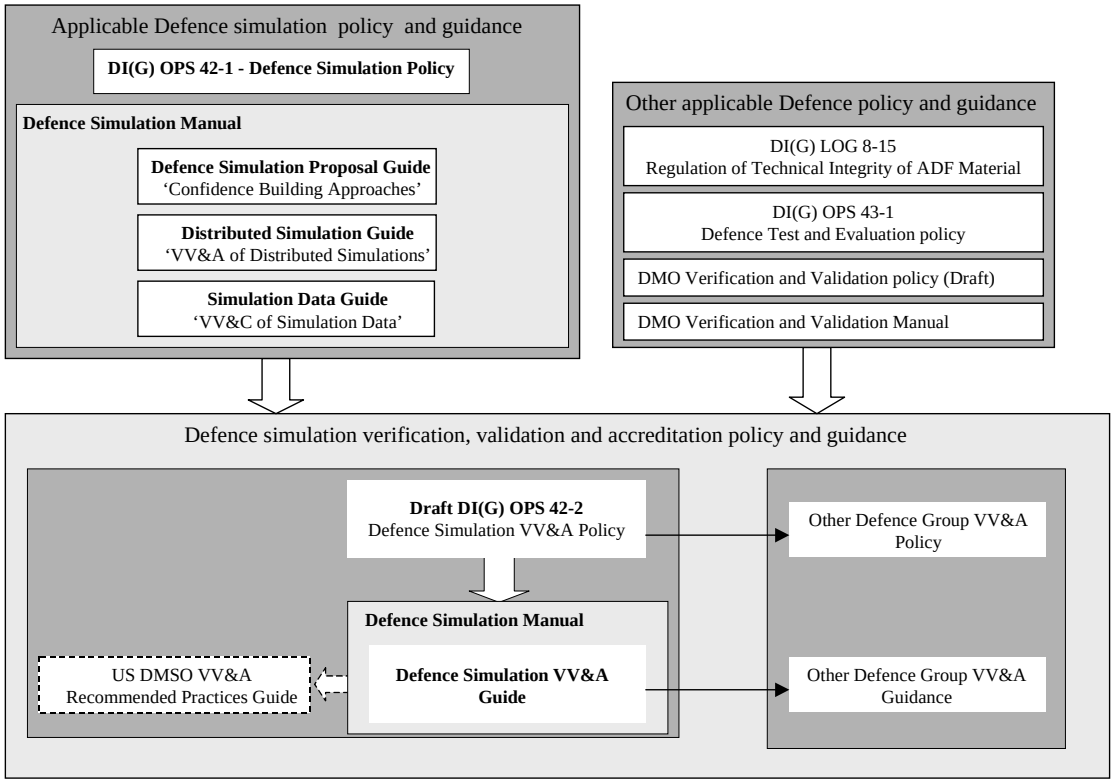


Figure 1-1: Relationships to other documents

2 INTRODUCTION TO SIMULATION VERFICATION, VALIDATION AND ACCREDITATION

Note 1. This chapter is based on the US Defence VV&A Recommended Practices Guide.

Simulation VV&A Purpose

The purpose of VV&A is to assure development of correct and valid simulations and to provide simulation users with sufficient information to determine if the simulation can meet their needs.[7]

11. The quality of any decision-making or training based on simulation outcomes is questioned if the simulation used is not a valid and verified representation of the real world for the purpose that it will be used. It is the responsibility of the user, or delegated representative, to accredit the simulation for its intended purpose. Verification and validation activities are performed to provide the data sets necessary to allow the user or delegated representative to complete the accreditation process.

VV&A is performed when the potential risk of making an incorrect decision as a result of training or analysis based on a simulation outweighs the costs of performing VV&A.

12. Verification, validation, and accreditation are three interrelated but distinct processes (refer to Figure 2-1). Together, they gather and evaluate evidence to determine, based on the simulation's intended use, the simulation's capabilities, limitations, and performance relative to the real-world objects it simulates. For this guide, the Verification and Validation (V&V) processes are combined into a single process.

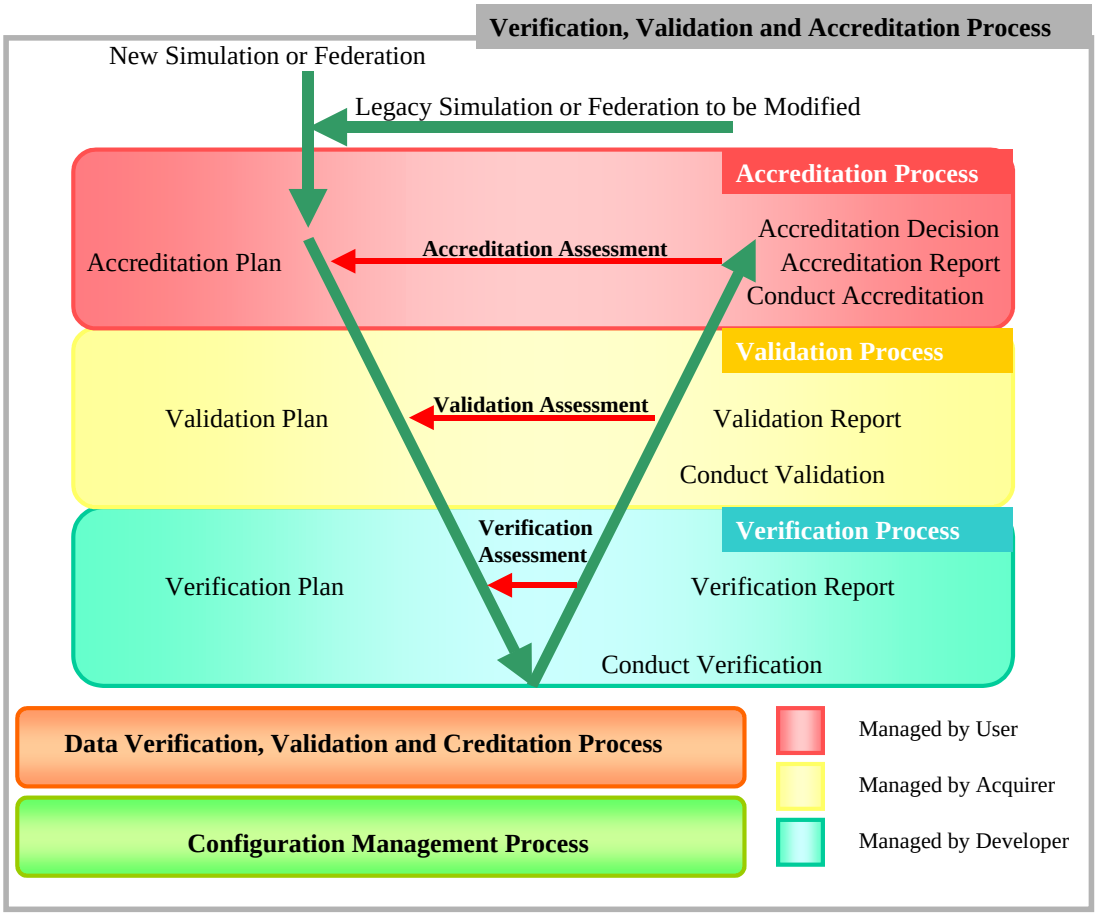


Figure 2-1: The VV&A Processes

[7] Reference F.

Ground Rules for VV&A[8]

1. The validity of a simulation is dependent both on the design and on the purpose for which the simulation will be used.
2. VV&A should be an integral part of the entire simulation lifecycle.
3. A well-formulated problem is essential to the acceptability and accreditation of simulation results.
4. Fitness for purpose can be claimed only for the intended use of the simulation and for the prescribed conditions under which it has been tested.
5. Simulation validation is but one part of confirming the rigour of analytical results. Simulation validation is no substitute for a sound analytical foundation.
6. V&V of each sub simulation or federate does not imply overall simulation or federation fitness for purpose and vice versa.
7. Accreditation is not simply a pass or fail choice … perfect representation of all aspects of the simulated system will not be achieved.
8. VV&A is both an art and a science, requiring creativity and insight.
9. The success of any VV&A effort is directly affected by the analyst or training provider.
10. VV&A must be planned and documented.
11. V&V requires some level of independence to minimise the effects of developer bias.
12. Successful VV&A requires verified, validated and certified data.
13. No rigid "cookbook" simulation VV&A process can fit all situations all the time.

13. V&V tools and techniques are not discussed in this guide, however the reader is referred to Reference F or other relevant software V&V documentation.

2.1 INTRODUCTION TO SIMULATION ACCREDITATION

14. According to draft DI(G) OPS 42-2, **simulation accreditation** is "the official certification that a simulation, or federation of simulations is acceptable for use for a specific purpose." In layman's terms, accreditation answers the question: "Should we use the simulation for the intended purpose?" Simulation accreditation is made by an official statement by the **Application Sponsor** (See Chapter 5) that the verified and validated simulation is acceptable for the specified use.

A simulation can receive an accreditation for use in one specific application (eg flight training) but *not be accredited for use in another application (eg aircraft* system design).

15. One must always keep in mind that the accreditation requirements drive the whole VV&A process. It is therefore necessary for the accreditations sponsor or **Accreditation Agent** (see Chapter 5) to clearly define the type of activities and data requirements necessary to lead to an accreditation as early as possible. Given cost considerations (see Section 4.2) the Accreditation Sponsor/Agent should leverage off other project activities (such as test and evaluation or T&E) as much as practical.

16. There are five different accreditation decisions to consider[9]:

a. **Full accreditation** – using the simulation as is (accepting the residual risks);

b. **Conditional accreditation** – constraining the application to minimise the residual risks;

[8] Reference G.
[9] Reference F.

c. **Accreditation is deferred for modification** – requiring corrections to be made that can reduce the residual risk even though they increase costs and cause delays;

d. **Accreditation is deferred for additional information** – requiring more information in order to understand the residual risks involved and instil confidence in the simulation's fitness before making a decision; and

e. **No accreditation** – the residual risks involved in using the simulation and the costs involved in mitigating the residual risk are too great.

2.2 INTRODUCTION TO SIMULATION VALIDATION

17. According to draft DI(G) OPS 42-2, **simulation validation** is "the process of determining the degree to which a simulation, or federation of simulations, is an accurate representation of the real world from the perspective of the intended uses of the simulation". In layman's terms, validation answers the question: "Are we developing the 'right' simulation for the purposes we have determined?" and focuses on simulation fitness for purpose. In its simplest form, validation consists of comparing a prediction (from a simulation) with an observation (from the real world), and making a judgment about whether the result is good enough for application to the problem.

Two Prerequisites for cost-effective simulation
1. A clear understanding of the intended uses; and
2. A clear definition of the real world.

18. The intended uses of the simulation sets the requirements for **functionality** (ie. what needs to be simulated) and for **fidelity** (ie. how well those functions need to match the real world). Without a good definition of what is to be validated against, the difference between a good validation result and a bad validation result cannot be determined. For example, will the simulation be validated against range data, laboratory data, another simulation, or the opinion of experts in the field? Each of these real worlds has inherent drawbacks and limitations that can make or break the apparent validity of a simulation.

19. Validation typically is addressed at two levels: conceptual model validation and results validation[10].

a. **Conceptual Model Validation** is the determination (usually by a group of experts) that the assumptions underlying the proposed conceptual model are correct and that the proposed simulation design elements and structure (ie the simulation's functions, their interactions, and outputs) will lead to results realistic enough to meet the requirements of the application.

b. **Results Validation** compares the responses of the simulation with known or expected behaviour from the subject it represents to ascertain that those responses are sufficiently accurate for the range of intended uses of the simulation. This process includes comparison of simulation outputs with the results of controlled tests, sensitivity analyses, or expert opinion.

20. An important aspect of validation to remember is that validation will not say a simulation is good or bad. It simply measures the difference between simulation outputs and the real world. The user (or nominated subject matter expert) then decides if the difference is

[10] Reference G.

small enough for the simulation to be used in a specific application and if the results, when used in that application, will have the expected accuracy.

21. One final observation on validation. The logic diagram of the alternative paths through a typical simulation is extremely large: sufficiently large, in fact, that it is, in practice, impossible to check every path. Hence, for all practical purposes, a simulation cannot be completely validated. Therefore, for the question, "Is this simulation validated?" the answer should always be, "Yes, for the conditions specified in the validation report." Validation is typically performed on those aspects of a simulation that are known to be important to a particular application.

2.3 INTRODUCTION TO SIMULATION VERFICATION

22. According to draft DI(G) OPS 42-2, **simulation verification** is "the process of determining that a simulation, or federation of simulations, implementation accurately represents the developer's conceptual description and specifications." In layman's terms, verification answers the question: "Are we developing the simulation 'right' to our specifications?" and focuses on simulation capability.

23. If planning to develop simulations, two things need to be completed before developing software code:

a. the **conceptual model** from which the software will be developed needs to be built and verified (known as **Conceptual Model Verification**), and

b. the proposed design that will support development of the simulation's software needs to be verified **(**known as **Design Verification**).

24. A mapping of the proposed design elements back to the conceptual model and simulation requirements helps to document that the requirements are appropriately addressed and that there is **traceability** between those requirements and the proposed design.

25. Once verified, the conceptual model and its associated design are converted into software by the developer. The next step is the verification of the software itself (usually called **Code Verification**). Code verification guarantees that the detailed design is implemented correctly in the software. Code verification normally entails detailed desk checking and software testing of the code, comparing it to the design elements, specifications, and operational criteria that were approved during verification of the conceptual model and detailed design, documenting any discrepancies and fixing any problems discovered.

26. Verification of legacy simulations[11] requires obtaining the conceptual model and design specifications, or some suitable substitute, and verifying that the simulation requirements are met. Generally, legacy simulations do not have this information available (or would be too costly to develop or acquire). In these cases, the verification activity may be unsuitable to undertake and validation of the simulation assumptions, limitations and design

[11] A legacy simulation was developed either in the past or for a different purpose. This includes commercial games used to conduct simulations. The emphasis in preparing a legacy simulation for use is the identification of critical deficiencies with respect to the current problem.

elements to your requirements would be necessary. However, there will remain residual risk in not undertaking the verification activity.

2.4 INDEPENDENT SIMULATION VERIFICATION AND VALIDATION

27. Independent Verification and Validation (IV&V) is where a person or team is employed to conduct V&V tasks, independent of the developers' team. This is an effective method of providing more specialist technical advice to the acquirer as project offices may well lack personnel with the necessary skills to evaluate and inspect software products. However, the costs can be high and the acquirer will need to focus the IV&V agent on specific requirements. IV&V will also add another management overhead to a project and place addition strain on the developer.

The amount of IV&V becomes a function of budget and the level of confidence and trust in the developer, as well as management/user requirements to demonstrate independence.

28. IV&V does not necessarily have to be independent of the company building the simulation. Larger companies have the scope to both develop and conduct IV&V, however, this is obviously open to some problems that will need to be closely managed.

Note 2. *An independent agent may be used to aid in conducting simulation accreditation activities, however, accreditation approval must be undertaken by the sponsor/user of the simulation.*

2.5 CONFIGURATION MANAGEMENT

29. Configuration Management (CM) is a development life-cycle process through which the integrity and continuity of development, upgrades, and maintenance are recorded, communicated, and controlled. CM can have a profound impact on the sustainability of simulation fitness for purpose. The key to maintaining the shelf life of V&V work is a structured, workable, and well maintained CM process that is integrated with simulation development. The reader is referred to Reference H for further CM guidance and recommended standards.

2.6 SIMULATION DATA

30. All simulations are driven by data, either as direct inputs by the user or as embedded constants that drive simulation characteristics. As well designed as a given simulation may be it will fail validation if the data that drive the simulation are inaccurate or inappropriate for the application. Data fitness for purpose is a major driver of simulation fitness for purpose. The reader is referred to Reference E for details on the process of verification, validation and certification of simulation data.

Note 3. *When talking about data, we use the term 'certification' rather than 'accreditation' as data is developed to a data standard as opposed to a particular application. Generally, the many diverse applications are not known at the time the data is acquired. However, data becomes a component of the simulation once the simulation is 'accredited'.*

2.7 VV&A OF DISTRIBUTED SIMULATIONS

31. The Australian Defence Organisation is currently utilising the Distributed Interactive Simulation (DIS) standard (IEEE 1278.4) and the High Level Architecture (HLA) standard

(IEEE 1516) for distributed simulations. IEEE 1278.4 contains guidance for the VV&A of DIS exercises. VV&A guidance for HLA Federations is currently being developed by the Simulation Interoperability Standards Organisation (SISO) and will be reviewed by ADSO for Defence use. The reader is referred to Reference D for specific details on the VV&A of distributed simulations.

3 SIMULATION VV&A PROCESS

Note 4. This chapter is based on the US Defence VV&A Recommended Practices Guide.

3.1 STRATEGIC ISSUES FOR IMPLEMENTING A SIMULATION VV&A PROCESS

32. Draft DI(G) OPS 42-2 (Reference B) highlights the following strategic issues for implementing a Defence wide VV&A process.

3.1.1 Increased Confidence in Simulation Use

33. Conducting VV&A increases confidence in the use of that simulation for that application. VV&A increases confidence in simulations by providing objective evidence of fitness for purpose within the confines of that intended use. A large challenge for the V&V practitioner lies in the selection and scoping of the most appropriate VV&A approach given the intended use.

3.1.2 Reduced Risk of Incorrect Simulation Use

34. Increased confidence in simulation use results in a reduced risk in relying on simulations outputs to support decisions and training. VV&A reduces the risk that simulation will lead to incorrect or indefensible results. The issue in this case is not really “What is the cost of V&V?” but rather “What is the cost of NOT doing V&V?” What is the cost of making an incorrect decision based on simulation results? These hidden costs of avoiding VV&A are frequently intangible, unpredictable, and unquantifiable. As a result, they tend to be ignored in the calculation of the value added by VV&A.

3.1.3 Increased Simulation Usability for Future Applications

35. V&V activities performed by multiple users on a stable simulation, typically one with a well-defined configuration management and development policy, will establish a body of evidence supporting its use for a wider range of applications and the more likely that it will receive more development and V&V attention. Other simulations that perform similar functions but that do not fare well in V&V or fitness for purpose will give way to those that do. In this way, V&V becomes a natural selection process for the development of fewer simulations but with greater capability and established fitness for purpose.

3.1.4 Resource Containment

36. If VV&A results are documented in a standardised way and made readily available to the user community (both locally and overseas), the cost of VV&A to support further accreditation will drop. This common body of evidence will eventually benefit all users of the simulation.

3.1.5 Potential for Better Analysis

37. With the advent of complex computer simulations that may appear to offer greater predictive power, the discipline attached to the analytical process may be weakened in favour of understanding the simulation itself. The requirement to perform VV&A can provide an incentive to maintain discipline in sound analytical practices. VV&A requires the

development of detailed simulation requirements that are focused on the intended use of the simulation for particular applications. The discipline required to develop well-defined simulation requirements clarifies analytical issues and may further develop and refine the value inherent in practical analytical techniques and approaches.

3.1.6 Satisfaction of Policy Requirements

38. Draft DI(G) OPS 42-2 requires that a tailored VV&A process be carried out for simulations in Defence. Service policies also require that VV&A is undertaken for service simulations. Simulation will be used increasingly across Defence (and industry) to enhance capability, save resources and reduce risk. Defence seeks to ensure that simulation can be integrated into Defence applications in a credible, justifiable, cost-effective way. VV&A will therefore play a vital role in all Defence activities that use simulation.

3.1.7 Interoperability

39. Defence faces an increasing need to combine simulations together in service, joint, national and international environments. Simulations may need to be quickly combined to form larger simulation applications to meet broader operational needs. To support this requirement, VV&A documentation will be required for simulations to assist the evaluation of their respective capabilities and limitations.

3.2 UNDERSTANDING THE SIMULATION VV&A PROCESS

3.2.1 VV&A Guiding Principles

40. The recommended VV&A process is based on the following guiding principles.

a. **All Simulation Applications Require Accreditation** - A simulation must be formally accredited for the specific purpose that it is going to be used if confidence in that use is to be established.

b. **The Simulation Application Sponsor Must Conduct Accreditation** - The Application Sponsor accredits a simulation based on the original defined requirement for the simulation application (this excludes safety certification accreditation which is required to be completed by independent bodies).

c. **Accreditation is Not Re-useable** - An accreditation is not re-useable. Each simulation activity is unique and therefore the user must accredit the simulation for its specific objective. If a simulation is modified by say, a capability enhancement to mitigate residual risk or a new set of input data, then the new modified simulation must be re-accredited before use.

d. **Accreditation is Based on V&V Data** - Accreditation requires the Application Sponsor to evaluate the fitness for purpose of the simulation for the intended use. This assessment is made using the evidence that is generated from verification and validation data.

e. **V&V Data is Highly Re-useable** - Verification and validation data is highly re-useable. V&V data derived for one simulation may be entirely re-useable for another simulation (with one or more similar functional components) undergoing V&V. This V&V data re-use makes the accreditation process very efficient.

f. **V&V Activities Should Leverage off other Project Activities** – To aid in the reduction of duplication of effort and cost, the V&V activities should use other project activity (eg T&E) data or be programmed around similar project activities.

g. **The Level of VV&A is Variable (Tailored)** - The level of VV&A necessary to provide the required level of accreditation evidence is a function of the risk of making an inaccurate decision or unwanted training effect as a result of using simulation and the available resources (budget, time and personnel).

3.2.2 Problem Solving Process

Note 5. This is the same VV&A process currently used by the US Department of Defence. This will allow a common simulation VV&A framework between the US and Australia.

41. The Problem Solving Process is shown in Figure 3-1:

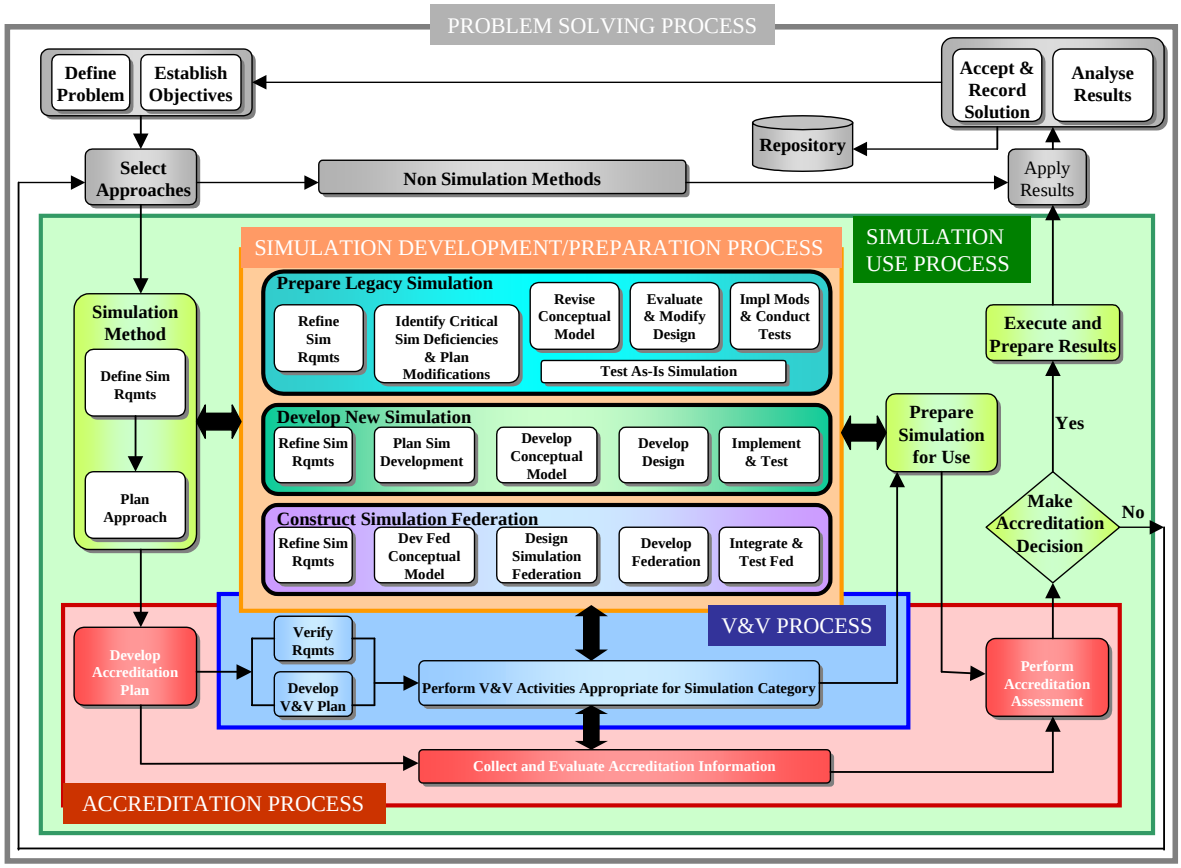


Figure 3-1: The Overall Problem Solving Process

42. Figure 3-1 shows five distinct but interrelated processes to solve problems using simulation. These are:

a. **Problem Solving Process** – begins with two critical activities, defining the problem and selecting the approach for resolving it. Simulation is but one method for obtaining information needed to solve a problem or support a decision[12].

b. **Simulation Use Process** – commences when simulation has been selected as a solution approach. It involves all activities associated with selecting, preparing, and executing (ie using) a simulation in support of the problem solving process.

c. **Simulation Development and Preparation Process** – encompasses all the activities needed to develop, modify, and otherwise prepare a simulation for a specific use.

d. **Verification and Validation Process** – encompasses all the activities needed to verify and validate a simulation. The relative importance of each activity and the specific tasks performed depend on the type of simulation and the specifics of the application.

e. **Accreditation Process** - encompasses all the activities needed to aid an accreditation decision to be made to use a simulation for a specific purpose.

[12] Other methods are gaming, field testing, experiments, analysis of existing data and subject matter experts.

43. This guide will only focus on the verification and validation process, and the accreditation process. The reader is directed to Reference F for further detail on the other processes (ie subparagraph 42 a, b, and c).

3.2.3 Recommended Accreditation Process

44. Figure 3-2 shows the recommended accreditation process for Australian Defence simulations.

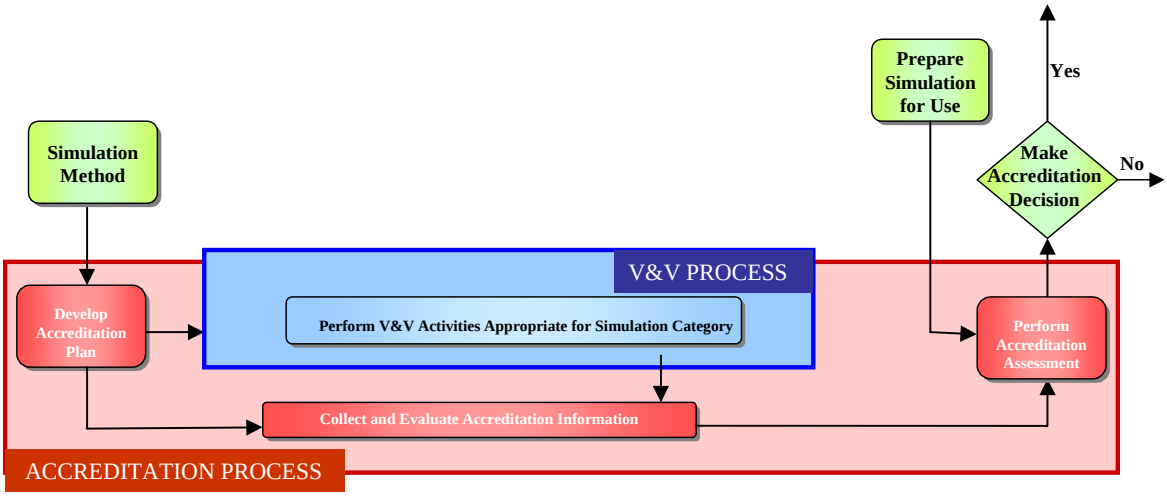


Figure 3-2: The Accreditation Process

45. **Develop Accreditation Plan** – This activity involves identifying all the information needed to perform the accreditation assessment, schedules, resources, etc. to be used in the accreditation assessment. See Section 6.1.

46. **Collect and Evaluate Accreditation Information** – The information needed for the assessment is collected from the V&V effort and other sources and evaluated to determine its completeness.

47. **Perform Accreditation Assessment** – The fitness for purpose of the simulation is assessed using all the evidence collected from the V&V effort and other sources and an Accreditation Report (see Section 6.4) with recommendations is prepared for the Application Sponsor.

48. Although accreditation is often perceived as occurring at the end of a development process, the actual assessment process should begin as early as possible so V&V activities and testing activities can provide appropriate and sufficient information to support the accreditation decision.

49. For more detailed guidance on conducting accreditation for simulations undergoing new development and legacy simulations refer to Reference F.

3.2.4 Recommended Verification and Validation Process

50. Figure 3-3 shows the recommended V&V process for Australian Defence simulations.

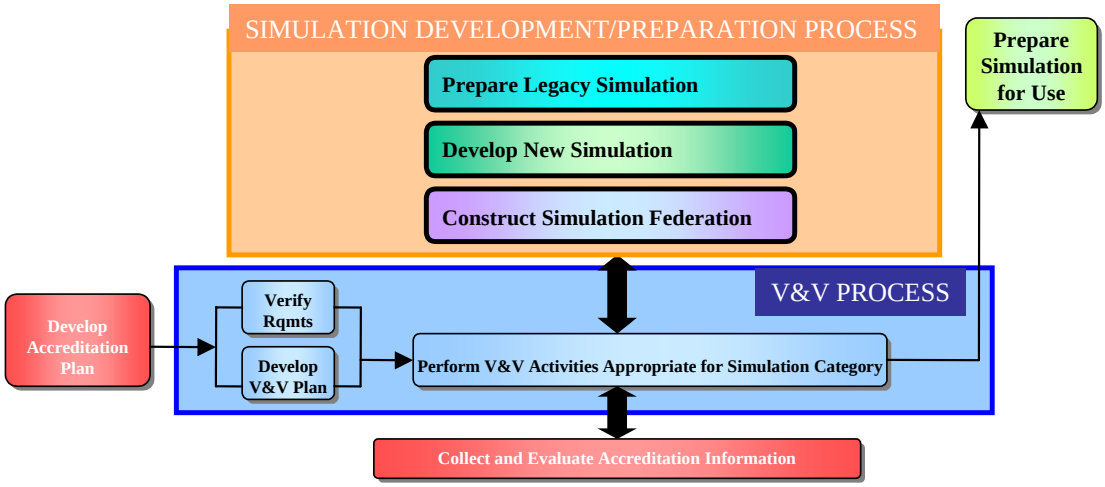


Figure 3-3: The V&V Process

51. The basic V&V activities apply to all three simulation categories of the Simulation Development/Preparation process; however, the relative importance of each activity and the specific tasks performed depend greatly on the type of simulation and the specifics of the application.

52. **Verify Requirements** – This activity involves confirming that the requirements for the simulation match those needed for the current problem, and are correct, consistent, clear, and complete.

53. **Develop V&V Plan –** This activity involves identifying the objectives, priorities, tasks, and products of the V&V effort; establishing schedules; allocating resources; etc. See Section 6.2.

54. **Perform V&V Activities Appropriate for Simulation Category** – This activity involves selecting the activities and tasks that best suit the needs of the current application. Normally this involves some level of effort evaluating the structure of the simulation as indicated below:

a. ***Validate Conceptual Model*** – confirming that the capabilities indicated in the conceptual model embody all the capabilities necessary to meet the requirements.

b. ***Verify Design*** – determining that the design is faithful to the conceptual model, and contains all the elements necessary to provide all needed capabilities without adding unneeded capabilities.

c. ***Verify Implementation*** – determining that the code is correct and is implemented correctly on the hardware.

d. ***Validate Results*** – determining the extent to which the simulation correctly addresses the requirements of the intended use.

e. Additional activities are included as needed based on the simulation category and the needs of the application.

55. It is virtually impossible to separately evaluate a simulation from the data it uses (eg input data, hard-wired data) because it is the interaction of data and code that produces simulation results, making both responsible for simulation fitness for purpose. This mutual

dependency suggests that data V&V activities must be considered part of the overall V&V process. Data V&V activities are discussed at Reference E.

56. For more detailed guidance on conducting V&V for simulations undergoing new development and legacy simulations refer to Reference F.

4 VV&A SCOPE AND ASSOCIATED COST

4.1 ESTIMATING THE AMOUNT OF VV&A TO BE UNDERTAKEN

57. The estimation of how much VV&A a simulation project should undertake is not a simple process and requires an appreciation of the following factors:

a. The relative impact of the simulation in meeting desired organisation outcomes (ie either as part of a decision process or a training process).

b. The criticality of the simulation results to the decision being reached.

c. Safety and regulatory requirements.

d. The likelihood of future utilisation of the simulation application beyond the current intended use (ie long-term use (reuse)).

e. Any VV&A previously undertaken for the simulation that will support the accreditation decision.

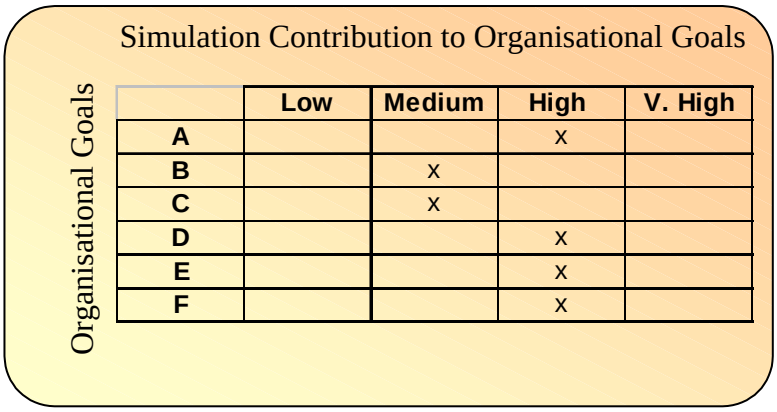
f. The availability of time, finance and personnel.

58. When completed, the VV&A scope assessment should be detailed in the Accreditation Plan for subsequent V&V planning. It is important here to avoid significantly underestimating the scope of VV&A as this would lessen the confidence in the simulations use, or significantly overestimating the scope as this would unnecessarily waste resources.

The estimation of the scope of VV&A requires making a trade-off between confidence in simulation outcomes and cost.

59. The following process for estimating VV&A scope is provided as an example of how this assessment may be conducted. It consists of four steps of analysis before the desired level of VV&A scope can be identified. These analysis steps are: Step 1: organisational goal analysis, Step 2: simulation analysis, , Step 3: VV&A investment analysis, and Step 4: resource availability analysis.

60. **STEP 1: Organisational Goal Analysis**. This analysis assesses the simulation contribution in meeting each organisational goal. The organisational goals could be at an effect level (eg. the Defence Strategic level, Defence Capability Level) and/or at the Defence structure level (eg. Group level, Branch Level, or Directorate level). The level chosen will determine the relative importance of the simulation and subsequently aid in determining VV&A investment priority. This analysis is shown diagrammatically in Figure 4-1.

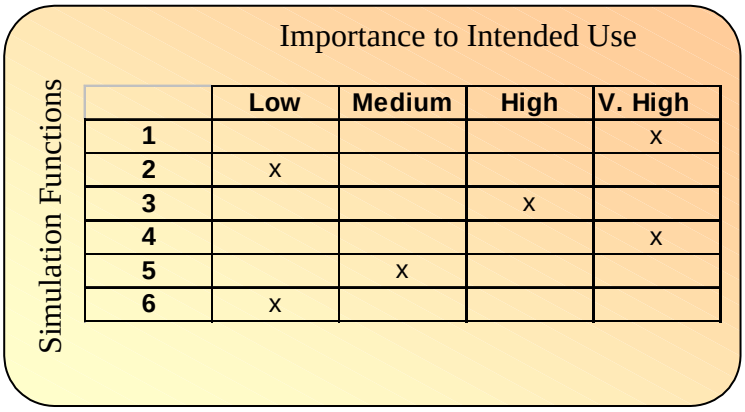


	Low	Medium	High	V. High
A			x	
B		x		
C		x		
D			x	
E			x	
F			x	

Figure 4-1: Organisation Goal Analysis

61. This analysis necessitates listing the applicable organisational goals that the simulation will support. These goals should be available from the Simulation Proposal documentation (refer to Reference C). In this example, the applicable organisation goals are listed in rows from A through to F. To determine the simulation contribution to the organisation goals for our example, four levels of impact have been created (ie Low, Medium, High and Very High) as columns. A Very High level indicates a direct relationship to the organisational goal, whereas a Low level indicates limited utility in achieving the goal objective. In this example, the simulation contribution has a high impact on organisation goals A, D, E and F and a Medium impact on goals B and C.

62. **STEP 2: Simulation Analysis**. This analysis determines the importance of individual simulation functions to the simulations' intended use. Simulation functions may be representational, operational or supporting in nature. This analysis is shown diagrammatically in Figure 4-2.



	Low	Medium	High	V. High
1				x
2	x			
3			x	
4				x
5		x		
6	x			

Figure 4-2: Simulation Analysis

63. In this example six simulation functions are identified as rows. Four levels of importance (low, medium, high and very high) are identified as columns. A Very High level indicates a direct relationship to the application objective, whereas a Low level indicates a limited utility in achieving the application objective. In our example, it was decided that functions 1 and 4 had a very high importance to meeting the intended use, function 3 of high importance, function 5 of medium importance and functions 2 and 6 of low importance.

64. **STEP 3: VV&A Investment Analysis**. This analysis determines the VV&A investment priority for each function identified in Step 2. It uses the results from the previous 2 steps. This is shown diagrammatically in Figure 4-3.

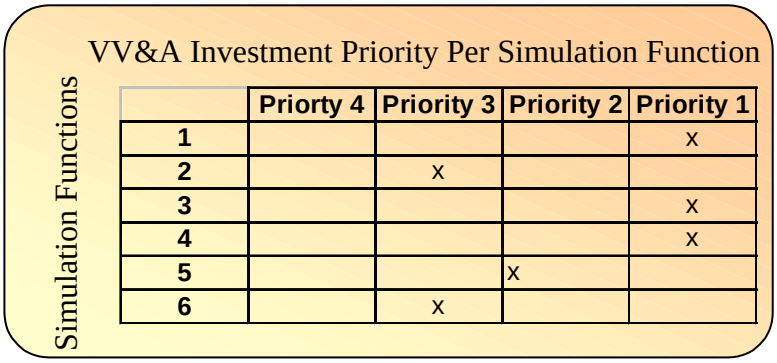


Figure 4-3: VV&A Investment Analysis

65. In this example, the simulation has a High level of contribution to organisational goals (from Step 1). Using this result it was determined that simulation functions 1, 3 and 4 should have a VV&A investment priority of 1, function 5 should have a VV&A investment priority of 2, and functions 2 and 6 should have a VV&A investment priority of 3. In this example, it was determined the all priority 1 and 2 functions will undergo intensive VV&A to ensure the desired level of confidence to meet the organisations goals is achieved. If in Step 1 a Very High level of contribution to organisational goals was assessed, then all functions would most likely undergo intensive VV&A.

66. **STEP 4: Resource Analysis**. The last analysis stage assesses the impact of available resources to undertake the desired VV&A investment. This is necessary as sufficient resources to undertake the required scope of V&V may not be available. However, any residual risk resulting from not undertaking the full V&V effort must be recorded firstly in the Accreditation Plan and subsequently in the Accreditation Report (see Chapter 6). This process is shown diagrammatically in Figure 4-4

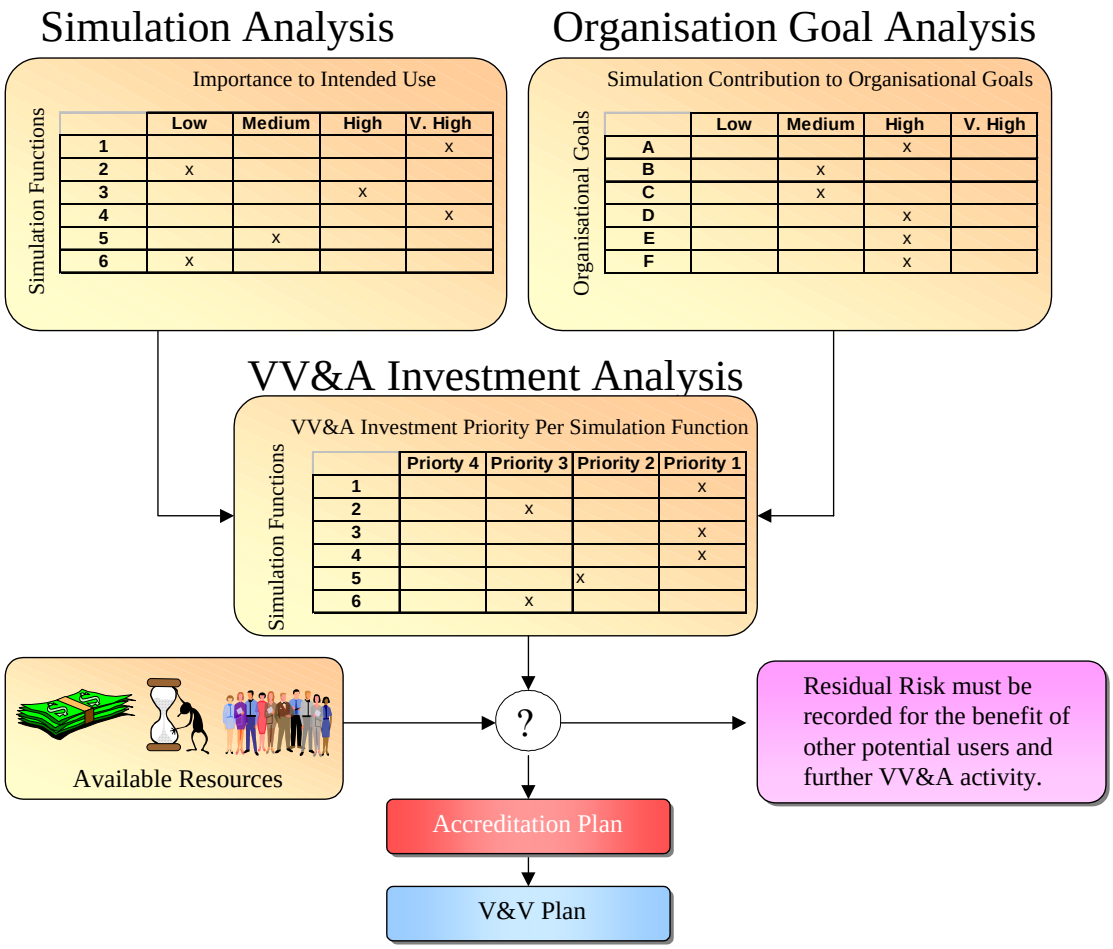


Figure 4-4: VV&A Resource Analysis

67. The final determined VV&A investment is then included in the Accreditation Plan with the associated V&V scope detailed in the V&V Plan. The V&V Plan should also indicate where the V&V effort can leverage off other activities in the development process such as T&E.

4.2 RESOURCING THE VV&A SCOPE

68. The Accreditation Plan should not only identify the VV&A scope but also an estimate of the resources required to achieve the identified scope. This estimate will be based on:

a. the amount of existing VV&A data that satisfies the VV&A scope (only the VV&A data gap should be resourced: see Figure 4-5),

A reused simulation will most likely require less VV&A and thus less resources than for a newly developed simulation.

b. prior resource assessments made in the Simulation Proposal,

c. historic data from previous simulation VV&A activities or similar T&E or software V&V activities, and

d. advice from subject matter experts.

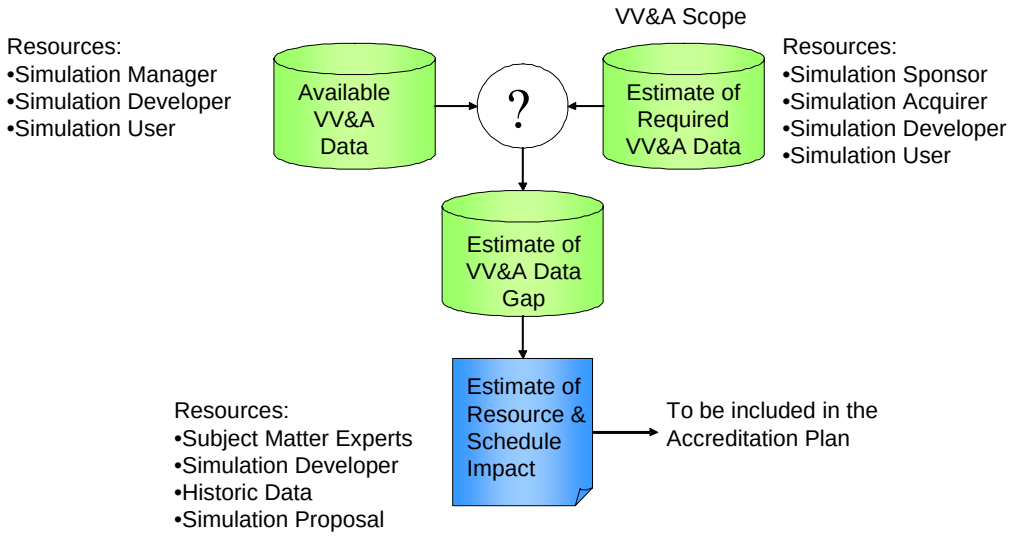


Figure 4-5: VV&A Resource and Schedule Estimation

69. The estimate of required resources will need to be refined as further detail is progressively obtained and more cost-effective options are selected as the project evolves. The estimate will also need to include any additional overhead when utilising IV&V.

70. If resource constraints are likely to affect the ability to undertake the original VV&A scope derived in Section 4.1, then either more resource effective solutions will need to be investigated or a new assessment will need to be made to reduce the VV&A scope by removing less important VV&A activities. However, any reduction of VV&A scope will lessen the overall confidence in the simulation and its results. Any residual risk from this decision will need to be recorded in the Accreditation Report.

Issue is not really “What is the cost of VV&A?”, but rather “What is the cost of NOT doing VV&A?”

5 SIMULATION VV&A ROLES

71. The VV&A process consists of five distinct roles. Formal definitions of the simulation VV&A roles are cited in draft DI(G) OPS 42-2 and are defined as follows:

a. **Simulation Application Sponsor** -The organisation that utilises the results or products from a specific application of a simulation, or federation of simulations.

b. **Simulation Accreditation Agent -** The organisation designated by the Application Sponsor to conduct an accreditation assessment of a simulation application, or federation of simulation.

c. **Simulation Validation Agent -** The organisation designated by the Application Sponsor to perform validation of a simulation, or federation of simulations.

d. **Simulation Verification Agent -** The organisation designated by the Application Sponsor to perform verification of a simulation, or federation of simulations.

e. **Simulation Developers** - Those who develop simulations including design and programming. They not only build the initial base level capability, but all subsequent levels of capability as well.

These roles may be carried out by separate organisations, separate people in the one organisation or carried out by one person. For example, the Application Sponsor and Accreditation Agent roles may be carried out by the one organisation or one person. Likewise for the Validation Agent and Verification Agent roles. The 'people' structure of the VV&A process is dependent on the size of the simulation undergoing VV&A and the decision making or training risk associated with the simulation outcomes. This structure is defined in the Accreditation Plan (see Section 6.1).

Note 6. Detailed discussions of each of these roles for new simulation developments, legacy simulation modifications, and simulation federations are provided at Reference F. However, Simulation Application Sponsor is referred to as 'User'.

72. In large developments personnel undertaking the above roles will also need to liaise and program activities with the Simulation Acquirer and Simulation Manager roles.

a. **Simulation Acquirers** - are those who procure simulations, with a focus on major and minor projects, including requirements analysis. They also administer the development of simulations.

b. **Simulation Managers** - are those who manage a simulation or an organisation that uses or relies on simulation.

Note 7. In Reference F, Simulation Acquirer is referred to as 'M&S PM' and Simulation Manager as 'M&S Proponent'

73. Table 5-1 shows typical responsibilities of each of these roles in relation to VV&A activities.

Table 5-1: Typical responsibilities for VV&A of simulation

Activity	Role			
	Application Sponsor	Accreditation Agent	V&V Agents	Simulation Developer
Define Simulation Requirements	Lead Approve	Review	Review	Assist
Define Acceptability Criteria	Assist Approve	Lead	Assist	Assist
Plan Simulation Development/ Preparation	Lead Approve			Assist
Develop Accreditation Plan	Review Approve	Lead	Assist	
Develop V&V Plan	Review	Assist	Lead	Review
Conduct Verification			Lead	Assist
Conduct Validation			Lead	Assist
V&V Report	Review	Review	Lead	Assist
Develop Accreditation Report		Perform	Assist	
Perform Accreditation Assessment	Monitor	Perform	Assist	
Make Accreditation Decision	Perform	Assist	Assist	
Maintain Configuration Control	Lead			Assist

Lead	Leads the activity. Normally involves participation from others.
Perform	Actually does the activity. Normally involves participation from others.
Assist	Actively participates in activity.
Review	Participation normally limited to reviewing results of activity and providing recommendations.
Monitor	Oversee activity to ensure it is completed appropriately but does not normally participate.
Approve	Determines when an activity is satisfactorily completed and another can begin. Determines what activity should be pursued next. (eg Whether to continue on to the next scheduled activity or to return to a previous activity.

6 SIMULATION VV&A DOCUMENTATION

74. The VV&A process for a simulation application will require planning and the presentation of evidence to enable a decision to be made on whether to use the simulation for the intended purpose. The documentation required by Defence to aid this process is shown in Figure 6-1. Further detail on each document is presented in the following sections.

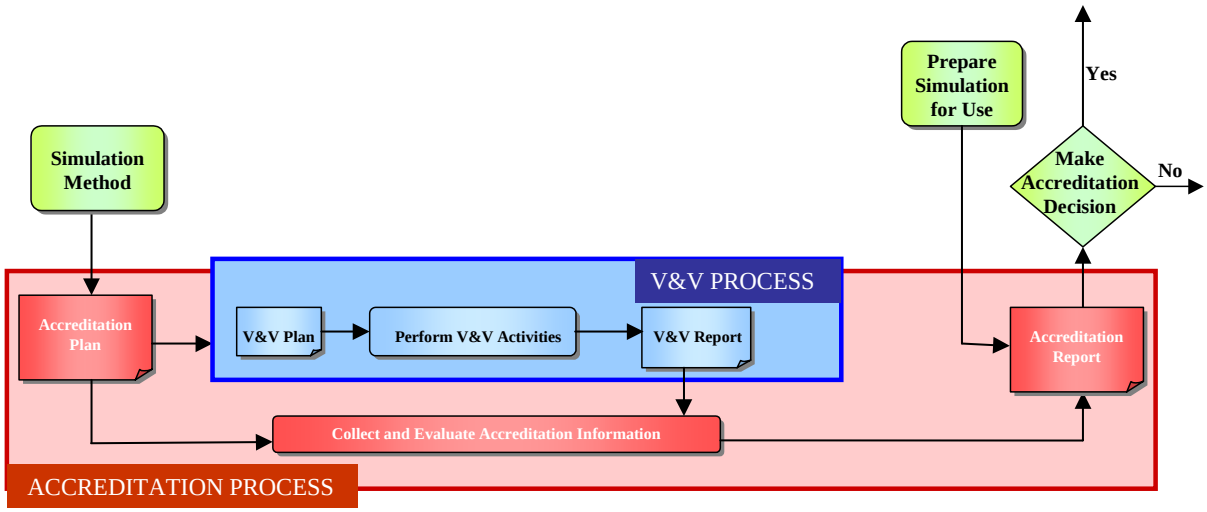


Figure 6-1: Defence Simulation VV&A Documentation

75. It should be noted that each of these documents should be tailored for the specific simulation application. Small and less critical simulation applications may combine accreditation and V&V plans into one consolidated VV&A plan. Likewise a single combined VV&A report may be acceptable. Larger or more critical simulation applications may generate interim reports at the end of each V&V step. The actual report formats used should satisfy the needs of the application and should capture valuable VV&A effort for use in other applications.

6.1 ACCREDITATION PLAN

76. The **Accreditation Plan** is the foundation document for the VV&A process. It describes the information needed to approve the use of a simulation for a particular application and the planned approach to collect or develop that information. It also establishes the accreditation team, identifies the accreditation resources and who is ultimately responsible.

77. Accreditation plans shall contain the following minimum information[13]:

a. Information on the intended use of the simulation.

b. Identification of the Accreditation Sponsor and Accreditation Agent (if different from the Accreditation Sponsor). It should also identify the Validation and Verification Agents.

c. The information needed to assess the fitness of the simulation for the intended application. Accreditation criteria are usually developed to aid this activity.

[13] Reference B.

d. The priorities based on associated risk.

e. The approach to be used for collecting or generating the information.

f. The approach for conducting the accreditation assessment.

g. Resources required and schedule for the VV&A process.

78. A recommended template for Defence simulation Accreditation Plans is provided at Annex E, 'Common VV&A Product Templates'.

6.2 VERIFICATION AND VALIDATION PLAN

79. The **Verification and Validation Plan** identifies the V&V tasks to be performed to address the accreditation information needs and priorities, the requirements to be addressed and the acceptability criteria to be used in validation, the data and techniques to be used, the data to be collected, and the rationale for each. The plan also identifies the resources needed to perform each task, establishes the schedule, and defines the relationship between individual V&V tasks and activities and other project activities.

80. V&V plans shall contain the following minimum information[14]:

a. Identification of the Validation Agent and the Verification Agent. It should also identify the Simulation Developer.

b. Information on the intended use and background of the simulation.

c. Identification of the V&V tasks to be performed to address the accreditation information needs and priorities.

d. Identification of the resources required to perform each task and the associated task schedules.

81. A recommended template for Defence simulation V&V Plans is provided at Annex E, 'Common VV&A Product Templates'.

6.3 VERIFICATION AND VALIDATION REPORT

82. The **Verification and Validation Report** documents the results of executing the V&V plan. Additionally, the report includes any identified simulation limitations and residual risk. It provides input to the accreditation assessment.

83. V&V reports shall contain the following minimum information[15]:

a. Identification of Validation Agent, Verification Agent and Simulation Developer.

b. A description of the simulation and its intended purpose.

c. Results of the verification and validation effort, including any identified simulation limitations and residual risk.

[14] Reference B.
[15] Reference B.

d. Any deviations from the V&V plan.

84. A recommended template for Defence simulation V&V Reports is provided at Annex E, 'Common VV&A Product Templates'.

6.4 ACCREDITATION REPORT

85. The **Accreditation Report** documents the decision to use or not to use a simulation for a particular application. It may include limitations on a simulation's use for the particular application. It may also contain direction for modification or for additional verification and validation to reduce overall application risk. The accreditation report provides the rationale for the decision.

86. Accreditation results shall be documented by the application sponsor and shall include the following[16]:

a. Identification of the Accreditation Agent if different from the Application Sponsor.

b. A description of the simulation and its intended purpose.

c. The Accreditation Agent's evaluation to include capabilities and limitations as they affect the appropriateness of the simulation, or federation of simulations for the intended purpose.

d. The Application Sponsor's decision on whether or not to accredit the simulation, or federation of simulations for the intended purpose.

87. A recommended template for Defence simulation Accreditation Reports is provided at Annex E, 'Common VV&A Product Templates'.

[16] Reference B.

7 RELATIONSHIP OF SIMULATION VV&A TO OTHER DEFENCE INITIATIVES

The importance of VV&A will increase due to the following significant Defence initiatives:

1. The requirement for ADF materiel to meet ADF technical regulatory requirements. ADF materiel includes those simulations that support ADF applications.
2. The increasing role of simulations in support of test and evaluation.
3. The increasing role of simulations in support of system verification and validation.

7.1 TECHNICAL REGULATORY FRAMEWORK

88. DI(G) Log 08-15 - Regulation of Technical Integrity of Australian Defence Force Materiel (Reference J), defines the common framework and requirements for the technical regulation of ADF materiel. The instruction makes the Service Chiefs accountable to the Chief of the Defence Force for ensuring ADF materiel technical integrity. It provides the following guiding principles:

> Regulatory requirements are to be justified in terms of risks to fitness for service, safety and the environment. ADF materiel must be designed, manufactured and maintained:
>
> a. to approved standards,
>
> b. by competent and authorised individuals,
>
> c. who are acting as members of an authorised organisation, and
>
> d. whose work is certified as correct.
>
> The regulatory processes applied to the technical integrity of ADF materiel are to be developed with an awareness and recognition of the civil regulatory regimes applicable to similar technologies.
>
> The degree of regulation is to be determined in accordance with sound risk management practice

89. This means that simulations that are 'ADF materiel' based on their intended application will need to meet technical regulatory requirements for fitness for service, safety and environmental risks (otherwise known as technical integrity). This would also imply that the results of simulations that are used to inform any ADF Materiel decision will need to undergo some form of fitness for purpose assessment. Following the VV&A process for these simulations should provide sufficient evidence to satisfy these regulatory requirements. It is recommended that Technical Regulatory Authorities (TRA) review simulation Accreditation Plans, in the above cases, to ensure all risk requirements have been addressed and that sufficient evidence will be obtained through the VV&A process. It is the responsibility of the Accreditation Sponsor (see Chapter 5) to ensure appropriate ADF materiel technical integrity requirements are satisfied before accrediting simulations for the intended ADF application.

90. The Services have the following technical regulation policies:

a. DI(G) OPS 02-2 – Australian Defence Force Air Worthiness Management (Reference K);

b. Navy: DI(N) Log 47-3 - Technical Regulation of Navy Materiel; and

c. Army: DI(A) Log 12-1 - Regulation of the Technical Integrity of Land Materiel.

91. The TRA have not yet promulgated general instructions for the degree of regulation applicable to 'ADF Simulation Materiel'. However, Air Force and CASA have promulgated the following instructions for the technical integrity of aircraft training simulators:

a. DI(AF) OPS 5-17 AMDT NO 1 Royal Australian Air Force Training Simulator Policy; and

b. CASA Part 60 (refer to http://www.casa.gov.au/).

7.2 TEST AND EVALUATION PROGRAM

92. DIG OPS 43-1 – Defence Test and Evaluation Policy (Reference L), outlines the Defence policy for the application of T&E. Simulation has two direct links to T&E:

a. **Simulation Support to T&E program**. Simulation is used as a tool to aid cost effective decision making when validating operational concepts and end-user requirements in a safe environment. Simulation can be applied throughout the life of a T&E program to achieve this aim. It is also much more cost effective to use simulation than live fire testing and field testing and will be increasingly used in these areas. If the simulations used do not have sufficient fidelity to represent the actual military systems in the types of environments where those systems will be used, then the simulated test results will be questionable. Simulation VV&A is important in assuring confidence of results in relation to the T&E applications.

b. **Simulation undergoing T&E**. As simulations are being developed they will be subject to a T&E program as well. This may or may not involve additional simulation support as described above. In relation to the simulation VV&A program, some savings can be made by leveraging from like T&E activities and appropriate T&E results.

7.3 SYSTEM V&V PROGRAM

93. The Defence Materiel Organisation (DMO) have developed a V&V Policy (Reference M) supported by a V&V Manual (Reference N) outlining how the DMO will apply system verification and validation across the capability systems life cycle. These documents indicate the significance of simulation to meet system V&V requirements. Simulation VV&A impacts the system V&V program in the following ways:

a. **Simulation Support to system V&V program**. Simulation will be used as one of the tools of the system V&V program to provide evidence to Acceptance authorities. It is therefore important that these simulations undergo sufficient simulation VV&A to ensure confidence in their results.

b. **Simulation systems undergoing system V&V**. Some simulations are actually large systems themselves being project managed as a single project or as an embedded element within a project (ie simulation training systems). VV&A agents will need to liaise closely with project managers to ensure appropriate system V&V requirements are addressed in the simulation VV&A program.

8 VV&A STANDARDS

94. Currently, there are no international or Australian standards that specifically address the VV&A of simulations. However, standards for the VV&A of distributed simulations (refer to Reference D) and general software V&V are available.

8.1 SIMULATION VERIFICATION AND VALIDATION STANDARDS

8.1.1 IEEE 1278 – IEEE Standards for Modeling and Simulation: Distributed Interactive Simulation

95. 1278.4-1997 - 'IEEE Recommended Practice for Distributed Interactive Simulation (DIS) - Verification, Validation and Accreditation' contains guidance for the VV&A of DIS exercises. The abstract for 1278.4-1997 follows:

> Guidelines are established for the verification, validation, and accreditation (VV&A) of distributed interactive simulation (DIS) exercises. ""How-to"" procedures for planning and conducting DIS exercise VV&A are provided. Intended for use in conjunction with IEEE Std 1278.3-1996, this recommended practice presents data flow and connectivity for all proposed verification and validation activities and provides rationale and justification for each step. VV&A guidance is provided to exercise users/sponsors and developers.

96. The standard defines three levels of simulation fitness for purpose for DIS Simulations:

a. **DIS Compliance**: A simulation/simulator that can send or receive Protocol Data Units (PDUs) in accordance with the IEEE Standard 1278.

b. **DIS Compatibility**: Two or more simulations/simulators that are DIS compliant and whose models and data that send and interpret PDUs support the realisation of a common operational environment among the systems (ie they are coherent in time and space).

c. **DIS Interoperability**: Two or more simulations/simulators that, for a given exercise, are DIS compliant and DIS compatible and whose performance characteristics support the fidelity required for the exercise.

8.1.2 IEEE 1516 - IEEE Standard for Modeling and Simulation (M&S): High Level Architecture (HLA)

97. VV&A guidance for HLA federations is currently being developed by SISO and will be reviewed by ADSO for Defence use. This guidance will overlay the Federation Execution Development Process (FEDEP) addressing overall VV&A methodology, roles and responsibilities, tasks, resulting products, and challenges.

98. HLA Interoperability is currently categorised into two broad areas:

a. **HLA Technical Interoperability** – the capability of Federates to physically connect and exchange data in accordance with the HLA standard, and

b. **HLA Substantive Interoperability** – is driven by the needs of the Federation and has to be addressed by each Federation in a Federation specific way.

8.2 GENERAL SOFTWARE VERIFICATION AND VALIDATION STANDARDS

99. A listing of the most popular industry software V&V standards can be viewed at http://www.12207.com/v&v.htm. The Defence Information Environment Approved Technology Standards List should also be reviewed (http://intranet.defence.gov.au/cio/). Defence commonly uses the following standards.

8.2.1 IEEE 1012 –1998, IEEE Standard for Software Verification and Validation

100. Provides an overall guide to software V&V activities. Considers the overall process in context of each activity. The abstract for IEEE 1012 –1998 follows:

> Software verification and validation (V&V) processes, which determine whether development products of a given activity conform to the requirements of that activity, and whether the software satisfies its intended use and user needs, are described. This determination may include analysis, evaluation, review, inspection, assessment, and testing of software products and processes. V&V processes assess the software in the context of the system, including the operational environment, hardware, interfacing software, operators, and users.

8.2.2 IEEE 1059 –1993 IEEE Guide for Software Verification and Validation Plans

101. Provides guidance on developing software V&V plans. The abstract for IEEE 1059 – 1993 follows:

> Guidance in preparing Software Verification and Validation Plans (SVVPs) that comply with IEEE Std 1012-1986 are provided. IEEE Std 1012-1986 specifies the required content for an SVVP. This guide recommends approaches to Verification and Validation (V & V) planning. This guide does not present requirements beyond those stated in IEEE Std 1012-1986.

8.2.3 MIL-STD-498, Software Development and Documentation

102. The US Department of Defence, 1998, MIL-STD-498 establishes uniform requirements for software development and documentation.

ANNEX A ABBREVIATIONS AND ACRONYMS

The table defines the acronyms and abbreviations used in the guide.

Acronym/ Abbreviation	**Explanation**
ADF	Australian Defence Force
ADSO	Australian Defence Simulation Office
CASA	Civil Aviation Safety Authority
CM	Configuration Management
DIS	Distributed Interactive Simulation
DI(G)	Defence Instruction (General)
DMO	Defence Materiel Organisation
FEDEP	Federation Execution Development Process
HLA	High Level Architecture
IEEE	Institute of Electrical and Electronics Engineers
IV&V	Independent Verification and Validation
PDU	Protocol Data Unit
SISO	Simulation Interoperability Standards Organisation
SVVP	Software Verification and Validation Plan
T&E	Test and Evaluation
TRA	Technical Regulatory Authorities
V&V	Verification and Validation
VV&A	Verification, Validation and Accreditation
VVAG	Verification, Validation and Accreditation Guide

ANNEX B DEFINITION OF TERMS

The table defines the Simulation specific terminology used in the guide.

Term	Definition
Accreditation (Simulation)	The official certification that a simulation, or federation of simulations is acceptable for use for a specific purpose.
Accreditation Agent (Simulation)	The organisation designated by the application sponsor to conduct an accreditation assessment of a simulation application, or federation of simulation.
Accreditation Criteria	A set of standards that a particular simulation, or federation of simulations must meet to be accredited for a specific purpose.
Application	The executing software on a host computer that models all or part of the representation of one or more simulation entities. The simulation application represents or "simulates" real-world phenomena for the purpose of training or decision making. Examples include manned vehicle (virtual) simulators, computer-generated forces (constructive), environment simulators, and computer interfaces between a distributed simulation network and real (live) equipment.
Application Sponsor (Simulation)	The organisation that utilises the results or products from a specific application of a simulation, or federation of simulations.
Common-Use Simulation	Simulation applications, services, or materials provided by a Defence Group to two or more Defence Groups.
Data Certification	The determination that data have been verified and validated.
Data Validation	The documented assessment of data by subject area experts and its comparison to known values.
Data Verification	Data verification is the use of techniques and procedures to ensure that data meets constraints defined by data standards and business rules derived from process and data modelling.
Federation Element (or federate)	Term applied to an individual simulation that is part of a federation. Federation elements may be distributed.
Federation	A system of interacting simulations, with supporting infrastructure, based on a common understanding of the objects portrayed in the system.
Model	A physical, mathematical, or otherwise logical representation of a system, entity, phenomenon, or process.
Simulation	The implementation or exercise of a model over time.
Simulation Acquirers	Those who procure simulations, with a focus on major and minor projects, including requirements analysis. They also administer the development of simulations.
Simulation Developers	. Those who develop simulations including design and programming. They not only build the initial base level capability, but all subsequent levels of capability as well.
Simulation Managers	Those who manage a simulation or organisations which use or rely on simulation.
Simulator	A device which employs simulation to replace a real world system or apparatus, eg for training purposes. A simulator generally has three elements - a modelled process which represents the real world system, a control system, and a man-machine interface.

Validation (Simulation)	The process of determining the degree to which a simulation, or federation of simulations, is an accurate representation of the real world from the perspective of the intended uses of the simulation.
Validation Agent	The organisation designated by the simulation sponsor to perform validation of a simulation, or federation of simulations.
Verification (Simulation)	The process of determining that a simulation, or federation of simulations, implementation accurately represents the developer's conceptual description and specifications.
Verification Agent	The organisation designated by the simulation sponsor to perform verification of a simulation, or federation of simulations.

ANNEX C REFERENCE DOCUMENTS

The table details the reference documents relevant to this guide.

Serial	*Reference*
A.	DI(G) OPS 42-1 Defence Simulation Policy. http://defweb.cbr.defence.gov.au/home/documents/data/ADFPUBS/DIG/go42_1.pdf
B.	Draft DI(G) OPS 42-2 Defence Simulation Verification, Validation and Accreditation Policy.
C.	'Defence Simulation Proposal Guide' 2002, Volume 1 Part 7 of the Defence Simulation Manual, Australian Defence Simulation Office. http://defweb.cbr.defence.gov.au/capability/ADSO/adso.htm
D.	'Distributed Simulation Guide', Version 1.0, January 2004, Volume 1 Part 9 of the Defence Simulation Manual, Australian Defence Simulation Office. http://defweb.cbr.defence.gov.au/capability/ADSO/adso.htm
E.	'Defence Simulation Data Guide', Volume 1 Part 10 of the Defence Simulation Manual, Australian Defence Simulation Office. http://defweb.cbr.defence.gov.au/capability/ADSO/adso.htm
F.	Verification, Validation and Accreditation Recommended Practices Guide, US DOD Defence Modeling and Simulation Office, August 2001. http://vva.dmso.mil/
G.	Verification, Validation and Accreditation Recommended Practices Guide, US DOD Defence Modeling and Simulation Office, November 1996.
H.	DI(G) Log 08-4 – Defence Policy on Configuration Management. http://defweb.cbr.defence.gov.au/home/documents/DATA/ADFPUBS/DIG/GL08_04.PDF
I.	'Modelling and Simulation Verification, Validation and Accreditation Guidebook', Ver 0.0 (draft) May 2003, Canadian DND, Synthetic Environment Coordination Office. http://www.drdc-rddc.gc.ca/seco/best_practices_e.html
J.	DI(G) Log 08-15 Regulation of Technical Integrity of Australian Defence Force Materiel. http://defweb.cbr.defence.gov.au/home/documents/DATA/ADFPUBS/DIG/GL08_15.PDF
K.	DI(G) OPS 02-2 Australian Defence Force Airworthiness Management. http://defweb.cbr.defence.gov.au/home/documents/DATA/ADFPUBS/DIG/go02_2.PDF
L.	DI(G) OPS 43-1 Defence Test and Evaluation Policy. http://defweb.cbr.defence.gov.au/home/documents/data/ADFPUBS/DIG/go43_01.pdf
M.	Draft DMO Verification and Validation Policy. http://qems.dcb.defence.gov.au/DesktopDefault.aspx?tabid=31
N.	DMO Verification and Validation Manual. http://qems.dcb.defence.gov.au/DesktopDefault.aspx?tabid=31

ANNEX D SIMULATION VV&A SUPPORT

Training and Education

As yet there are no Australian simulation VV&A courses. However, AEgis Technologies (based in Huntsville, Alabama, USA) run a comprehensive VV&A training programs and will travel to Australia to conduct training. Refer to http://www.aegistg.com/MSVVA.html.

Subject Matter Experts

This section provides the Defence Organisation personnel who have gained significant expertise in simulation VV&A and its application. Simulation oints of contact for these organisations can be found at Annex A of the Defence Simulation Manual (SIMMAN).

Defence Science and Technology Organisation

Air Operations Division
The Advanced Distributed Simulation Laboratory within AOD continues to build expertise in VV&A and associated tools for Distributed Simulation.

Maritime Operations Division
The Maritime Operations Division operates the Virtual Ship and Virtual Submarine and has accumulated an expertise in building VV&A for HLA based Simulations.

Army Simulation Wing
The Army Simulation Wing (ASW) was established to manage Army's Simulations and be responsible for their technical control. The ASW is directly responsible for the Army Synthetic Environment.

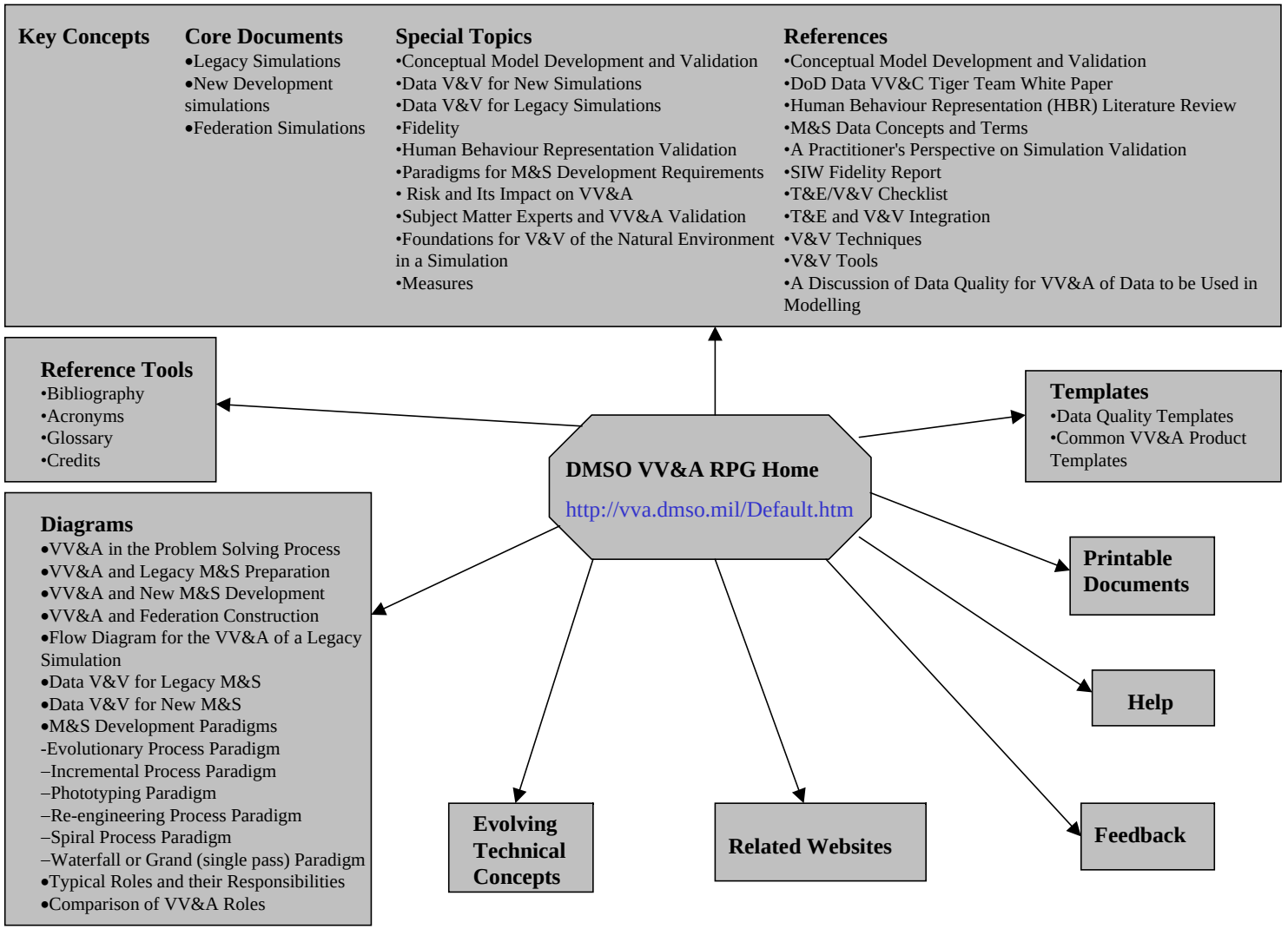
Defence Materiel Organisation

Aerospace Systems Division
The Aerospace Simulators Systems Support Office provides expertise on any matter relating to Aerospace Simulation and its regulation.

Capability Development Group

Australian Defence Simulation Office
ADSO with access to broad knowledge of VV&A and its application can offer advise on relevant sources of Australian and overseas documentation and expertise.

ANNEX E DMSO VV&A RECOMMENDED PRACTICES GUIDE SITE MAP



ANNEX F SIMULATION VV&A EXAMPLES

Suitable VV&A simulation projects underway or completed will be provided here to assist knowledge sharing.

Simulation Verification, Validation and Accreditation Guide
Evaluation Form

Because this Guide will continue to be a 'living' document, ADSO welcomes your comments and will use the feedback to ensure that the Guide meets the needs of the audiences for which it is intended. Please take a moment to answer some or all of the five questions below. Including your name and address will be appreciated but is not necessary. Send your responses to:

Mr Darren Mc Farlane
ADSO Navy 1
R1-3-B066
Phone: (02) 6265-4797; Fax: (02) 6265-2223;
e-mail: darrenmcfarlane@defence.gov.au

* * * * *

1. **According to your understanding of Simulation VV&A, is any information presented in this Guide incorrect or inaccurate? (You may want to attach a copy of the page marked with your suggested changes.)**

Page and line number	***What is in error in this statement or discussion, in your estimation?***

2. **In your opinion, should any discussions in the Guide be expanded and presented in greater detail? Is any statement or discussion unclear?**

Page and line number	***What unanswered question(s) do you have after reading this material?*** ***For the work you do, what additional information do you need? Is this statement or discussion unclear?***

3. **In your opinion, should any material in the Guide be eliminated or condensed?**

Page and line number	***Why do you believe these statements or discussions should be omitted or shortened? (eg, 'too detailed for my needs,' 'redundant,' 'irrelevant for my needs,' 'too elementary.')***

4. **Did you find any typos, misspellings, or other production errors in the Guide?**

Page and line number	*Error*

5. **Do you have any other suggestions for making the Guide a more effective and usable document?**

Optional

Name_____

Address_____

_____

_____

Phone_____Fax_____

e-mail address_____

Thank you for taking the time to share your opinions with ADSO.