Australian Government
Department of Defence

Defence Simulation Standards Guide

Australian Defence Simulation Office

Department of Defence, Canberra

DRAFT

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Foreword

The Defence Simulation Standards Guide (DSSG) provides a source of information and advice in relation to current and emerging simulation standards applicable to 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.

As standards reflect a consensus view of current technology they have a limited validity before requiring review, withdrawal or revision. The DSSG will be updated as required, to reflect these changes and any changes in Defence policy or guidance. Comments or further clarification on any aspect of the DSSG are welcomed. Please complete the evaluation form at the back of this document.

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Table of Contents

List of Figures

Amendment List

Serial	Amendment	Date Effected
01	Original Release	

1 INTRODUCTION

1.1 BACKGROUND

1. "Defence looks increasingly to simulation as a way to help decision makers take better account of the complexity, the dynamics and the uncertainties that pervade modern warfare."[1] This requires defence to "focus on ensuring that the most effective use is made of current capabilities while actively pursuing opportunities presented by future investments in new and improved approaches."

2. Simulation application use in Defence is to develop well beyond the individual, to collaboration between individuals and groups including our allies. Simulation applications are to expand from specific technical disciplines to a coherent suite drawing on a common pool of data and assumptions. The framework of simulation is to support strategic decision making, capability development, acquisition, operations and through life support.

3. The continued adoption, use and development of standard methods, tools and technologies for simulation developers, acquirers, managers, users and supporters provides the opportunity for the effective and efficient use of simulation to meet the goals of Defence simulation policy.

1.2 PURPOSE OF THIS GUIDE

4. The Defence Simulation Standards Guide (DSSG) provides a basic introduction of the importance of standards in simulation acquisition, development and management. It is intended to cover all simulation standards of relevance to the Australian Defence Organisation (ADO). This guide:

a. lists and categorises simulation standards and their status;

b. provides an overview of the main simulation standards used by defence;

c. defines the process by which simulation standards are managed in the ADO;

d. identifies key local and international standards bodies; and

e. provides details of sources of support and further information.

1.3 GUIDE OVERVIEW

5. The definition of what constitutes a simulation standard and the different forms of standards, i.e. open, defence and proprietary, are defined in chapter 2. A brief discussion of the general principles for the decision to use standards and the general benefits and limitations of standards application are provided.

6. The process by which simulation standards are evaluated, tailored, updated and recommended for Australian Defence and Commercial use is defined in chapter 3. The developer, maintainer and point of contact details, provides the appropriate channel for requesting amendments.

[1] Reference DI(G) OPS 42-1 para 1.

7. Categories and sub categories of simulation standards are defined in chapter 4. The categorisation provides a grouping of standards based on the common purpose of the standards as relevant to defence simulation. Key organisations and standards for each category are identified.

8. To aid in the selection of the most appropriate standards, a brief overview of each of the main simulation standards, its defence status (i.e. superseded, mandatory or emerging), main goals, limitations and differences from the other main standards in the same category, are provided in chapter 5. The source of the standard is also provided to give some indication as to the breadth of industry and regional participation during its development and coverage in its application.

9. Chapter 6 provides a listing of standards organisations by standards type, i.e. international open, defence and proprietary. A brief overview of each of the key simulation standard organisations, their contact details and the key simulation standards they are responsible for is included.

10. Guidance is provided in chapter 7 on the application of simulation standards to aid in addressing the practical issues for the application of simulation as laid down in the Defence Simulation Policy[2].

11. Chapter 8, identifies organisations offering training and support relevant to the application of simulation standards to the defence environment. The chapter includes references to a number of websites that provide substantial amounts of useful material and to local points of contact.

1.4 DEFENCE SIMULATION STANDARDS POLICY

12. The DSSG will assist the ADO and the supporting simulation industry and academic organisations to efficiently achieve the goals of the Australian Defence Simulation Policy.

13. The Defence Simulation Policy[3] states the vision for simulation in Defence as follows:

> *"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."*

14. Part of the conceptual vision for simulation in defence[4] states that:

> *"As the use of simulation in Defence has expanded, so too has the opportunity to minimise the incremental cost of each simulation. Clear and coordinated requirements have combined with developments in simulation technology and standards to create significant opportunities for reuse of simulations and simulation elements, and the development of 'omnibus' simulations which address a number of related needs".*

[2] Reference DI(G) OPS 42-1, para 22.
[3] Reference A, para. 6
[4] Reference A, Annex A para 10

15. The conceptual vision also describes the expectation for the ubiquity of simulation in all elements of activity and as an integral part of all processes. Its scope for simulation training ranges from a few individuals to large groups including groups from allied nations. Achievement of this vision will require interoperability of simulations and compatibility of the representation of the synthetic environments. The broad adoption of distributed simulation standards and representation standards will be a necessary to achieve this aim.

16. Defence Simulation Policy has identified the practical issue of confidence building and data reliability that need to be addressed. Confidence building standards provide a process for establishing fitness for purpose of both simulations and the associated databases.

17. Compliance with simulation engineering and simulation management standards will be a necessity for efficient supply and exchange of technology, tools and products if defence is to address its strategic issues of ensuring the right levels of industry and academic participation and the development of effective management of investments in simulation.

18. The need to adopt simulation standards to achieve the Defence vision for simulation has been specifically recognised in Army Simulation Policy[5], Air Force Simulation Policy[6] and Navy Simulation Policy[7].

19. The Australian Defence Simulation Office (ADSO) is the branch within the Australian Defence Headquarters with the roles of policy direction, collaboration and coordination of simulation activities across Defence[8]. This includes the responsibility for Defence Simulation Standards.

1.5 RELATIONSHIP TO OTHER DOCUMENTS

1.5.1 Relationship of this document to other parts of the SIMMAN.

20. This guide is part of the Defence Simulation Manual (SIMMAN). This document provides an overview of Defence Simulation Standards covering all aspects of Defence Simulation. Other parts of SIMMAN contain sections on standards specifically pertaining to the topic of that part.

21. The relationship between this document, applicable Defence simulation policy and other guidance documents is shown in Figure 1-1.

[5] Reference C, para 64, 68, 73
[6] Reference D, para 11
[7] Reference E, para 31,
[8] Reference A, para 17.

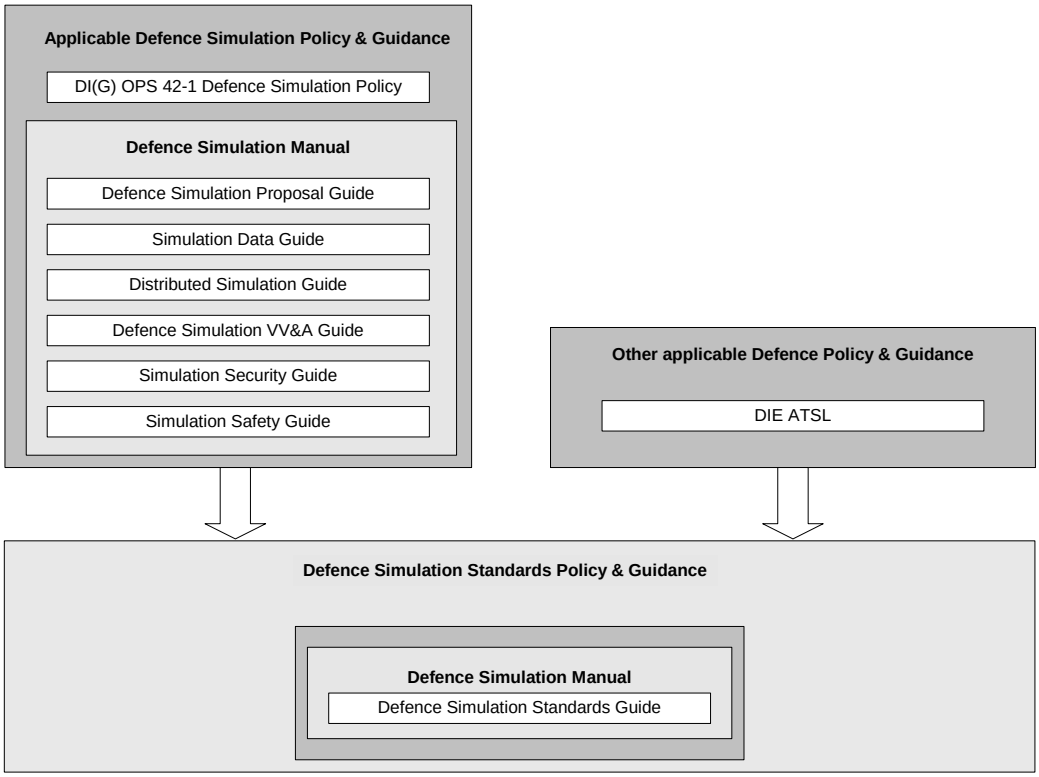

Figure 1-1 Relationships to other documents

1.5.2 Relationship of this document with DIE ATSL

22. The Defence Information Environment (DIE) Approved Technology Standards List[9] (ATSL) (covered by DIMPI 3/2002) contains the mandatory and emerging technology standards that are to be used for all Defence Information Infrastructure (DII) and Communications and Information Systems (CIS) and Management Information Systems (MIS). The ATSL is to be used by all ADO staff, Defence consultants and contractors responsible for DIE-related capability development, architecture development, procurement and projects.

23. Defence Simulations are deemed to be DII and/or CIS and/or MIS and hence compliance with ATSL is required unless an exemption has been granted. ATSL policy[10] allows for alternative technology standards to be proposed to the DIEC on the grounds of exceptional business and/or technical requirements.

24. Defence simulation standards for combined interoperability of simulations between the CCEB nations of AUS, USA, UK, CAN & NZ are cited in ADatP-34 Volume 4 (DIMPI 2/2002 refers) and are replicated in the ATSL. ADatP-34 Volume 4 contains the list of combined interoperability standards for CCEB nations.

[9] Reference F, Chapt. 1, Overview, Purpose of the DIE ATSL.
[10] DIMPI 3/2002

2 WHAT ARE STANDARDS AND WHY USE THESE

2.1 DEFINITION OF STANDARDS

2.1.1 Definition of a "standard"

25. Standards Australia defines[11] a standard as a: "document, established by consensus and approved by a recognised body, that provides, for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context."

26. The US DOD Defense Modeling and Simulation Organisation (DMSO) Online M&S Glossary[12] provides the following definition of a standard: "A rule, principle, or measurement established by authority, custom, or general consent as a representation or example."

27. The Standards Australia definition of a standard is applicable throughout this document.

2.1.2 Definition of a Defence Standard

28. The term Defence Standard is defined here to mean a standard developed specifically to fulfil the needs of Defence organisations. Defence standards include United States (US) Department of Defence (DoD) standards (MIL-STDs) and the North Atlantic Treaty Organisation (NATO) standards (STANAGs).

2.2 USE OF STANDARDS

29. The general guiding principle for the use of standards is:

> *Simulation standards should only be applied where the benefits of complying with the standard will outweigh the cost of compliance.*

30. In some cases this assessment has been undertaken by others resulting in the requirement to comply with a standard being mandated through regulation or legislation. The most common examples of this are safety and security standards.

31. General benefits available from the application of standards and some of the limitations are outlined below.

2.2.1 General Benefits of Standards Application

32. Standards have an increasingly important role in enabling the efficient delivery and management of the defence vision for simulation across the breadth of applications and the realisation of the benefits sought. Standards will assist by providing proven industry consensus based methods of:

[11] Reference Standards Australia, Preparing Standards, Standardisation Guide, 2 March 2004. Chapter 1.
[12] Reference DMSO, Online M&S Glossary DoD 5000.59-M. https://www.dmso.mil/public/resources/glossary/

a. improving the communication within teams and with the broader simulation community by employing standard terms and methods of specifying requirements.

b. defining common forms for representations, providing consistency and allowing for reuse and interchange of data.

c. enabling interoperable distributed simulation by defining standard architectures and communications interfaces.

d. ensuring confidence in the use of simulation and the simulated results by defining fidelity requirements and standard methods for validation, verification and accreditation of simulations.

e. reducing development costs by using a standard language, approaches and developing standards compliant shareable, reusable simulation and simulation data components.

f. benefiting from sharing of data and ideas, cooperation and interaction with the broader simulation community facilitated by the use of a common simulation engineering language, methods, tools and practices.

g. reducing project management, safety and security risks by employing standard based approaches and performance level.

h. Providing more efficient and effective simulation management by using standards approaches and common simulation and simulation data components.

i. reducing training effort and improve resource availability through standardising on procedures, practices and method by reducing the variety.

j. simplifying life cycle issues by providing standard baseline formats and methods for data exchange formats between new and old formats and standard interfaces to legacy systems.

2.2.2 General Limitations of Simulation Standards

33. By their very nature open (non proprietary) standards are developed from a common need and consensus hence they lag the latest developments. Standards are therefore best applied to aspects where a common need exists.

34. Complying and demonstrating compliance to a standard typically adds to initial cost and delivery time. The extent of the additional cost and time will depend on the breadth of adoption and maturity of the standard.

35. As technology changes so does the consensus on the state of the art, as a result standards will also change.

36. Although efforts are often made to provide some level of backward compatibility, there is no fundamental requirement for the developers of standards to guarantee that there will be a low cost (or any) migration path between various versions of standards.

37. The specification of proprietary standards may result in vendor lock-in, lack of interoperability or place unnecessary restriction on the ability of other vendors to offer

products or services and should therefore be avoided. Where proprietary standards are specified the acquirer should ensure that a licence to use these standards is available at a fair price to all potential users.

2.3 DEFENCE SIMULATION STANDARDS POLICY STATUS

38. The defence simulation policy status, "Status" as contained in Annex D is intended to be consistent with the DIE ATSL Policy Status[13], however where the DIE ATSL Policy Status contains two status levels, M – Mandatory and E – Emerging, two additional status levels have been included in this document, these being S- Superseded and R- Recommended.

39. This document uses the status of superseded to refer to legacy standards that will continue to be in use in legacy systems. The status of recommended is used where significant benefits cannot be realised with a single mandated standard.

[13] Reference F, Chapt 1, para 0107.

3 DEFENCE MANAGEMENT OF SIMULATION STANDARDS

40. This chapter describes the processes for creating, updating, amending and distributing defence simulation standards and the roles of the relevant authorities.

3.1 LEVELS OF STANDARDS

41. The process for managing standards is dependent on the level of applicability of the standard. The levels of simulation standards are defined below:

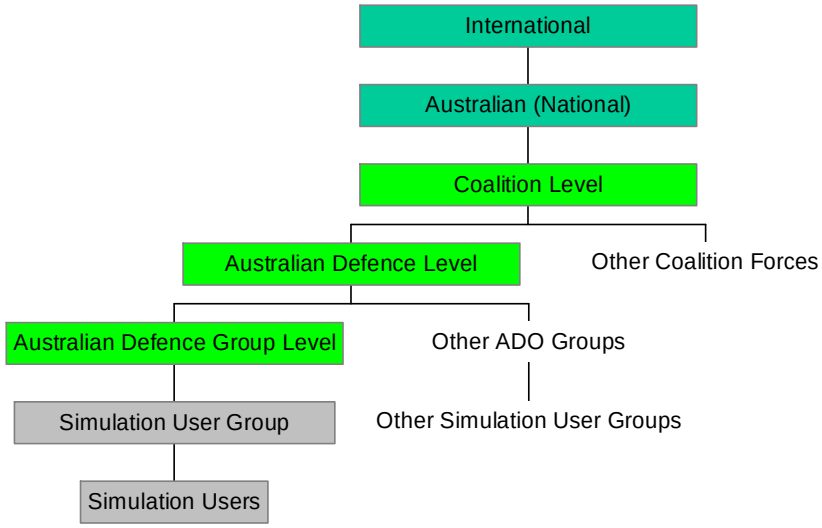

Figure 3-1 Levels of Defence Simulation Standards

a. Within Defence

i. **Australian Defence Group Level** – simulation standards where application is limited to within a single group.

ii. **Australian Defence Level** – simulation standards where application is for more than one Defence group but is limited to use within the ADO.

iii. **Coalition Level** – simulation standards for application by more than one Defence Force (i.e. combined or coalition simulations).

b. Outside Defence

iv. **Australian** – simulation standards specifically developed or adopted (with or without modification) for use within Australia.

v. **International** – simulation standards intended to establish common international practices.

42. The Defence management of simulation standards for each of the levels above is described below.

43. The process for managing simulation standards used by the ADO is also dependent on the origin of the standards. Standards developed and used only within the ADO can be managed completely within the ADO, whereas standards developed by organisations external to the ADO will require the involvement of those external organisations. Hence it is useful to further categorise standards by origin as either:

a. Internal Standards – being those defence simulations standards developed and maintained by groups within the ADO; and

b. External Standards – being those developed by any organisations external to the ADO, eg Standards Australia.

3.2 MANAGEMENT OF SIMULATION STANDARDS WITHIN DEFENCE

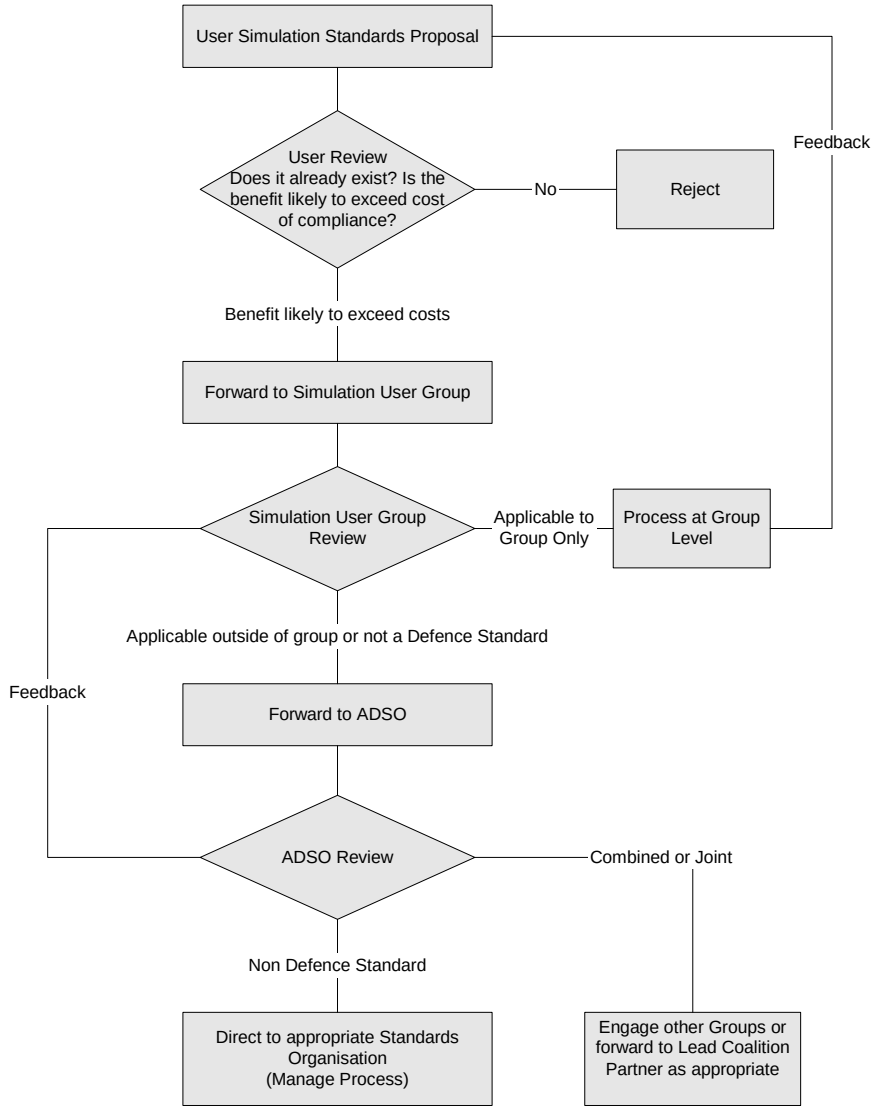

Figure 3-2 Process for managing Defence Simulation Standards

44. This section describes the management of simulation standards applicable within Defence for simulation standards intended specifically for defence purposes. A general overview of the process is provided in Figure 3-2.

45. Throughout Defence the following applies.

General Policy is to only use and develop internal defence standards where external standards do not satisfy the intended application.

3.2.1 Australian Defence Group Level

46. Proposals for the creation, amendment or adoption of internal simulation standards intended to be put to use solely within that group should be approved by that group's simulation cell (or simulation coordination group).

47. Proposals for the adoption of an externally developed simulation standard to be put into use for the sole use of that group should be approved by that group's simulation cell (or simulation coordination group).

48. Proposals for the creation or amendment of an externally developed simulation standard should be provided to ADSO via the groups simulation cell (or simulation coordination group).

49. Any individual or simulation user group may raise a proposal for consideration by its simulation coordination group. Definition of the specific format and content required in the proposal and the procedure for processing the proposal is the responsibility of the relevant simulation group.

50. The simulation standards contact for each group is provided in Annex A of the Defence Simulation Manual (SIMMAN).

3.2.2 Australian Defence Level

51. ADSO is responsible for the management of Australian Defence Level simulation standards. This role includes the coordination and management of inputs from multiple groups, the review of inputs and the management of negotiation required to achieve consensus between the interested groups.

3.2.3 Defence Coalition

52. The responsibility for simulation standards required to support coalition or combined simulations with:

- NATO; and
- CCEB Nations

is the responsibility of the lead coalition partner. Standards issues should be forwarded via ADSO to the lead coalition partner.

3.2.4 Outside of Defence

53. Outside the ADO, ADSO has a responsibility for representing the Defence view on simulation standard issues. ADSO may delegate this responsibility to other Defence organisation members.

54. The development and adoption of national standards and Australia's participation in the development and adoption of international (open) standards is via Standards Australia. ADSO represents and promotes the Defence interest via its membership of the Standards Australia IT-031 Modelling and Simulation Standards Committee. The IT-031 committee is Standards Australia's vehicle for the influencing of or proposing new international (ISO/IEC) standards.

55. Other simulation related standards organisations, such as SISO and the IEEE, operate independently of ISO hence other avenues of engagement are required. The SIAA is the simulation industry body in Australia currently offering the opportunity to coordinate standards development processes through these organisations. ADSO is an associate member of this organisation, again with the role of representing and promoting Defence interests and goals for simulation standardisation.

3.3 CREATING OR AMENDING STANDARDS

56. The process and issues associated with proposing new simulation standards or amendments to existing simulation standards is described for Australian Defence, National Standards (AS), International Standards (ISO/IEC) and Open Standards. For changes to proprietary standards it is recommended that direct contact be made with the commercial originator.

3.3.1 Australian Defence Simulation Standards

57. Requests beyond group level, for amendments to, or for new, Defence Simulation Standards from within Defence should be communicated to ADSO. Requests from within Groups should be forwarded via the appropriate Defence Simulation Coordination Groups (SCG). There are SCGs for each Defence Group. The points of contact for the SCGs are provided in Annex A of SIMMAN.

3.3.2 International Defence

58. Proposals for amendments to International Defence simulation standards (eg NATO or US DoD standards) should be directed to ADSO.

3.3.3 National (Australian) Standards

59. Australian Standards have a maximum validity period of 15 years after which they will be withdrawn or may be revised and reissued. Typically they are reviewed every 5 to 7 years.

60. A request, to prepare a new standard, or to revise, amend or withdraw an existing standard are accepted by Standards Australia from the government, an industry or trade association, professional body, consumer organisation or individual. Proposals may also be raised internally by Standards Australia committees.

61. The process for developing a new Australian Standard and/or a Joint Australian/ New Zealand standard is provided in detail in reference AA.

a. **Stage 1, Proposal** - the proposal is evaluated and approved or rejected.

b. **Stage 2, Working draft** – a Technical Committee is formed which has a membership including all interested sectors. The committee is responsible for producing a working draft, including amendments or revisions.

c. **Stage 3, Public Comment**- the working draft is made available via the Standards Australia website for public comment. The committee actively seek comment.

d. **Stage 4, Approval** – prior to adoption the technical committee holds a formal ballot of committee members seeking consensus approval of the content of the standard. Only after consensus is achieved can the document proceed on to becoming a standard. The standard is then approved by the relevant Standards Sector Board or Standards Development Board.

e. **Stage 5, Publication** – Standards Australia arrange for the Standard to be published and made publicly available via Standards Australia International (SAI) Global.

f. **Stage 6, Servicing** – The Technical Committee may be required to review amendments. There are two types of amendments, corrections which correct misprints or production faults but do not add to or change the standard and revised text which may add material or change the application of the standard.

62. Further information describing how new national standards, revision, amendments or requests to withdraw a standard are submitted, evaluated and then implemented by Standards Australia is provided reference AA which is available from their website.

63. Requests for the creation or amendment to Australian Standards from within Defence should be directed to ADSO.

3.3.4 International Standards (ISO/IEC)

64. International Standards are developed along the same principles as Australian Standards, except that input must come via the country representative, Standards Australia. Hence proposers only need concern themselves with contacting Standards Australia.

65. International Standards are reviewed at least every 5 years to check for changes in technology and relevance.

66. Requests (proposals) must be submitted via national member. In the case of Australia our national member (representative) is Standards Australia. National member puts proposal to the ISO Council, which meets 3 times a year. ISO Council may then pass proposal on to appropriate standards committee.

67. Original individual requestors or requesting organisations may become involved by contributing to the standards development through their national ISO member (i.e Standards Australia). This may include serving on national delegations participating in ISO technical committees, or providing input during the process of developing a national consensus for presentation by the national delegation.

68. International organisations and associations, both non-governmental and representing industry sectors, can apply for liaison status to a technical committee. They do not vote, but can participate in the debates and the development of consensus."

69. Some further details on the process can be found on the ISO/IEC website.

3.3.5 International Open Standards

3.3.5.1 IEEE/IEEE-SA

70. The IEEE-SA has a detailed process for creating or amending standards, details of which are provided on their website. In brief, a project authorisation request (PAR) must be submitted for either creating a new standard or for an amendment. This form requires a sponsor who must be an IEEE or IEEE-SA member. Participating in a standard's balloting invitation pool also requires IEEE-SA membership.

71. Because there is currently no working relationship between the IEEE and ISO or SAIL, therefore any requests in relation to IEEE standards will need to be taken up directly with the IEEE-SA. Any requests from within Defence should be directed to ADSO.

3.3.5.2 OGC

72. Details of the process for creating new standards or for amendments is provided in the Open GIS Consortium's "The OGC Technical Committee Policies & Procedures" document available for download from the OGC website. The OGC currently has 9 levels of membership tailored to the various organisations size and type. Technical Committee members and above can participate and vote in OGC technical committees. Technical Committees are the vehicles for standards development and maintenance. Technical committee members may submit technologies in response to Consortium requests.

73. OGC standards The OGC also provides a public forum which allows questions and issues to be raised by members of the public. The forum is available via the web[14].

74. A number of OGC standards relevant to the representation of simulation data have been recently published under the ISO/IEC banner. Additional standards are currently passing through the ISO/IEC approvals process. Any requests regarding these standards will be processed through SAIL, hence requests from within Defence should be directed to ADSO.

3.3.5.3 OMG

75. Requests for creating new standards or for amendments need to be raised by OMG members. Details of the process for having new standards developed by OMG are provided in the OMG "Policies and Procedures Document" (currently version 2.3). The OMG Hitchhiker's Guide Version 7.0 serves as an aid to navigating through and complying with the OMG technology adoption process. Both of these documents are available for download from their website.

76. The OMG website also contains a web page for directly reporting bugs and issues related to OMG specifications. The page includes an intellectual property rights clause to allow recommended fixes to be incorporated into OMG specifications.

77. Any requests from within Defence relating to OMG standards should be directed to ADSO.

3.3.5.4 SISO

78. The creation or amendment of SISO standards is covered by the "SISO Balloted Products Development Process" (SISO-ADM-003-2002) document. This can be downloaded from the SISO website. The process begins with a product nomination (PN) that then goes

[14] OGC Public Forum access site is http://feature.opengeospatial.org/forumbb/

through the SISO internal approval process after which it passes to a product development group (PDG). The PDG are responsible for the standards development. The PDG are made up of SISO members, typically parties who have an interest in the development of the product and who can volunteer their time for its development. Voting on the adoption standards is from a consensus of members.

79. SISO standards are subject to a periodic review cycle. Review periods range from 2 to a maximum of 5 years. The IEEE publishes approved SISO standards.

80. The Simulation Industry Association of Australia (SIAA) is currently negotiating a relationship with SISO to allow the SIAA to become involved in, and influence, the content of SISO developed standards.

81. ADSO are SIAA associate members and hold SISO membership. Requests from Defence for amendments to or for new SISO standards should be directed through ADSO.

3.3.5.5 Web3D

82. Web3D's X3D standards are currently in the process of being adopted as ISO standards, hence any amendments should be directed through Standards Australia as they are the Australian ISO representatives. Individuals, companies and organisations can become Web3D members directly. Members can directly participate in working groups. Further details are provided on their website.

83. Any requests from within Defence relating to OMG standards should be directed to ADSO.

3.3.6 Proprietary Standards

84. Proposals for amendments to proprietary standards need to be made directly to the developers. Contact details are provided in Annex D. Any requests from within Defence relating to proprietary standards should be directed to ADSO.

3.4 AVAILABILITY & DISTRIBUTION

3.4.1 Defence Standards & Manuals

3.4.1.1 For ADO personnel

85. Initial enquiries for Defence Simulation Standards where the source is unknown should be directed to ADSO.

3.4.1.2 NATO

86. A number of NATO standards including STANAGS and ADatP are available for download from the NATO website. Contact details for this organisation are provided in Annex E.

3.4.2 Australian Standards

87. Australian Standards are available from the Defence Library DEFWEB site (free) or SAI Global. Electronic or hardcopies can be purchase via SAI Global and Standards Australia website. Contact details for this organisation are provided in Annex E.

3.4.3 International Standards

88. ISO and ISO/IEC standards are also available from SAI Global as above.

3.4.4 International Open Standard

89. Simulation related International Open Standards as listed in Annex D are available from the original developers websites as listed in the Standards list. Additional contact details for these organisations are provide in Annex E.

3.4.5 Proprietary Standards

90. Proprietary standards are typically available directly from their developers. Contact details for these organisations are provided in Annex E.

4 CATEGORISATION OF SIMULATION STANDARDS

4.1 MAIN CATEGORIES OF DEFENCE SIMULATION STANDARDS

91. Defence Simulation Standards fall into the following categories.

a. ***Simulation Management Standards*** include standards that assist in the effective management of simulations.

b. ***Simulation Engineering Standards*** include standards that assist in the development of simulations.

c. ***Confidence Building Standards*** specifically address the fitness for purpose of simulations.

d. ***Distributed Simulation Standards*** assist in combining and the interoperability of simulations.

e. ***Representation Standards*** assist in the representation of simulated entities and environments.

92. Information regarding the type of standards, i.e. defence, open or commercial, and the intended coverage of the standards, i.e. single organisation, national or international is provided in chapter 3.

4.2 SUB CATEGORIES OF DEFENCE SIMULATION STANDARDS

93. The sub categories shown in Figure 4-1 have been developed to provide additional categorisation of Defence simulation standards.

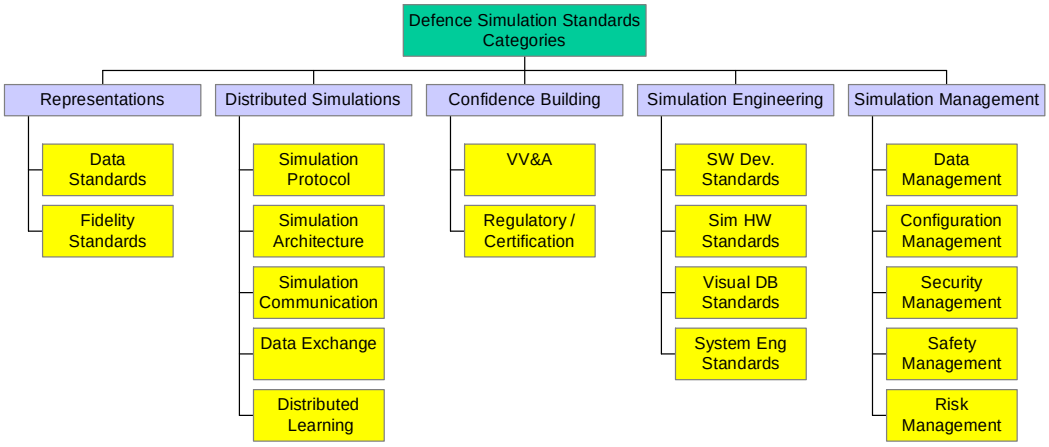

Figure 4-1 Categorisation of Defence Simulation Standards

94. A listing of Defence Simulation Standards by category is provided in Annex D. The Annex identifies the status of individual standards, i.e. emerging, current or superseded, is the developer/maintainer of the standard and the Defence point of contact for the standard.

4.2.1 Representations

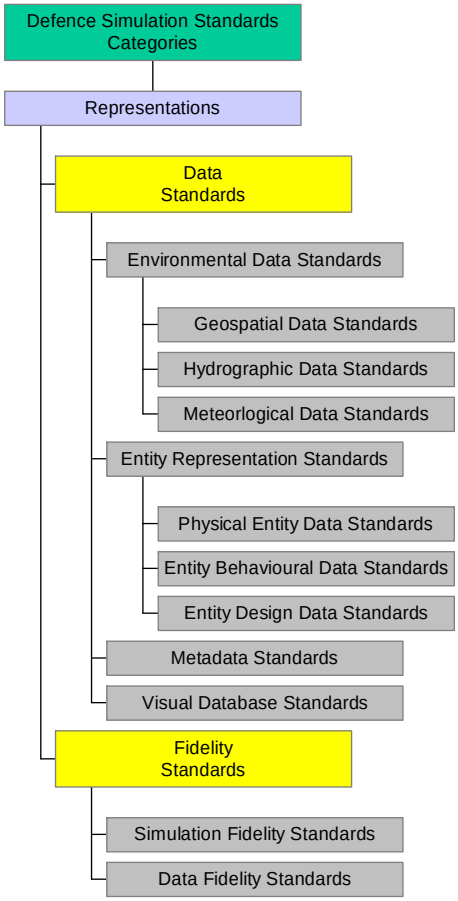

Figure 4-2 Simulation Representation Standards

95. Representations define how real world items are represented (appear and behave) in the modelled or simulated world. Representations include: environmental data which provides the detailed definition of items such as, geography, terrain, vegetation, rivers, roads and man-made structures; and entity data which describes people, vehicles, machines and equipment.

96. Representation data may also include data about the data, i.e. metadata[15]. Metadata is often used to verify the compatibility, consistency, accuracy and validity of the data for simulation interoperability and accreditation purposes, or for reuse.

97. As well as defining properties like size, weight, velocity, formation, environmental and entity data representations must also include data allowing the identification of the

[15] A more detailed description of Metadata is provided in the SDG, Reference G section 4.2.

environment or entity. Standards exist for the format and structure of environmental and entity data and for the format and content of the Metadata as described in the following sections. There are however currently no standards to ensure the consistent representation of data between different DIS or HLA simulations.

98. Interoperability between DIS based simulations is facilitated by Protocol Data Units (PDUs). The PDUs allow for the identification of entity and entity states but do not ensure consistency of the identity data values used by the individual simulations. The ADF DIS enumerations address the issue of consistency of PDU data values.

99. As for DIS the HLA standard does not ensure the consistent representation of data between different HLA simulations. The Real time Platform Reference Federation Object Model (RPR FOM) addresses the issue of consistency of enumeration type data between DIS and HLA simulations and can also be used to achieve consistency between HLA simulations.

100. Standardisation of representations is necessary to facilitate reuse and interoperability. This is particularly important because of the need to ensure the consistency and integrity of data between simulations and minimise the substantial cost, effort and time associated with collection and validation.

101. Additional information on representation standards is provided in section 5.1.

4.2.1.1 Data Standards

102. Data representation (in defence applications) can be further broken down into environmental data, entity representation standards, metadata standards and visual database standards. Environmental data defines the modelled or simulated world and entity data describing the objects operating in that world. Metadata standards exist for all data types, metadata provides data about the data. Visual database standards define the way the data displayed through the simulations visual display is represented. A detailed discussion of simulation data and data standards is provided in the Simulation Data Guide. A brief overview is provided below.

4.2.1.2 Environmental Data Standards

103. Environmental data representation standards are further categorised into geospatial, hydrographical and meteorological. The categorisation of these standards matches the specialist areas and organisation which are the source of the associated data, eg Open Geospatial Consortium (OGC), International Hydrographic Office (IHO), Bureau of Meteorology.

104. A list of these standards by category is provided in Annex D. A more detailed description of each of these data standards is provided in the Simulation Data Guide. The Simulation Data Guide also provides details of Australian sources for environmental data, such as DIGO, Geosciences Australia, Australian Hydrographic Office and Bureau of Meteorology.

4.2.1.3 Entity Representation Standards

105. “An entity is considered anything within a simulation, which requires specific detail in order to create a static or dynamic model of its real world equivalent (other than

environmental categories)"[16]. Entities include physical models such as aircraft, vehicles, bridges etc. and systems such as radar.

106. **Physical entity data standards** – should define a consistent way in which dimensional and appearance characteristics are represented, for the entire electromagnetic spectrum (IR, radar, visual), if required by the simulation. Physical entity representations also include audio emanations.

107. The current state of physical entity standards is:

a. According to the Simulation Data Guide section 4.4.1, at this time there are no formal recognised standards for Physical Entity Data.

b. HLA does not currently define a requirement for physical entity data representation.

c. Detailed 3-dimensional geometry as used for the visual representation of entities is frequently represented in de facto industry standards, eg Openflight.

d. Physical entity data may be represented in one of the standard CAD formats. STEP (ISO 10303 FDIS) the standard for product representation and exchange is currently passing through the ISO approvals process.

e. There are a number of data exchange standards for physical characteristics. These include IGES and SEDRIS.

f. No specific standard for the format of audio data in simulations exists.

108. **Entity Behavioural Definition Standards** – should enable a standard way for representation of the manner in which an entity acts and interacts (behaves) in its environment, including interactions with other entities (both fixed and dynamic).

109. The current status of behavioural definition standards is:

a. According to the Simulation Data Guide[17], at this time there are no formal recognised Behavioural Entity Data Standards. Current standards define standard methods for the communication of the results of entity behaviours to allow interaction (and hence interoperability) between simulation entities.

b. Common entity behaviours need to be incorporated in each networked simulation, identified by enumerations defined for that specific project.

c. DIS is purely a communication protocol; compliant simulations behaviours have no common format.

110. **Entity Design Data Standards -** According to the Simulation Data Guide[18], at this time there are no formal recognised standards for Entity Design Data Standards.

[16] Reference G, SDG section 3.3.2
[17] Reference G, SDG Part 10 section 4.4.2
[18] Reference G, SDG section 4.4.3

4.2.1.4 Fidelity Standards

111. Simulation fidelity requirements are determined by the need to meet the fitness-for-purpose criteria for the intended application. Fidelity requirements are usually defined for each specific application.

112. Due to the long history and comprehensive safety regulations of the aviation industry, flight-training simulators are the only simulation application with widely adopted fidelity standards. CASA MOS Part 60, which superseded CASA's FSD1 and FSD2, are the Australian Standards defining fidelity requirements for Approved Flight Simulators and Approved Synthetic Trainers.

113. Interoperable simulators should be built to a consistent fidelity standard to provide a level playing field (for all participating simulations). There can be little confidence in the overall result being any better than the lowest fidelity simulator.

4.2.2 Distributed Simulation Standards

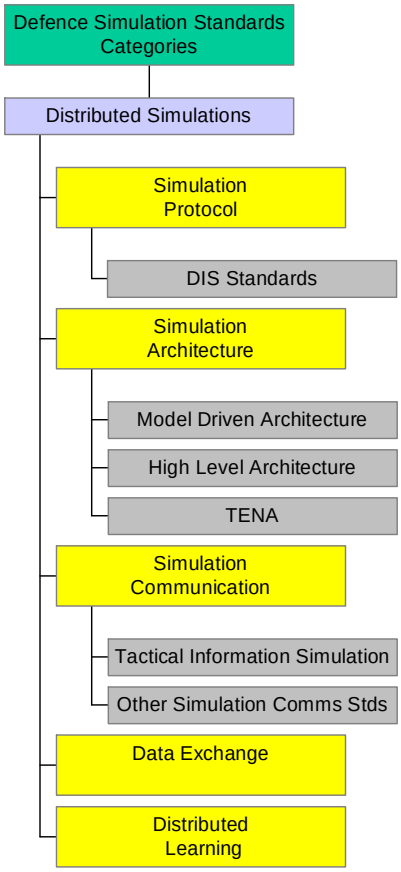

Figure 4-3 Distributed Simulation Standards

114. Distributed Simulation Standards define the technical requirements of a common framework for combining simulations. These standards cover communication protocols,

system architecture, communications and data exchange. The Distributed Simulation Guide[19] provides an overview of the concepts of Distributed Simulation technology and provides guidance on, combining Australian Defence Simulations and Simulation Interoperability with our allies and coalition partners.

4.2.2.1 Simulation Protocol Standards

115. A simulation protocol, as defined in the Australian Defence Simulation Glossary[20], is a set of rules and formats (semantic and syntactic) that define the communication behaviour of simulation applications.

116. Simulation protocol standards define the data parameters to be communicated, the format of the parameters and the rules or algorithms for interpreting the data. The most common defence simulation protocol is the DIS protocol. As is the case for DIS, the protocol standard may be supported by an enumeration and bit code standard, which defines the numerical values and associated definitions for the data parameters.

117. Simulation protocol standards need to be supported by the definition of additional simulation communications standards, eg although DIS PDU may be defined, the transfer of this data could be packeted and communicated differently for “Broadcast DIS" (UDP packets) or “Multicast DIS” (UDP and TCP multicast packets - from memory).

4.2.2.2 Simulation Architecture Standards

118. Simulation architecture standards define design rules for a software structure (architecture). The rules are intended to allow simulations to be constructed from compliant component simulations, hence providing for reusability of components and interoperability between these. Simulations built to the standard should be capable of operating as a network of simulations regardless of the simulation protocol standard. If simulators do not share the same protocol standard they may require a "bridge" application on each of the simulators to convert from one protocol standard to the other.

119. The most common Defence simulation architecture standard is HLA. Simulation architecture standards need a framework of supporting standards that defines the run time infrastructure (hardware and software) and lower level standards that describe the format of the data and interface properties. Simulators that share the same simulation architecture but have different simulation protocols can be integrated by adding a "bridge" between the simulations.

4.2.2.3 Simulation Communication Standards

120. To enable distributed simulations to communicate with each other they require a common (standard) communications infrastructure. This consists of the low-level communications services that may include both communications hardware and software.

121. For DIS, it is necessary to use the same version, ensure that the systems support the same PDUs, and also the same enumerations database to achieve interoperability. DIS operates via User Datagram Protocol (UDP) packets broadcast over the network.

Comment: Not quite sure what original text meant; tried to add some sense?

122. HLA is a high level architecture that does not deal with protocols or the communication layer, however the RPR FOM is commonly adopted at the protocol level.

[19] Reference H.
[20] Reference I, ADSG.

The lower level communications issues are addressed by the selection of a common RTI. There is a lack of standardisation at the RTI level so different RTI's may not be compatible.

123. The GRIM "Guidance, Rationale, and Interoperability Modalities" document defines the requirement to be compliant to the RPR-FOM and a mapping from DIS to the FOM. A simulation can be defined to be GRIM-RPR 1.0 compliant, meaning that it is HLA compliant and "RPR-FOM 1.0 (protocol) compliant" as defined in the GRIM document.

4.2.2.4 Simulation Data Exchange Standards

124. Simulations depend on large amounts of simulation and model data. The resources (time and costs) required to acquire this data may adversely impact on the feasibility of the simulation system[21]. Therefore there are substantial cost and efficiency benefits to be gained by adopting a common modelling and simulation data standard that would enable data and model reuse.

125. However there are and will continue to be a large number of data representation formats used by various modelling and simulation tool vendors and simulator builders as the internal data representation has a significant impact on the simulation or modelling tool performance. As a result as the various developers strive to deliver increased capability and performance, new data formats are likely to emerge.

126. The multitude of data formats makes data reuse more difficult as it requires translation of data between the various proprietary and generally incompatible formats. To overcome the translation problems a number of data exchanges standards have been developed. The aim being to ensure that all vendors are able to import and export their proprietary format to and from the standard data exchange format. This ensures the possibility of data exchange and substantially reduces the number of data conversion programs required, i.e. instead of each vendor having to be able to import and export to every other simulator or modelling tool builders format, each organisation only needs to be able to import and export to the data exchange format.

127. There are however a number of different data exchange standards that have been developed for specific types of data, used by the various disciplines, i.e. geospatial, hydrographical and product data exchange. As all these data types are being combined for use by simulation applications, in 1994 the simulation industry led by DMSO, commenced the developed and promotion of a single, all encompassing data exchange format, SEDRIS.

128. Although the data formats of most data exchange standards are not designed for the internal data representation in modelling tools and simulations, there are some that do both eg STEP.

4.2.2.5 Distributed Learning Standards

129. Distributed learning standards have emerged from a desire to accelerate the large-scale development of cost effective distributed learning systems by providing a common framework for interoperability, accessibility and reusability of Web-based learning content. These systems are intended to[22] provide high quality education and training, tailored to individual needs, delivered cost effectively anytime anywhere with the delivery medium being the computer and web.

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[21] Reference G, SDG paragraph 4.
[22] Reference J, SCORM 2004 Overview, section 1.1.

130. Distributed learning standards are becoming more important to the simulation community as e-learning moves to incorporate simulations[23] and as the simulation community looks toward web-based deployment of simulations[24].

4.2.3 Confidence Building Standards

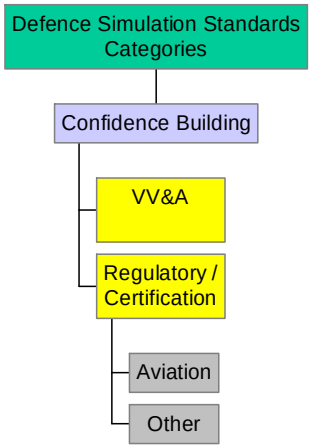

Figure 4-4 Confidence Building Standards

131. Confidence Building[25] Standards incorporate all those standards associated with ensuring fitness for purpose, establishing both the overall credibility of simulation outcomes and the necessary levels of user confidence in these.

132. These standards deal with:

a. Verification, Validation and Accreditation (VV&A);

b. Independent Verification and Validation (IVV); and

c. Regulatory Certification Standards.

133. Approaches to confidence building are provided in detail in the Simulation Verification, Validation and Accreditation Guide and as part of other simulation related standards, eg DIS part 4 (IEEE 1278.4-1997). General standards such as IEEE 1012-1998 Standard for Software Verification and Validation also provide guidance relevant to simulation software.

134. Regulatory standards are mandatory standards that are intended to ensure health, safety or security. Operators demonstrating their ability and commitment to complying are usually licensed. Failure to comply with regulatory standards has a legal consequence.

[23] Reference J, section 1.6.2 Future Scope of SCORM.
[24] Reference K, Websim Initiative Overview.
[25] Reference L, section 1.

4.2.4 Simulation Engineering Standards

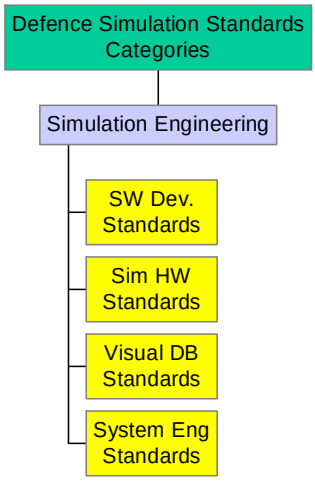

Figure 4-5 Simulation Engineering Standards

135. The Simulation Engineering Standards category is intended to include all those engineering, standards applicable to simulation development, manufacture and support. This category is the subset of the general engineering and software standards that are specifically relevant to modelling and simulation and includes standards covering:

a. Software Development;

b. Simulation Hardware (computers networks and hardware in the loop);

c. Visual Database; and

d. System Engineering.

136. Their adoption is intended to support efficient communication, collaboration and sharing of information between simulation researchers, developers, manufacturers and supporters across industry, defence and academia and to assist in achieving broad adoption of best simulation engineering practices.

4.2.5 Simulation Management Standards

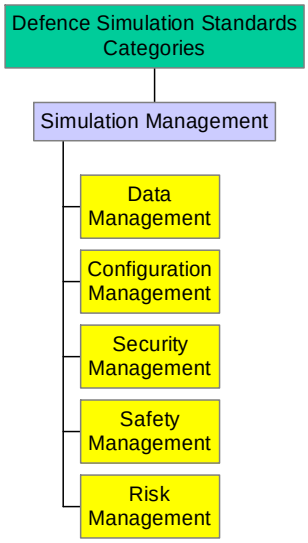

Figure 4-6 Simulation Management Standards

137. The Simulation Management Standards category is intended to include all those management standards applicable to simulation research, development, manufacture and support. This category is the subset of the general project management standards that are specifically relevant to modelling and simulation and includes standards covering:

a. Data Management Standards;

b. Configuration Management Standards;

c. Security Management Standards;

d. Safety Management Standards; and

e. Risk Management Standards.

138. Their adoption is intended to support efficient communication, collaboration and sharing of information between simulation researchers, developers, manufactures and supporters across industry, defence and academia and to assist in achieving broad adoption of best simulation management practices.

5 OVERVIEW OF COMMONLY USED DEFENCE SIMULATION STANDARDS

5.1 REPRESENTATIONS

5.1.1 Data Standards

5.1.1.1 Environment Standards

139. The following environmental data standards are described in the Simulation Data Guide section 4.3. Their full titles, reference identifier, developer/maintainer, defence status, a defence point of contact and references for further information are provided in the Defence Simulation Standards List of Annex D.

- ISO 19100 series - OpenGIS Standards
- Arc Digitised Raster Graphics (ADRG)
- Controlled Image Base (CIB)
- Digital Chart of the World (DCW)
- Digital Elevation Model (DEM)
- Digital Feature Analysis Data (DFAD)
- Digital Terrain Elevation Data (DTED)
- GeoTIFF
- Vector Product Format
- Vector Smart Map (VMAP)
- World Vector Shoreline (WVS)

5.1.1.2 Visual Database Standards – Proprietary

140. The following visual database proprietary standards have been developed by MultiGen-Paradigm Inc (MPI). MPI isa major supplier of 3D visual database content creation tools and image generation software applications. They have had in the past a large proportion of the market, particularly in the defence and flight simulator market and hence OpenFlight has achieved the level of being a defacto industry standard.

a. **OpenFlight** – is MultiGen-Paradigm's 3D visual content database format. It is a proprietary format developed by MultiGen-Paradigm to work efficiently with their realtime image generator application.

b. **MetaFlight** – is MultiGen-Paradigm's formal database description specification. It is an XML compliant, high level description of visual databases, describing the structure, organization, file naming and coordinate systems of all the datasets that comprise a single more complex database.

141. Due to the growth of visual databases in the movie and games industries a number of other proprietary tools, and hence their database formats, are gaining market share, these include 3D Studio Max from Discreet[26] (an AutoCAD related company), MAYA from Alias[27]

[26] Reference U.
[27] Reference V.

5.1.1.3 Entity Standards

142. There are currently no specific defence simulation entity standards, however the STEP – Standard for Product Data Representation and Exchange is being investigated as potentially partially filling this role

5.1.2 Fidelity Standards

5.1.2.1 AS/NZS ISO 19113:2004 Geographic information – Quality Principles

143. This standard[28] provides principles for describing the quality of geographic data and specifies components for reporting quality information. It also provides an approach to organizing information about data quality. It does not define a minimum acceptable level of quality for geographic data. Data quality level is use dependent and requires an assessment based on fitness for purpose.

5.1.2.2 CASA MOS Part 60 – Synthetic Training Devices (STD)

144. This standard replaced CASA's FSD-1 and FSD-2. It was updated to match the International Civil Aviation Organisation (ICAO) Manual of Criteria for the Qualification of Flight Simulators (MCQFS) Document 9625-AN/938 Second Edition (pending 1 July 2004).

145. The standard describes the requirements for qualifying Aeroplane Flight Simulators to level A,B,C or D. It includes requirements for the testing of Synthetic Training Devices (STD) for qualification, the requirements statements of compliance (SOC) etc. Flight Training Devices which previously had coverage in FSD-2 are now to be covered by: Joint Aviation Requirement – Synthetic Training Device – 2A to Level 1 or 2 or The Federal Aviation Administration Advisory Circular 120-45A to Level 4,5 or 6.

146. CASA MOS Part 60 can be downloaded from the CASA website.

147. The Air Force currently uses the above commercial aviation standards for defining the fidelity requirements of military flight simulator but with extra military credit sequences added into the appropriate Annexes of the above.

5.1.2.3 Advisory Circular AC 120-63

148. This document is also referenced by the Air Force for defining fidelity requirements for helicopter simulator qualification.

5.2 DISTRIBUTED SIMULATIONS

149. Distributed simulation standards are required to allow independently developed simulations to be able to be connected together to form a larger combined (system) simulation.[29] In defence applications the two dominant standards are DIS and HLA. In the commercial segment CORBA is also quite common for low level and Microsoft DirectX DirectPlay in networked games.

5.2.1 Simulation Protocol Standards

150. The purpose of simulation protocol standards is provided in section 4.2.2.1.

[28] Reference AE.
[29] Reference H, section 2.1

5.2.1.1 Distributed Interactive Simulation (DIS IEEE 1278)

151. DIS (IEEE 1278) was the first broadly adopted simulation protocol standard that was used for defence simulations. Its development began in the US in the 80's with the first version, version 1, released in 1992. As a result it is now a mature product.

152. SISO SAC is responsible for further development and maintenance of DIS. Formal approval of releases, management and distribution of the standard is via the IEEE. The standards can also be sourced from the IEEE.

153. The use of DIS was mandated for use in US DoD simulations but is now being gradually replaced by HLA, although there are a still large number of DIS legacy simulations. The DIS standard (as specified in AdatP-34 Vol 4) is mandated[30] for use in all future Australian Defence contracts when there is a known or potential requirement to operate with CIS of CA, NZ, UK or US.

154. DIS Versions 1 through 5 are now superseded by DIS version 6 (IEEE 1278.1a:1998), which is the current version. There is also a new version under development by SISO that is expected to be at IEEE balloting status in early 2006.

155. To ensure interoperability of DIS compliant simulations it is also necessary to ensure the implementations are the same, i.e. the same DIS versions and enumeration sets need to be used. ADSO recommends that IEEE 1278.1a-1998 standard PDU's be utilised. Need to find out if there are any network performance standards, I am not aware of any, are their any ADSO recommendations/requirements.

156. DIS is used only for real-time simulations, although it is technically possible to use it for non-real-time applications.

5.2.1.2 RPR FOM (High Level Architecture)

157. The need to reduce the effort required in the conversion of DIS simulations to HLA and to promote interoperability between DIS and HLA compliant systems has resulted in the development of the following data representation protocol standards:

- RPR FOM 1.0 provides the functionality of IEEE 1278.1:1995 (version 5)
- RPR FOM 2.0 provides the functionality of IEEE 1278.1a:1998 (version 6)

5.2.1.3 Guidance, Rationale and Interoperability Modalities (GRIM)

158. There may be some debate as to whether the GRIM document is a standard, but it is included here since the GRIM document defines what is required to be compliant to the RPR-FOM and provides a mapping from DIS to the FOM. eg: A simulation can be specified to be GRIM-RPR 1.0 compliant, meaning that it is HLA compliant and "RPR-FOM 1.0 (protocol) compliant" as per the definition in the GRIM document.

5.2.2 Simulation Architecture Standards

159. The purpose of simulation architecture standards is provided in section 4.2.2.2.

[30] Reference H, section 4.3.1

5.2.2.1 High Level Architecture (HLA), IEEE Standard 1516

160. The HLA standard defines [31] a general purpose architecture for simulation reuse and interoperability. HLA was developed under the leadership of DMSO for the US DoD to facilitate the interoperability of all types of models and simulations. The baseline definition was completed in 1996.

161. Since November 2000 HLA has been officially the preferred architecture for simulation interoperability within the US DoD.

162. The HLA standards were approved as open standards through the IEEE. IEEE retains the responsibility for approval of releases, management and distribution of the standards. SISO SAC is responsible for further development of HLA standards. The standards can also be sourced from the IEEE.

163. The current version of HLA is IEEE 1516:2000. The HLA standard consists of 4 parts:

- IEEE 1516 – 2000 Framework and Rules
- IEEE 1516.1 – 2000 Federate Interface Specification
- IEEE 1516.2 – 2000 Object Model Template Specification
- IEEE 1516.3 – 2003 Recommended Practices for High Level Architecture (HLA) Federation Development and Execution Process (FEDEP)

Further explanation of these parts is provided in the DSG, sect 2.3.1.

164. ADSO recommends that the use of IEEE 1516:2000 be adopted for future Australian HLA applications.

165. HLA simulations require Run Time Infrastructures (RTIs) to support their operation. Unfortunately there is no standard for RTI's that ensures interoperability among simulations using different RTI's. To address this issue DSTO and ADSO will/are investigating suitable RTI's for Australian adoption. Therefore currently the acquirer must choose the most appropriate RTI for his/her specific application.

166. Version 6 of the RTI 1.3 Next Generation (RTI 1.3 NG V6) was the last freely available and supported RTI product released by the DMSO HLA program. Subsequent versions must be purchased from commercial suppliers.

167. Details of the advantages and disadvantages of HLA are provided in the DSG section 2.3.3.

5.2.2.2 The Test and Training Enabling Architecture (TENA)

168. TENA is an emerging standard that is intended to provide affordable interoperability to test and training ranges. It supports integrated testing and simulation based acquisition through the concept of a "Logical Range"[32]. In a logical range, real military assets can interact with each other and with simulated weapons and forces, no matter where these forces actually exist throughout the world.

169. TENA is an architecture that references a number of commercial and open standards, the two key standards being the US DoD Joint Technical Architecture (JTA) (now called the US DOD IT Standards Registry (DISR)) and HLA.

[31] Reference R.
[32] Reference W.

170. TENA defines a new standard, the TENA middleware API, which will be standardised by the Range Commanders Council (RCC).

171. TENA is being developed by the Foundation Initiative 2010 project, sponsored by US Central Test and Evaluation Investment Program (CTEIP). Further information can be found at the FI2010 project website[33].

5.2.3 Simulation Communication Standards

5.2.3.1 Distributed Interactive Simulation (DIS IEEE 1278)

The communication services and profiles required for DIS are provided in IEEE 1278.2:1995.

5.2.3.2 HLA RTI

Refer to 5.2.2.1 above. The communications standard required will be dependent on the RTI and the performance requirements of the application.

5.2.3.3 Link 16

SISO has currently under development, through one of its PDG's, a simulation standard for Link 16 Tactical Data communications. The standard will address both DIS and HLA compliant simulations.

5.2.4 Data Exchange Standards

172. The purpose of data exchange standards is provided in section 4.2.2.4.

5.2.4.1 SEDRIS

173. SEDRIS development began in 1994 as a US government program under sponsorship of a number of organisations including DARPA. Primary sponsorship was subsequently taken over by DMSO. SEDRIS has been developed to[34] address the problem of environmental data representation and interchange for heterogeneous systems to interoperate in networked and distributed applications. It provides for establishing a common representation of "place", relative to the application view of the world.

174. SEDRIS provides standards for the representation of environmental data and for the interchange of environmental datasets.

175. The SEDRIS standards are currently passing through the final phases of the approval process to become international standards under the ISO/IEC banner.

176. The SEDRIS standards consist of the following parts:

- SEDRIS Part 1: Functional Specification - ISO/IEC 18023-1
- SEDRIS Part 2: Abstract Transmittal Format - ISO/IEC 18023-2
- SEDRIS Part 3: Transmittal Format Binary Encoding - ISO/IEC 18023-3
- SEDRIS Language Bindings Part 4: ISO C - ISO/IEC 18024-4
- Environmental Data Coding Specification (EDCS) - ISO/IEC 18025
- Spatial Reference Model (SRM) - ISO/IEC 18026
- EDCS Language Bindings Part 4: ISO C - ISO/IEC 18041-4
- SRM Language Bindings Part 4: ISO C - ISO/IEC 18042-4

[33] Reference www.fi2010.org
[34] Reference X, www.sedris.org/ab_1trpl.htm

177. An excellent overview of SEDRIS and its components is provided on the SEDRIS website[35].

178. The SEDRIS Data reference model (DRM) defines a scheme for the representation of environmental data. It provides identification of the data elements, their attributes and logical relationships. It avoids addressing the location of objects or enumeration of the objects.

179. The SEDRIS Spatial Reference Model (SRM) deal with spatial models used by SEDRIS and algorithms for transformation between difference spatial reference frames

180. The SEDRIS EDCS provides the enumerations for the environmental data objects being represented.

181. The SEDRIS transmittal format provides a platform independent interchange mechanism for SEDRIS transmittals.

5.2.4.2 IGES – Initial Graphics Exchange Format

182. IGES was developed within the computer aided drafting industry to facilitate the exchange of 2D and 3D models (typically of mechanical components or for architectural, engineering and construction (AEC) projects) between different CAD vendor's proprietary formats. It has been around for many years and undergone a number of revisions. The current version is IGES Version 4.0 (AS 3643.1-1989) and (AS 3643.2-1992). This standard is sometimes useful in modelling and simulation for the conversion of models created with CAD tools into a format that can be imported into other CAD and visual database creation tools.

183. A continual issue with IGES has been that it has struggled to keep up with the additional features and representations used in CAD and visualisation tools so often data is lost through the conversion process and model databases need to be repaired after conversion,. However as model creation can be very resource intensive, considerable savings can still be gained though IGES data exchange.

184. IGES is slowly being superseded by STEP and other direct proprietary conversion routines.

5.2.4.3 STEP – Standard for Exchange of Product Model Data

185. ISO 10303 Standard for Exchange of Product Model Data is a comprehensive series of standards that provide a representation of product information along with the necessary mechanisms and definitions to enable product data to be exchanged. These apply to the representation of product information, including components and assemblies; the exchange of product data, including storing, transferring, accessing, and archiving.

186. The STEP electronic product definition data covers CAD, CAM, PDM and ERP systems applications. This covers exchange of data for design, manufacture and through life support of the product.

187. The STEP standards are currently being employed for product definition in major defence projects including the US Joint Strike Fighter and Eurofighter. A feasibility study for

[35] Reference X.

the application of STEP in the Australian Defence Industry, funded by AusIndustry, has been carried out. A follow on project proposal "SPIDER" is currently being evaluated.

188. Standards Australia Committee IT-06-01 Industrial Automation Systems and integration are responsible for the Australian adoption of STEP standards.

189. The use of STEP as an exchange mechanism for other non-design and manufacture simulation and modelling application is an emerging opportunity.

5.2.5 Distributed Learning Standards

5.2.5.1 Shareable Content Object Reference Model (SCORM 2004)

190. SCORM, the Shareable Content Object Reference Model has been developed by Advanced Distributed learning (ADL). It is intended to allow for the reuse of learning content as "instructional objects" for use in computer and web-based learning.

191. SCORM provides a technical framework of guidelines, specifications and standards for both learning management systems (LMS) capable of delivering the reusable instructional content and the content. It also covers how individual elements of learning content can be aggregated together, user performance assessed and provide a logical training sequence and navigation through the instructional objects.

192. The SCORM standard consist of 4 documents, the SCORM Overview, the Content Aggregation Model (CAM), the Run-Time Environment (RTE) and Sequencing and Navigation (SN). The current version is version 1.3 referred to as SCORM 2004.

193. As the future scope of SCORM [36] development, includes the incorporation of simulation aspects and as the Websim initiative is working toward web based simulation SCORM is likely to become increasingly important to the training application areas of simulation and modelling.

5.2.5.2 Aviation Industry CBT Committee (AICC) Guidelines & Recommendations (AGR's)

194. There are nine current AGR's. A shortened description of the current AGR's as available on the AICC website[37] is provided below.

a. **AGR 001 – AICC Publications** (superseded)

b. **AGR 002 – Courseware and Delivery Stations**: This document deals with the recommend configuration of computers for courseware delivery

c. **AGR 003 – Digital Audio**: This document recommends guidelines that promote the interoperability of digital audio.

d. **AGR 004 - Operating/Windowing System**: This document provides a formal recommendation to the aviation industry for an operating and windowing system used for delivery of CBT.

[36] Reference J, section 1.6.2.
[37] Reference Y.

e. **AGR 005 – CBT Peripheral Devices**: This document provides recommendations to promote interoperability of input devices etc.

f. **AGR 006 – Computer Managed Instruction (CMI):** This document deals with guidelines to support the ability of a given CMI system to manage CBT lessons from different origins and for a given CBT lesson to exchange data with different CMI systems.

g. **AGR 007 – Courseware Interchange**: This document recommends guidelines for the interchange of the elements that occur in CBT courseware, i.e. standard data formats text, graphics, audio etc.

h. **AGR 008 – Digital Video**: This document recommends guidelines for the creation, distribution, and use of digital video in CBT courseware.

i. **AGR 009 – Icon Standards: User Interface**: This document recommends guidelines for the functions of the student/user interface and their associated graphic representation in CBT courseware.

j. **AGR 010 – Web-based Computer-Managed Instruction**: This document recommends guidelines that promote the interoperability of web-based CMI systems.

5.2.5.3 IEEE Standards for Learning Technology

195. The IEEE 1484 Standards for Learning Technology is a multi-part series of standards based on the work originally done by the AICC. The standards are intended to provide a a for and improve interoperability among different Computer Managed Instructional (CMI) and Learning Management Systems (LMS).

196. The current standards include the following parts, some of which are still under development.

a. IEEE 1484.1-2003 Standard for Learning Technology - Learning Technology Systems Architecture (LTSA), developed by IEEE LTSC WG1

b. IEEE 1484.4 Digital Rights Expression Language (DREL) under development by IEEE LTSC WG4

c. IEEE P1484.11.1/D6, 2001-04-14 Draft Standard for Learning Technology - Data Model for Content to LMS Communication

d. 1484.11.2: ECMAScript API for Content to Runtime Services Communication

e. IEEE P1484.11.3/D6, 2001-04-26 Draft Standard for Learning Technology - HTTP-based Protocol Binding for IEEE 1484.11.1

f. IEEE P1484.11.4/D6, 2001-04-29 Draft Standard for Learning Technology - JavaScript API Binding for IEEE 1484.11.1

g. IEEE P1484.11.5/D6, 2001-05-04 Draft Standard for Learning Technology - Courseware Aggregation Data Model for Interchange

5.2.5.4 IMS Instructional Management System (IMS) Project

197. Further information can be found at http://www.imsproject.org.

5.2.5.5 Standards for: Information Technology for Learning Education & Training (ITLET)

198. Further information can be found at http://jtc1sc36.org/.

5.3 CONFIDENCE BUILDING

5.3.1 VV&A Standards

199. Currently, there is/are no international or Australian standard/s that address the VV&A of simulations. However, standards for VV&A of distributed simulations (refer to section 5.3.2) and general software V&V standards are available.

5.3.2 Simulation Verification and Validation Standards

5.3.2.1 IEEE 1278 – IEEE Standards for Modelling and Simulation: Distributed Interactive Simulation

200. 1278.4-1997- IEEE Recommended Practice for Distributed Interactive Simulation - Verification, Validation and Accreditation' contains guidance for the VV&A of DIS exercises.

201. The standard offers the specifier the choice of three levels of simulation credibility for DIS Simulations: compliance, compatibility and interoperability. Only DIS Interoperability level of credibility ensures that two or more simulators will, for a given exercise, have the capability and data compatibility allowing them to communicate with each other with the performance characteristics required to support the fidelity required for the exercise. Further details can be found in the Distributed Simulation Guide, section 8.

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

202. 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 FEDEP addressing overall VV&A methodology, roles and responsibilities, tasks, resulting products, and challenges.

203. 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.

5.3.3 General Software Verification and Validation Standards

204. 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.

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

205. 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.*

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

206. 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.*

5.4 SIMULATION ENGINEERING

207. This section does not provide a comprehensive list of all standards applicable to the simulation engineering but rather lists some of the most commonly used standards by the Australian Defence Industry or standards unique to the simulation applications.

5.4.1 Software Development Standards

5.4.1.1 MIL-STD-498, Software Development and Documentation

208. The US Department of Defence, 1998, MIL-STD-498 establishes uniform requirements for software development and documentation. It is particularly useful for assisting in Interface Requirements Specification (IRS), Interface Design Description (IDD) and Data Item Descriptions (DIDS).

5.4.1.2 IEEE 610.3 Glossary of Simulation Technology

209. This glossary attempts to define terms used in the field of modelling and simulation. Topics covered include general modelling and simulation concepts, types of models and simulations, modelling and simulation variables, game theory, and queuing theory. The Glossary of Simulation Technology should not be taken as a complete reference as some terms may have been excluded if they were parochial to one group or organisation; are company proprietary or are defined in other IEEE 610 series glossaries.

5.4.1.3 IEEE 610.12 Software Engineering Terminology

210. This document is a glossary of software engineering terminology, which identifies terms currently in use in the field of software engineering. Standard definitions for those terms are established.

5.4.1.4 Model Driven Architecture (MDA)

211. The Model Driven Architecture (MDA) is based on established OMG standards, including: UML, XML, MOF and CORBA and is intended to support evolving standards in the various application domains. The MDA is particularly relevant to the Simulation arena as it is a vendor neutral way of separating the logic behind a specification from the specifics of the particular middleware that implements it. By providing an architecture that assures Portability, Platform Independence and Domain Specificity, MDA accommodates evolving specifications while preserving any existing technological investment. As new platforms and technologies emerge, MDA enables rapid development of new specifications that use them, streamlining the process of integration.

5.4.1.5 Unified Modelling Language (UML)

212. Through any of twelve standard diagrams the Unified Modelling Language (UML) lets one produce visual models and representations of software systems, including their structure and design, allowing the software architect to accommodate the necessary functionality while at the same time supporting the good software practices of scalability, robustness, security and extensibility before committing any implementation to code.

UML is middleware independent and is at the core of the Model Driven Architecture (MDA).

5.4.1.6 Common Warehouse MetaModel (CWM)

213. The Common Warehouse MetaModel (CWM) is a specification that describes metadata interchange among data warehousing, business intelligence, knowledge management and portal technologies. It incorporates the OMG Meta-Object Facility (MOF), which bridges the gap between dissimilar meta-models by providing a common basis for meta-models. If two different meta-models are both MOF-conformant, then models based on these can reside in the same repository. The Common Warehouse Metamodel is a specification for modelling metadata for relational, non-relational, multidimensional systems, and most other objects found in a data warehousing environment.

214. The CWM Metamodel consists of a number of sub-metamodels that represent common warehouse metadata in the following major areas of interest to data warehousing and business intelligence:

- Data Resources -- These include metamodels that represent object-oriented, relational, record, multidimensional, and XML data resources. In the case of object-oriented data resource, CWM reuses the base object model.
- Data Analysis -- These include metamodels that represent data transformations, OLAP (On-line Analytical Processing), data mining, information visualization, and business nomenclature.
- Warehouse Management -- These include metamodels that represent warehouse processes and results of warehouse operations.

5.4.1.7 Extensible Markup Language (XML)

215. Extensible Markup Language (XML) is designed to improve the functionality of the Web by providing more flexible and adaptable information identification. It is commonly used for documents containing structured information.

216. A markup language is a mechanism to identify structures in a document. The XML specification defines a standard way to add markup to documents. Structured information contains both content (words, pictures, etc.) and some indication of what role that content plays (for example, content in a section heading has a different meaning from content in a footnote, which means something different than content in a figure caption or content in a database table, etc.).

217. It is called extensible because it is not a fixed format like HTML (a single, predefined markup language). Instead, XML is a metalanguage, a language for describing other languages, which lets one design customised markup languages for limitless different types of documents. This feature is enabled since XML is written in SGML, the international standard metalanguage for text markup systems (refer ISO 8879).

5.4.1.8 ISO/IEC 19775 X3D

218. The ISO/IEC 19775-1:2004 X3D standard defines the architecture and base components of X3D. X3D defines a runtime system and delivery mechanism for 3D content and applications running on a network. X3D supports several file format encodings and programming languages, providing interoperability for 3D data and significant flexibility in manipulating, communicating and displaying scenes in real time. X3D incorporates graphics hardware features to provide high performance and visual impact in an extensible architecture that supports ongoing evolution.

219. The ISO/IEC 19775-1:2004 standard does not define physical devices or any other implementation-dependent concepts (e.g. screen resolution and input devices) as it is intended for a wide variety of devices and applications.

5.4.1.9 ISO 15836 Dublin Core

220. The Dublin Core metadata element set is a standard for cross-domain information resource description. For Dublin Core applications a resource will typically be an electronic document. This standard is for the element set only, which is generally used in the context of a specific project or application. Local or community based requirements and policies may impose additional restrictions, rules, and interpretations. It is not the purpose of this standard to define the detailed criteria by which the element set will be used with specific projects and applications.

5.4.1.10 MS Standards

221. Windows NT4, Windows XP, Win32 API, DirectX are Microsoft proprietary standards. Details are available from Microsoft.

5.4.1.11 OpenGL

222. Introduced in 1992 and used throughout the simulation industry OpenGL is an environment for developing portable, interactive 2D and 3D graphics applications. By giving software developers access to geometric and image primitives, display lists, modelling transformations, lighting and texturing, anti-aliasing and blending across multiple platforms OpenGL allows applications to produce consistent visual results on any OpenGL API-compliant hardware and operating system.

223. Operating on image data as well as geometric primitives OpenGL is an open, scaleable, vendor-neutral, multiplatform graphics standard that allows hardware developers to differentiate their products by developing extensions that allow software developers to access specific hardware performance and technological innovations.

5.4.2 Simulation Hardware Standards

224. There are no standards that specifically address simulation hardware.

5.4.3 Visual Database Standards

5.4.3.1 OpenFlight®

225. OpenFlight is MultiGen-Paradigm's native 3D content. It is the leading visual database standard in the world and has become the defacto standard format in the visual simulation industry. OpenFlight's logical, hierarchical scene description file format informs the real-time image generator what, when, and how to render, resulting in real-time 3D scenes with precision and reliability. It comprises flexibility, open connectivity and easy interoperability along with advanced real-time functions, including:

- Levels of detail (LOD);
- Culling volumes;
- Switch Nodes;
- Drawing priority, and;
- Binary separating planes.

5.4.3.2 MetaFlight®

226. MetaFlight is a formal database description specification. Contrasted with OpenFlight, which describes and contains the geometry and structure within a single file, MetaFlight describes the structure, organisation, file naming and coordinate systems of all the datasets that comprise a single more complex database.

227. MetaFlight provides the bridge between database generation tools and run-time applications. It simplifies data integration and optimises real-time-paging efficiency by communicating the metadata that enables run-time applications to take advantage of the database structure. It comprises the following features:

- High-level description of visual databases;
- Improvement of run-time application's ability to load and process the database;
- Smarter loading and real-time management;
- Increased determinism in runtime applications;
- Integration with MultiGen Creator, Creator Model Studio, Creator Terrain Studio, and Vega Prime, and;
- XML Compliant.

5.4.3.3 OpenSceneGraph

228. The OpenSceneGraph is an OpenSource, cross platform graphics toolkit for the development of high performance graphics applications such as flight simulators, games, virtual reality and scientific visualisation. Based around the concept of a SceneGraph, it provides an object oriented framework on top of OpenGL. It frees the developer from having to implement and optimise low-level graphics calls, and provides many additional utilities for rapid development of graphics applications.

229. The aim of OpenSceneGraph is to make the benefits of SceneGraph technology freely available to both commercial and non-commercial users. Written entirely in Standard C++ and OpenGL, it makes full use of the STL and DesignPatterns, and leverages the open source development model in order to provide a development library that is legacy free and focused on the needs of end users. The key strengths of OpenSceneGraph are its

performance, scalability, portability and the productivity gains associated with using a fully featured scene graph. It runs on all Windows platforms, OS X, GNU/Linux, IRIX, Solaris and FreeBSD operating systems.

5.4.3.4 STEP

230. The Standard for the Exchange of Product Model Data (STEP), is a comprehensive ISO standard (ISO 10303) that describes how to represent and exchange digital product information. It provides a representation of product information along with the necessary mechanisms and definitions to enable product data to be exchanged. STEP applies to the representation of product information, including components and assemblies; the exchange of product data, including storing, transferring, accessing, and archiving. It defines the basic principles of product information representation and exchange used in ISO 10303.

5.4.4 System Engineering Standards

5.4.4.1 MIL-STD-499 Systems Engineering

231. The purpose of this standard is to provide a set of criteria that serves as a guide to contractors preparing proposed Systems Engineering Management Plans (SEMPs) for the conduct and management of their systems engineering effort on a particular program. Additionally, it is intended for US Government personnel, when either tailoring a bid work statement calling for SEMPs, or competitively evaluating and validating proposed SEMPs, and negotiating these into contract statements of work. It also provides the basis for validating the contractor's SEM capability.

5.5 SIMULATION MANAGEMENT

5.5.1 Data Management Standards

5.5.1.1 IEEE 1233-1998 System Requirements Development

232. This standard provides guidance for the development of the set of requirements, System Requirements Specification (SRS) that will satisfy an expressed need. Developing an SRS includes the identification, organisation, presentation, and modification of the requirements. Also addressed are the conditions for incorporating operational concepts, design constraints, and design configuration requirements into the specification. This standard also covers the necessary characteristics and qualities of individual requirements and the set of all requirements

5.5.2 Configuration Management Standards

5.5.2.1 IEEE 1042 – 1987 IEEE Guide to Software Configuration Management

233. This guide provides guidance in planning software configuration management (SCM) practices that are compatible with ANSI/IEEE Std 828-1983, IEEE Standard for Software Configuration Management Plans. Three groups are served by this guide:

- developers of software;
- software management community, and ;
- those responsible for preparation of SCM plans.

234. The developers of software will be interested in the different ways SCM can be used to support the software engineering process. The management community will be interested in how the SCM plan can be tailored to the needs and resources of a project. Those preparing plans for SCM will be interested in the suggestions and examples for preparation of a plan.

235. The introduction of this guide presents a technical and philosophical overview of the SCM planning process. Subsequent paragraphs in the body of the guide contain general statements of principles, commentary on issues to consider, and lessons learned for the corresponding paragraph in the outline of the ANSI/IEEE Std 828-1983 Plan. Four Appendices illustrate how the ANSI/IEEE Std 828-1983 can be used for a variety of different projects. A fifth Appendix lists current references that may be useful in planning SCM.

5.5.3 Security Management Standards

5.5.3.1 AS/NZS ISO/IEC 17799:2001 Information Technology – Code of Practice for Information Security

236. This Standard is intended for use by managers and employees, who are responsible for initiating, implementing and maintaining information security within their organisation and it may be considered as a basis for developing organisational security standards.

237. A comprehensive set of controls comprising the best information security practices currently in use is provided in this Standard. This guidance is intended to be as comprehensive as possible. It is intended to serve as a single reference point for identifying the range of controls needed for most situations where information systems are used in industry and commerce and can therefore be applied by large, medium and small organisations.

5.5.3.2 SECMAN

238. SECMAN Security Manuals are unclassified Defence Security Manuals prepared by the Defence Security Branch. The SECMAN manuals cover Security Policy, Industrial Security, Information System Security, Protective Security, Personnel Security, Project Security**,** Facility Security as well as providing a number of checklists and procedures to assist in implementing security in various situations.

239. Information System Security (SECMAN Parts A, B, C, E, F & I) is of most relevance to simulation engineering as it defines Protection for a Typical System against Typical Threats to achieve an Acceptable Risk.

5.5.4 Safety Management Standards

5.5.4.1 CASA FSD-1, FSD-2, MOS Part 60

240. The Civil Aviation and Safety Authorities standards FSD-1, FSD-2, MOS Part 60 are regulatory standards to maintain flight safety by ensuring the fitness for purpose of flight training simulators and synthetic trainers and hence the quality of training resulting from their use.

5.5.5 Risk Management Standards

5.5.5.1 AS/NZS ISO/IEC 4360:1999 Risk Management

241. This Standard provides a generic guide for managing risk. This Standard may be applied to a very wide range of activities, decisions or operations of any public, private or community enterprise, group or individual. This Standard specifies the elements of the risk management process, but it is not the purpose of this Standard to enforce uniformity of risk management systems. It is generic and independent of any specific industry or economic sector. The design and implementation of the risk management system will be influenced by the varying needs of an organisation, its particular objectives, its products and services, and the processes and specific practices employed.

242. This Standard should be applied at all stages in the life of an activity, function, project, product or asset. The maximum benefit is usually obtained by applying the risk management process from the beginning. Often a number of discrete studies are carried out at different times, and from both strategic and operational perspectives.

243. The process described here applies to the management of both potential gains and potential losses.

5.5.5.2 IEEE 1540:2001 Standard for Software Life Cycle Risk Management

244. This standard describes a process for the management of risk during software development, operations and maintenance. It is consistent with IEEE/EIA 12207.

6 STANDARDS ORGANISATIONS

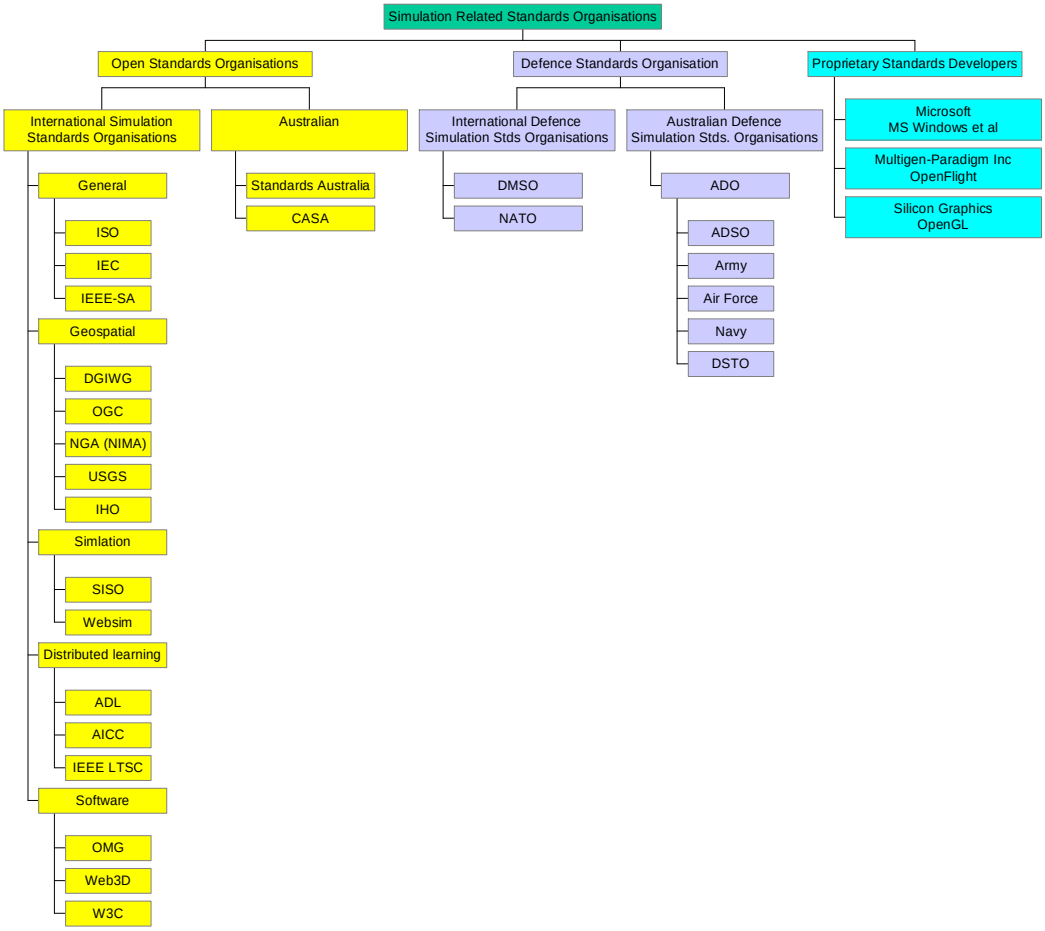

Figure 6-1 Simulation Related Standards Organizations

245. Standards Organisations have the responsibility for the development, approval/adoption, distribution and maintenance of standards. As such they are both the source of the latest standards information and the final point of contact for request for changes or additions to standards. Hence a brief summary of the key simulation standards bodies is provided here. The process for requesting the development of a new standard or amendment to a standard is detailed in section 3.

246. Simulation standards have been typically developed by:

- special interest groups with a common interest (open)
- individual simulation tool or simulator developer developing a new product (commercial/proprietary)
- a major simulation industry sponsor normally a government funded organisation eg US DoD, CAA. (Govt/Defence)

These groups then often seek to have national or international standards bodies ratify this standards to encourage broader adoption. This document groups the standards bodies in the above categories.

247. The major simulation standards bodies and the key committees responsible for simulation standards are identified in Annex C. Relevant relationships between the bodies are also identified. A cross reference of standards produced or maintained by each body and contact details for the relevant bodies is also included in the Annex.

6.1 INTERNATIONAL OPEN STANDARDS BODIES

6.1.1 International Organisation for Standardisation (ISO)

6.1.1.1 ISO Overview

248. ISO (International Organisation for Standardisation) is the world's largest developer of standards being a network of the national standards institutes of 146 countries. It operates on the basis of one member per country, with a Central Secretariat in Geneva, Switzerland, that coordinates the system.

249. ISO is a non-governmental organisation, acting as a bridging organisation between the public and private sector, in which a consensus can be reached on solutions that meet both the requirements of business and the broader needs of society, such as the needs of stakeholder groups like consumers and users. Many ISO standards are mandated by its' member governments. ISO is funded from its national members and the sale of standards.

250. Standards are developed by technical committees which are made up of technical experts and other representatives of other relevant bodies such as, government agencies, testing laboratories, consumer associations, and environmentalists. The standards are developed following ISO rules and policy. Further details are provided on their website[38].

6.1.1.2 ISO Modelling & Simulation Standards

251. ISO has recently published, as International Standards, a number of modelling and simulations standards developed by various industry associations such as the SEDRIS and OGC. Some of the key simulation and modelling standards published by ISO include:

- Various SEDRIS and SEDRIS related data exchange standards
- Various Open geospatial standards for geographic information
- The STEP CAD data format standard

252. A more complete list of ISO published modelling and simulation standards is provide in Annex D.

6.1.1.3 Amending ISO Standards

253. Standards Australia is Australia's ISO member (representative). As such any proposals for amendments to ISO or ISO/IEC standards need to be submitted via Standards Australia. Further details are provided in section 3.3.4 of this document.

6.1.2 International Electro-technical Commission (IEC)

6.1.2.1 IEC Overview

254. The International Electro-technical Commission (IEC) is[39] "the leading global organisation that prepares and publishes international standards for all electrical, electronic

[38] Reference M.
[39] Reference IEC website.

and related technologies. These serve as a basis for national standardization and as references when drafting international tenders and contracts."

6.1.2.2 IEC Modelling & Simulation Standards

255. The IEC jointly publishes standards with ISO. The key simulation and modelling standards published jointly by ISO/IEC include those in section 6.1.1.2.

256. A more complete list of ISO and joint ISO/IEC published modelling and simulation standards, is provided in Annex D.

6.1.2.3 Amending IEC Standards

257. Standards Australia is Australia's ISO/IEC member (representative). As such any proposals for amendments to ISO or ISO/IEC standards need to be submitted via Standards Australia. Further details are provided in section 3.3.4 of this document.

6.1.3 The Institute of Electrical and Electronics Engineers Standards Association (IEEE-SA)

6.1.3.1 IEEE-SA Overview

258. The Institute of Electrical and Electronics Engineers (IEEE) claim[40] to be the world's largest technical professional society, developing standards covering: power and energy, biomedical and healthcare, information technology, telecommunications, transportation, nanotechnology and information assurance. IEEE's standard's development process is based on openness and consensus. Further details on the process can be found on their website.

259. The Standards Association of the IEEE (IEEE-SA) is a division of the IEEE that is responsible for the development of standards. It is headquartered in New Jersey, USA.

6.1.3.2 IEEE Modelling & Simulation Standards

260. The following general purpose standards of relevance to the modelling and simulation community are published by the IEEE:

- Glossary of modelling and simulation terminology
- IEEE Standard for Software Verification and Validation
- IEEE Guide to Software Configuration Management
- IEEE Guide for Developing System Requirements Specifications

261. The IEEE has recently published under its banner a number of important simulation standards developed by SISO including:

- The DIS family of standards
- The HLA family of standards

6.1.4 IEEE Learning Technology Standards Committee (IEEE/LTSC)

262. The Learning Technology Standards Committee (LTSC) is a committee of the IEEE. The LTSC develops technical standards, recommended practices, and guides for learning technology. More detailed information is provided on their website[41].

[40] Reference IEEE website.
[41] Reference N.

263. The IEEE LTSC is undertaking further development of the work done by the Aviation Industry CBT Committee (AICC).

6.1.5 Open Geospatial Consortium, Inc. (OGC)

6.1.5.1 OGC Overview

264. The Open Geospatial Consortium, Inc. (OGC) is a non-profit, international industry consortium made up of private companies, government agencies and universities. It claims to be the leading developer of standards for geospatial and location based services. It standards are developed through a consensus based program and are publicly available. It creates open and extensible software application programming interfaces for geographic information systems (GIS) and other mainstream technologies

265. OpenGIS® Specifications support interoperable solutions that "geo-enable" the Web, wireless and location-based services, and mainstream IT. The specifications empower technology developers to make complex spatial information and services accessible and useful with all kinds of applications.

266. The vision and mission and details of OGC operations are provided on their website.

6.1.5.2 OGC Modelling & Simulation Standards

267. The following geospatial standards of relevance to the modelling and simulation community were developed and/or are published by the OGC:

- ISO 19101 Geographic Information - Reference Model
- ISO 19108 Geographic Information – Temporal Schema
- ISO 19125 Geographic Information – Simple Feature Access
- ISO 19128 OpenGIS® - WMS
- ISO 19136 OGC GML

6.1.6 Simulation Interoperability Standards Organisation (SISO)

6.1.6.1 SISO Overview

268. The Simulation Interoperability Standards Organisation (SISO) is focused on facilitating simulation interoperability and component reuse through the interchange of ideas and education of M&S practitioners through forums, workshop and conferences and through supporting the development of standards and guides. Originating from a US conference held in 1989 called, "Interactive Networked Simulation for Training", its membership now exceeds 1400 from 28 countries, representing well over 400 organisations, including commercial, academic, government, and military agencies.

269. SISO develops standards for simulation interoperability and component reuse across the DoD, other government, and non-government applications. Details of its structure and operations are provided on the SISO website.

6.1.6.2 SISO Simulation & Modelling Standards

270. The following simulation and modelling standards were developed and are maintained by SISO. They are published through the IEEE

- The DIS family of standards IEEE 1278
- The HLA family of standards, IEEE 1516

6.1.7 The Object Management Group (OMG)

6.1.7.1 OMG Overview

271. The Object Management Group™ (OMG™) is focused on producing and maintaining specifications for interoperable enterprise wide applications. Its standards cover software design, development, deployment and maintenance. It is a not for profit organisation based in the USA. Its specifications are publicly available.

272. OMG has a relationship with ISO[42] that allows the specifications it develops to be submitted to ISO via their fast track adoption process. OMG also has relationships with a number of other standards related bodies[43]. Further details of its structure and operations are provided on the OMG website.

6.1.7.2 OMG Simulation & Modelling Standards

273. All OMG specifications can be downloaded from their site free of charge. The following simulation and modelling related standards were developed and are maintained by OMG.

- MDA® – Model Driven Architecture
- UML™ – Unified Modelling Language
- CWM™ – Common Warehouse Metamodel
- CORBA™ – Common Object request Broker (includes OMG IDL & IIOP Protocol)

6.1.8 Web3D Consortium

6.1.8.1 Web3D Consortium Overview

274. The Web3D Consortium[44] "was formed to provide a forum for the creation of open standards for Web3D specifications and to accelerate the worldwide demand for products based on these standards through the sponsorship of market and user education programs." Web3D is a non profit organisation which is a funded via it membership. Membership is open to anyone interested in supporting the goals of the consortium.

275. The consortium is focused exclusively on Web 3D currently developing the X3D standard, (it originally developing VRML). It addresses the full range of 3D applications, including medical applications and mechanical and architectural design as well as 3D terrain modelling.

276. Web3D standards are royalty free, but are being adopted as ISO standards so will have to be purchased via ISO or its associated standards distribution organisations.

6.1.8.2 The Web3D Consortium's Modelling & Simulation Standards

277. The Consortium's main standard is X3D, an extensible open file format standard for 3D visual effects, behavioural modelling and interaction. X3D is the enhanced successor to the pre-XML Virtual Reality Mark-up Language (VRML).

278. XML encoding enables 3D to be incorporated into web services, architectures, and distributed environments and facilitates moving 3D data between applications.

[42] Reference O.
[43] Reference O.
[44] Reference P, /contact/about.html

6.1.9 Aviation Industry CBT Committee (AICC)

279. The Aviation Industry CBT (Computer-Based Training) Committee (AICC) was formed in 1988 as an international association of technology-based training professionals.

280. Its membership includes aircraft manufacturers, aviation industry trainers (including the military), government regulators, CBT software vendors and CBT courseware developers. It develops guidelines for aviation industry in the development, delivery, and evaluation of CBT and related training technologies. Further details are provided on the organisation's website[45].

281. Although the AICC is an aviation industry based organisation it also promotes interoperability standards for use across multiple industries. AICC does not strictly provide standards but rather provides AICC Guidelines and Recommendations (AGR's). Italso provided tools and processes for certifying that a product is built according to their AGR's, although the term compliant is specifically avoided.

6.1.10 Advanced Distributed Learning (ADL) Initiative

282. The Advanced Distributed Learning (ADL) Initiative was launched in 1997 by the US Department of Defence and White House Office of Science and Technology Policy (OSTP).

283. ADL's mission as stated in the SCORM 2004 Overview[46] is provided below. "The mission of the ADL Initiative is to provide access to the highest quality education and training, tailored to individual needs, delivered cost effectively anytime anywhere."

284. The ADL approach to this task has been the development of SCORM. A brief description of SCORM is provided in section 5.2.5.1. Further information including copies of the SCORM documentation can be obtained from the ADL website.

6.2 INTERNATIONAL DEFENCE STANDARDS BODIES

6.2.1 Defence Modelling and Simulation Office (DMSO)

6.2.1.1 DMSO Overview

285. DMSO[47] is the US Department of Defense (DoD) organisation responsible for ensuring that modelling and simulation technology developments are consistent with US DoD requirements and other related initiates. They sponsor many of the major modelling and simulation standards initiatives, particularly for reusability and interoperability. Details of their vision and mission are provided on their website.

6.2.2 North Atlantic Treaty Organisation (NATO)

286. The North Atlantic Treaty Organisation (NATO) is responsible for the development of NATO standards (STANAGs). Further information on NATO can be found

[45] Reference Q, "What is the AICC" http://www.aicc.org/pages/aicc_faq.htm.
[46] Reference J.
[47] Reference R, www.dmso.mil/public/.

on the NATO website[48]. A number of STANAGs are available for download from the website.

6.2.3 US DoD MIL-STD's

287. The US Department of Defense is responsible for the development and management of a large number of military standards belonging to the broadly applied MIL-STD series.

6.3 AUSTRALIAN STANDARDS BODIES

6.3.1 Standards Australia

6.3.1.1 SAIL Overview

288. Standards Australia International Limited (SAIL), known as Standards Australia (SA) is Australia's peak non-government standards development body. This status is recognised through a Memorandum of Understanding with the Commonwealth Government. It consists of 72 Members representing groups with an interest in the development and application of standards and related products and services. It is Australia's representative on the International Organisation for Standardisation [ISO], the International Electro-technical Commission [IEC], and the Pacific Area Standards Congress [PASC]. Standards Australia is a not-for-profit organisation.

289. Standards Australia develops standards through a consensus based development process. The process is based on transparency, consensus and stakeholder representation from interest groups that include governments, industry bodies, trade and professional associations, academia and consumer groups.

290. It is responsible for the development and maintenance of Australian Standards, including the adoption of international (ISO/IEC) standards. It does not sell or distribute standards. Standards Australia works in partnership with SAI Global Limited, that sells and distribute Australian Standards.

291. Further details of SAIL's mission, structure and operations are provided on their website.

6.3.1.2 SAIL Modelling and Simulation Standards

292. Currently there are no specific modelling and Simulation Australian Standards, but there are several Australian Standards relevant to modelling and simulation. These include:

- Geospatial data standards AS/NZS ISO 19101 & 19108
- The IGES CAD Data exchange standard AS 3643.1
- Dublin Core AS/NZS ISO 15836:2004
- Information Security Management AS/NZS ISO/IEC 17799:2001
- General Risk Management AS/NZS 4360:1999

Further details of these standards are provided in Annex D.

[48] Reference ??, http://www.nato.int/

293. Standards Australia has also the established the following committees.

- IT-031 Computer Modelling & Simulation
- IT-019-01 Information Technology for Learning, Education, and Training Committee

294. These committees belong to the Business Standards Divisions. The Business Standards Division's role is to "Develop contemporary and relevant standards that assist businesses to perform more effectively in highly competitive markets. It is responsible for standardisation in the areas of communications, information technology, electronics, electromagnetic compatibility, e-business health informatics, management systems, contracts and business and organisational practices."

6.3.1.3 SAIL Computer Modelling & Simulation Committee (IT-031)

295. IT-031 was formed in April 2004. To focus on the Australian adoption and/or development of computer modelling and simulation standards. IT-031 work is closely related to ISO JTC1/SC24. Details of its terms of reference and operations are available from SAIL.

6.3.1.4 Information Technology for Learning, Education, and Training Committee (IT-019-01)

296. IT-019-01 was formed in August, 2001. Its focus is on standardisation in the field of information technologies for learning, education, and training to support individuals, groups, or organisations, and to enable interoperability and reusability of resources and tools. It works closely with ISO JTC1/SC36. Details of its terms of reference and operations are available from SAIL.

6.4 OTHER KEY STANDARDS RELATED BODIES

6.4.1 Australian Defence Simulation Office (ADSO)

297. The Australian Defence Simulation Office is the group within the ADO who have the responsibility[49], in consultation with the Defence Simulation Forum (DSF), to develop and implement a Defence Simulation Plan.

298. The responsibilities of ADSO, as per DI(G) OPS 42-1 are:

a. formulation of appropriate guidelines for the development, acquisition and use of computer-based modelling and simulation systems in Defence;

b. securing benefits for the Australian Defence Force (ADF) from the coordination of computer-based modelling and simulation activities in Defence;

c. promoting interoperability within Defence and with overseas partners to facilitate mutually beneficial collaboration;

d. participation by Australian industry and academia in Defence computer-based modelling and simulation activities to achieve the highest leverage for the Defence effort;

[49] Reference A, para. 31

e. encouraging growth within the Defence Organisation of the skills needed in personnel who can then take full advantage of the opportunities offered by computer-based modelling and simulation for the enhancement of ADF capability; and

f. sponsoring simulation developments, acquisition and activities which cross boundaries between Defence Groups and which may therefore be under-resourced.

299. ADSO is the channel for ADO input into modelling and simulation standards.

6.4.2 Civil Aviation Safety Authority

300. The Civil Aviation Safety Authority (CASA) is the Australian Civil Aviation Regulator as such they are responsible for putting out:

- Civil Aviation Regulations (CARs)
- Civil Aviation Orders (CAOs)
- Civil Aviation Advisory Publications (CAAPs)
- Civil Aviation Safety Regulations (CASRs)
- CASA Procedure Manuals

301. Referenced in the CARs and CAOs are the following simulation and modelling standards:

- Operational Standards and Requirements - Approved Synthetic Trainers (FSD-2) Version 1.2 Jan 2002
- Manual Of Standards Part 60 – Synthetic Training Devices Version 1.0 (Draft) replacing FSD-1.

302. Further details regarding the operations of CASA including their process for developing and issuing regulation and standards can be found on their website[50].

6.4.3 Simulation Industry Association of Australian (SIAA)

303. The Simulation Industry Association of Australian (SIAA) is a not for profit industry based association. It mission [51] is to advance the research, development, and use of simulation technologies and practices in Australian industry, academia, and government. Details of the objectives of this organisation can also be found at their website.

304. The SIAA is currently involved in the development of simulation and modelling standards. It is a founding member of the Standards Australia IT-031 Computer Modelling and Simulation Committee and its standards sub-committee has developed the ADF DIS Enumeration Standard that it has submitted to SISO.

305. The standards sub-committee provides a channel for Australian industry input in to the development of simulation and modelling standards.

[50] Reference S, www.casa.gov.au.
[51] Reference T, website www.siaa.asn.au.

7 APPLICATION OF DEFENCE SIMULATION STANDARDS

7.1 GOALS OF STANDARDS APPLICATION

306. Defence Simulation Policy goals for the use of simulation[52], are to enhance capability, save resources and reduce risks. To achieve this Defence Simulation Policy has identified the key practical issues for simulation[53] and formulated these into six criteria against which all future simulation projects need to be assessed. These six criteria are:

1. User requirements
2. Representations
3. Data availability and reliability
4. Technology
5. Confidence building
6. Cost benefit

307. To assist in establishing where simulation standards can be applied to support the Defence Simulation Policy goals for the use of simulation, these are considered from the perspective of the Acquirer, Developer, User, Manager and Supporter in section 7.2 below.

308. Defence Simulation Standards are also considered in terms of application area. The applications are mapped into 5 main simulation standard categories as described in detail in section 4. A discussion of each category of standard is provided in that section.

7.2 APPLICABLE SIMULATION STANDARDS BY ROLE

7.2.1 Simulation Acquirer

309. A Simulation Acquirer is defined in the Australian Defence Simulation Glossary[54], as "one who procures simulations, with a focus on major and minor projects, including requirements analysis. Simulation Acquirers also administer the development of simulations."

310. The SPG[55], provides substantial guidance on undertaking a requirements analysis in accordance with Defence Simulation Policy, hence guidance on relevant standards only is provided in this document.

311. The Simulation Acquirer needs to combine user requirements with defence cost benefits goals and data availability. These are drivers for the data representations and simulation technologies used.

7.2.1.1 User Requirements - Effective Communication

312. To ensure the effective communication of requirements the acquirer should ensure that their terminology is consistent with that defined in the Simulation Glossary as included under Simulation Engineering standards. IEEE 1233 also provides guidance on the development of system requirements.

[52] Reference A, para 6.
[53] Reference A, para 22.
[54] Reference I.
[55] Reference Z.

7.2.1.2 User Requirements - Interoperability

313. Where user requirements require combined or interoperable simulations appropriate Distributed Simulation Standards should be specified as listed in Annex D. The two key defence simulation standards are DIS and HLA. Detailed guidance on the benefits and limitations associated with the application of these standards is provided in the DSG.

314. Interoperable simulations will also require the availability of consistent simulation data. This is covered in more detail below.

7.2.1.3 Confidence Building

315. To create confidence in the delivered simulation both VV&A standards and fidelity standards for the simulations and underlying data should be specified.

316. For VV&A of DIS simulations IEEE 1278.4 should be used, refer to DSG section 8.1. For VV&A of HLA simulation there are currently no VV&A standards available, refer to the DSG section 8.2.

317. Flight simulator and synthetic trainers must be built and certified against fidelity standards, CASA MOS Part 60 for Approved Flight Simulators. The Air Force adds additional requirements (military credit sequences) to these standards to meet their requirements for military aircraft.

318. The user requirements should define the fidelity of the data required. Many of the geospatial standards offer differing levels of fidelity. The acquirer will need to specify the appropriate geospatial data and fidelity standard from the list provided in Annex D. AS/NZS ISO 19113:2004 can also be used as a reference to define Geographic information quality. Further information can be found in the SDG.

7.2.1.4 Representations

319. The acquirers requirement to promote reuse and to achieve full life cycle cost benefits through reusability, reconfigurability and scalability of data and simulations is one of the drivers for the specification of representation standards

320. User and/or defence policy requirements for joint or combined training that demand interoperability, also drive the use of common, standards compliant or compatible data representations and simulation technologies. Standard representations across all simulations also increase the likelihood of suitable data availability.

321. There are currently no standards for the low level data representation, as used by visual databases; this data is typically provided in a proprietary database format. In this case the acquirer should consider also having the data provided in a neutral or data exchange format or provide a conversion tool to allow for conversion of data to a standard exchange format such as SEDRIS.

7.2.1.5 Data Availability & Reliability

322. As stated above, under representations, the likelihood of data availability can be increased or the potential for reuse improved by specifying a standard data format or data exchange standard. Data reliability is partially addressed by the data fidelity specified as part of the data standard and for geographic information is covered by the geographic information quality standard as listed in Annex D. The validity of data at any point in time can be assessed as part of the simulation validation and verification process and/or certification

process. Standards covering these processes are provided in Annex D under Confidence Building.

7.2.1.6 Cost/benefits

323. Effective management practices are required to ensure the efficient achievement of the above outcomes. The standards, as listed under Simulation Management in Annex D, can be specified to ensure compliance with a commonly accepted industry approaches to these issues. These cover system requirements development, risk management, security, safety, design reviews and configuration management. Note that the application of some of these standards are mandatory. Mandatory standards are identified in the DIE ATSL.

7.2.1.7 Technology

324. Usually the acquirer is not directly concerned with the technology but rather is focussed on ensuring that the user requirements are met in the most cost effective manner. However much of the recent simulation technology development in defence, particularly as sponsored by the US DoD through DMSO, has been focussed on simulation interoperability and reusability. Two of the results of this have been HLA and SEDRIS. These are technologies, not simulations or simulation tools, which are now being adopted as international industry standards. Specification of these standards should be considered for simulations and data exchange for all simulations including non-interoperable simulations, as the fundamental goals of these standards are fully consistent with Defence Simulation Policy.

7.2.2 Simulation Developer

325. A Simulation Developer is defined in the Australian Defence Simulation Glossary[56], as "One who develops simulations including design and programming .A Simulation Developer does not only build the initial base level capability, but all subsequent levels of capability as well."

326. The Simulation Developer's goal is to convert user requirements into simulations in the most cost effective manner.

327. The simulation standard employed by the developer will be largely dictated by the acquirer. Where the acquirer does not mandate or recommend the application of standards listed above, the developer should adopt these for the reasons stated above.

328. In additional there are various standards covering design documentation and common methods for representing software architectures and data structures. These are listed under the Simulation Engineering category in Annex D. Broad adoption of these standards should assist the developer in ensuring efficient and effective communication of design information throughout the engineering team, and with the customer when required. They should also assist in cooperation, communication and movement of staff between various industry suppliers.

329. Adoption of standards to provide an operating baseline will also increase the user base and hence the commercial viability of provision of the associated training and support services.

[56] Reference, I.

7.2.3 Simulation User perspective

330. A Simulation User is defined in the Australian Defence Simulation Glossary, as "One who uses simulations, in an application area, and require more than a basic awareness of simulation to do this effectively. Those users who only require a basic understanding of simulation to use it, eg. soldiers in a weapons simulation trainer, are not included in this category."

331. From the user's perspective the simulation needs to be capable of doing the task for which they, or their management intended. They also need to have access to the data required for the simulation and be confident in accuracy and validity of the results.

332. Simulation Standards of relevance to the user include those associated with:

a. user requirements definition (although the primary responsibility for requirements is included under Acquisition);

b. data availability, representation and fidelity; and

c. confidence building (verification validation and accreditation).

333. A list of applicable standards under the above categories is provided in Annex D.

334. The user may also be involved in the development of new proposals. Guidance on the development and assessment of proposals, (against the six assessment criteria set out in the Defence Simulation Policy) is described in the Simulation Proposals Guide.

7.2.4 Simulation Manager

335. A Simulation Manager is defined in the Australian Defence Simulation Glossary, as "Those who manage a simulation or an organisation that uses or relies on simulation.".

336. Simulation standards most relevant to the Simulation Manager are those required to ensure: the simulation is capable of delivering the current and future capabilities of the users; that the validity of simulation output is verified and meets any necessary accreditation or certification requirements for its application; that the simulation and associated simulation data is current and can be maintained in a cost effective manner; and that all the required simulation safety and security requirements are being addressed.

337. Simulation standards of relevance to the Simulation Manager are:

a. the simulation terminology glossary ;

b. the VV&A standards as appropriate to the simulations being managed;

c. the data standards and fidelity standards as relevant to the simulations being managed;

d. the system engineering life cycle process standard;

e. simulation safety standards;

f. simulation security standards.

7.2.5 Simulation Supporter

338. A Simulation Supporter is defined in the Australian Defence Simulation Glossary, as "Those who maintain or support simulations to the level of capability as accepted by the Simulation Manager from the Simulation Acquirer. This includes provision of technicians, logistics, people and data. This category also includes those who train others in simulation topics including how to build and run them".

339. As such the Simulation Supporter is likely to be responsible for simulation software an data updates, revalidation and certification of the simulation after any upgrades or data updates

340. Therefore simulation standards of relevance to the Simulation Supporter includes all of those listed for the Simulation Manager plus:

a. software and in some cases hardware configuration management standards;

b. familiarity with the technology standards as applicable to the simulators being supported;

341. Data exchange and interoperability standards may also be of interest to the supporter in the following circumstances:

a. if the simulator being supported is to be linked to and made interoperable with other simulations; and

b. if the data from either the simulation being supported or from another simulation is to be used/reused.

7.3 APPLICABLE SIMULATION STANDARDS BY FORM OF SIMULATION

342. The following provides some additional notes regarding the application of simulation standards that are of particular relevance to the following forms of simulation.

7.3.1.1 Constructive Simulations

343. The definition of a Constructive Simulations, as defined in the Australian Defence Simulation Glossary, is:

"In constructive simulations individuals generally stimulate (make inputs to the constructive models but they are not directly involved in determining the outcomes of the simulations. Constructive simulation are used typically in situations, such as combat engagement simulations for example, where participants seek to achieve a specified military objective given pre-established resources and constraints. They may also use engineering, cost and support models".

344. As constructive simulations can be run faster than real time, for practical reasons[57] DIS is not used in this type of application. HLA is a more appropriate standard as it supports real-time and logical time (event triggered) management.

[57] Reference SDG section 2.3.3

7.3.1.2 Virtual Simulations

345. The definition of a Virtual Simulation, as defined in the Australian Defence Simulation Glossary, is:

"Virtual Simulations inject humans in the loop to exercise motor control, decision-making, or communications skills. The human element of a virtual Simulation is not modelled. The simulated systems in virtual Simulation would be made up of constructive Models. Examples include individual aircraft (or weapon system) simulators and virtual prototypes".

346. By the nature of the simulation, where a human is included in the loop the simulation must run in real-time. The DIS standard is well suited to real-time interoperable simulations. Currently a majority of interoperable Australian Defence Virtual Simulations comply with the DIS Standard.

347. HLA is also suited to this type of simulation and offers the potential for reduced bandwidth for distributed simulations. Additional information can be found in the DSG. For further advice contact ADSO.

348. Humans in the loop may be subject to simulator sickness and/or the simulation may not be valid in terms of human response if latencies exceed specified levels. There are no standards that define the requirements in this area. This requires careful specification. Further information is provided in the CASA standards for approved flight trainers and synthetic training devices.

7.3.1.3 Live Simulations

349. The definition of a Live Simulation, as defined in the Australian Defence Simulation Glossary, is:

"Traditionally having a training focus, live simulations represent military operations using military personnel and equipment in which simulated experiences are achieved using near-combat conditions. The advances of computer-based simulation support is enriching this field, enabling real time data collection and exercise control, including the real-time insertion of virtual simulations to stimulate live responses (eg; computer controlled targets on live-firing ranges, EW threat/missile engagement scenarios)".

350. By nature these simulations are real-time. TENA is an emerging (US DoD) standard aimed at providing affordable interoperability between instrumentation based test and simulation based training ranges.

7.4 IDENTIFICATION AND EVALUATION

351. The determination of the relevance of a particular category of simulation standard is driven by the requirements of the simulation. Detailed guidance on the determination and assessment of requirements for defence simulations is provided in the Simulation Proposal Guide.

7.4.1 Applicability of Simulation Standards

352. The DIE ATSL includes an applicability column within its tables of standards. In this document, the potential applicability of individual simulation standards should be based on the description of the standard provided in section 5. The applicability of a specific category of simulation standard should be based on an assessment of the benefits of the category described in section 4.

Comment: Shouldn't we always try to use standards for developing systems?

8 TRAINING AND SUPPORT

8.1 TRAINING

353. Details of Simulation and Training Courses are provided in reference AB "Simulation Training and Education". A list of organisations and previously presented courses on simulation standards related topics is provided below. Further details of the courses and contact details for the organisations are provided in reference AB.

8.1.1 Training providers

8.1.1.1 Universities

354. The following Australian Universities provide post graduate and undergraduate courses or subjects in simulation:

- RMIT
- University of NSW (ADFA)
- Central Queensland University
- Curtin University of Technology
- University of Ballarat

355. The following overseas Universities provide post graduate and undergraduate courses or subjects in simulation:

- University of Central Florida
- Old Dominion University, Virginia Modeling, Analysis and Simulation Center (VMASC), Virginia
- The Royal Military College of Science (RMCS), Cranfield University, UK
- US Naval Postgraduate School
- Arizona State University

8.1.1.2 Other Organisations & Companies

356. The following organisations provide courses in simulation:

- SIAA
- ADSO
- Permian
- Distributed Simulation Technology Inc (DiSTI)

8.1.2 DIS Training

357. The SIAA provided a workshop as part of a previous SimTecT conference on simulation interoperability, which included discussion of DIS.

8.1.3 HLA Training

358. The University of Ballarat provides has previously provided HLA training via a SIAA sponsored course. Permian has also provided an introductory course in HLA.

8.1.4 SEDRIS Training

359. The SIAA provided a workshop as part of a previous SimTecT conference addressing the issues concerning the use and implementation of SEDRIS.

8.1.5 STEP

360. The SIAA in conjunction with RMIT have as part of a previous SimTecT conference provided a course on simulation based business and simulation based design, which included an outline of STEP.

8.2 GENERAL SUPPORT FROM STANDARDS ORGANISATIONS

8.2.1 IEEE

361. IEEE products and support services are accessible via their website. These include the downloading/purchasing of IEEE publications (a small number of documents and standards are free) and information about conferences and workshops. The IEEE-SA website also contains an "IEEE Standards FAQs" section, which provides more information on Standards related issues and procedures.

8.2.2 OGC

362. The OGC runs an Outreach and Community Acceptance Program (OCAP) intended to encourage the adoption and implementation of OpenGIS specifications. The resources offered include: technical documents, training materials, test suites, reference implementations and other interoperability resources developed in OGC's Interoperability Initiatives. The OGC also supports publications, workshops seminars and conferences. Further details are available from the OGC website.

8.2.3 OMG

363. OMG provides extensive support facilities accessible via its website to assist users in application of their standards. These include: a large number of whitepapers covering their standards and their adoption, (which are free to download); a technology tutorials section; and hyperlinks to member companies who provide training services in UML, CORBA and other OMG standards.

8.2.4 SEDRIS

364. A detailed discussion of SEDRIS and its application, including a description of what it is and is not is provided on the SEDRIS website. The website also provides details of the current status of the ISO adoption of SEDRIS and extensive support tools and utilities that can be freely downloaded. These include software development kits (SDKs) and environmental data coding specifications (EDCS).

8.2.5 SISO

365. The SISO website provides a listing of SISO standards and guidance products. It also lists products (including potential new standards) that are currently under development as

well as active study groups. Much of the material can be either viewed on the website or freely downloaded.

8.2.6 Web3D

366. Web3D's provide a substantial amount of support freely available from its website. This includes, links to tool & application suppliers (including freeware products), FAQs, sample applications, various examples and a conformance suite.

8.2.7 Proprietary

367. These organisations include Microsoft, MPI, Macromedia and the like. These organisations typically provide a range of training and support services on a fee for service basis. Some also include FAQ and other introductory information via their websites for free.

8.3 LOCAL SUPPORT AND DEFENCE POINTS OF CONTACT

368. Defence Points of contact (POC) for local support to ADO personnel are provided in Annex A of SIMMAN. These people have agreed to act as contacts within their organisations to provide advice and assistance on simulation standards and related issues for Defence simulation projects.

8.3.1 Simulation User Groups

369. The point of contact for standard related issues at Australian Defence Group Level should be the relevant simulation cell or simulation user group for that group.

8.3.2 ADSO

370. Simulation standards related issues at the Australian Defence level or above should be directed to ADSO.

8.3.3 SIAA

371. The SIAA provides forums, runs an annual conference (SimTecT), organises seminars and workshops and has founding membership of the Standards Australia IT-031 Modelling and Simulation Standards Committee. Further details can be found on the SIAA website.

ANNEX A - ABBREVIATIONS AND ACRONYMS

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

Acronym/ Abbreviation	Explanation
3D	3-Dimensional
ADF	Australian Defence Force
ADL	Advanced Distributed Learning
ADO	Australian Defence Organisation
ADSO	Australian Defence Simulation Office
AGR	AICC Guidelines and Recommendations
AICC	Aviation Industry CBT Committee
API	Application Programmers Interface
ADRG	Arc Digitised Raster Graphics
ATSL	Approved Technology Standards List
CA	Canada
CAA	Civil Aviation Authority
CAD	Computer Aided Design
CAM	Computer Aided Manufacture
CASA	Civil Aviation Safety Authority
CCEB	Combined Communications Electronics Board
CDR	Critical Design Review
CIB	Controlled Image Base
CIS	Communications and Information Systems
CM	Configuration Management
CMI	Computer Managed Instruction
CORBA	Common Object Request Broker
CTEIP	Central Test and Evaluation Investment Program
CWM	Common Warehouse Meta-model
DARPA	Defence Advanced Research Projects Agency
DCW	Digital Chart of the World
DEM	Digital Elevation Model
DFAD	Digital Feature Analysis Data
DIE	Defence Information Environment
DII	Defence Information Infrastructure
DIEC	Defence Information Environment Committee
DIDS	Data Item Descriptions
DI(G)	Defence Instruction (General)
DIS	Distributed Interactive Simulation
DIMPI	Defence Information Policy Instruction
DMO	Defence Material Organisation
DMSO	Defence Modeling & Simulation Office
DoD	US Department of Defense
DRM	Data Reference Model
DSG	Distributed Simulation Guide
DSSG	Defence Simulation Standards Guide
DSTO	Defence Science & Technology Organisation

DTED	Digital Terrain Elevation Data
EDCS	Environmental Data Coding Specification
ERP	Enterprise Resource Planning
FEDEP	Federation Execution Development Process
FOM	Federation Object Model
FSD	Flight Simulator Device
GRIM	Guidance, Rationale and Interoperability Modalities
HLA	High Level Architecture
HTML	Hyper Text Mark-up Language
ICAO	International Civil Aviation Organisation
IDD	Interface Design Description
IEC	International Electro-technical Commission
IEEE	Institute of Electrical and Electronics Engineers
IEEE-SA	Institute of Electrical and Electronics Engineers – Standards Association
IGES	Initial Graphics Exchange Standard
IHO	International Hydrographic Organisation
IRS	Interface Requirements Specification
ISO	International Standards Organisation
IV&V	Independent Verification and Validation
JTA	Joint Technical Architecture
LOD	Level of Detail
LMS	Learning Management System
M&S	Modelling & Simulation
MCQFS	Manual of Criteria for the Qualification of Flight Simulators
MDA	Model Driven Architecture
MIS	Management Information Systems
MOF	Meta Object Facility
MOS	Manual of Standards
MPI	Multigen Paradigm Inc.
NATO	North Atlantic Treaty Organisation
NZ	New Zealand
OGC	Open Geospatial Corporation
OLAP	On-line Analytical Processing
OMG	Object Management Group
OSTP	US Department of Defence and White House Office of Science and Technology Policy
PAR	Product Authorisation Request
PDM	Product Data Management
PDR	Preliminary Design Review
PDU	Protocol Data Unit
PN	Product Nomination
RTE	Run Time Environment
RTI	Run Time Infrastructure
SAI Global	Standards Australia International Global
SAIL	Standards Australia International Limited
SCORM	Shareable Content Object Reuse Model
SCM	Software Configuration Management
SDG	Simulation Data Guide
SDR	System Design Review

SEDRIS	Synthetic Environment Data Representation Interchange Standard
SEMP	System Engineering Management Plan
SIAA	Simulation Industry Association of Australia
SIMMAN	ADSO Simulation Manual
SISO	Simulation Interoperability Standards Organisation
SISO SAC	Simulation Interoperability Standards Organisation – Standards Committee
SN	Sequencing & Navigation
SOC	Statements of Compliance
SRM	Spatial Reference Model
SRR	System Requirements Review
SRS	System Requirements Specification
SSR	Software Specification Review
STD	Synthetic Training Device
STEP	Standard for the Exchange of Product Model Data
SVVP	Software Verification and Validation Plan
TENA	Test and Training Enabling Architecture
T&E	Test and Evaluation
TRA	Technical Regulatory Authorities
UK	United Kingdom
UML	Unified Modelling Language
US	United States
VPF	Vector Product Format
VMAP	Vector Smart Map
VRML	Virtual Reality mark-up Language
V&V	Verification and Validation
VV&A	Verification, Validation and Accreditation
VVAG	Verification, Validation and Accreditation Guide
WVS	World Vector Shoreline
XML	Extensible Mark-up Language

ANNEX B - DEFINITION OF TERMS

Simulation specific terminology used in the guide is as per the Australian Defence Simulation Glossary.

ANNEX C - REFERENCE DOCUMENTS

The table details the reference documents relevant to this guide.

Serial	Doc. Reference	Reference	Source
A	DI(G) OPS 42-1	Defence Instruction (General) OPS 42-1 Defence Simulation Policy	
B		Defence Simulation Plan, Issue 1	
C	DCA DIR 06/01	Army Policy on the Management and Employment of Simulation, Australian Army Headquarters	
D	DI(AF) OPS 5-17	Royal Australian Air Force Training Simulator Policy, Department of Defence, Air Force Headquarters	
E	DI(N) ADMIN 67-1	Navy Policy on the Management and Employment of Simulation, Department of Defence, Navy Headquarters	
F	DIMPI 3/2002	Defence Information Management Policy Instruction 3/2002 - Defence Information Environment (DIE), Approved Technology Standards List (ATSL) Version 2.2, 25 June 2004.	
G	SDG	Simulation Data Guide, Australian Defence Simulation Office, Department of Defence, Canberra	ADSO Website
H	DSG	Distributed Simulation Guide, Australian Defence Simulation Office, Department of Defence, Canberra	ADSO Website
I	ADSG	Australian Defence Simulation Glossary, Australian Defence Simulation Office, Department of Defence, Canberra	ADSO Website
J	SCORM 2004	Shareable Content Object Reference Model (SCORM), 2004 Overview, Advanced Distributed Learning (ADL)	Downloadable from the ADL website, http://www.adlnet.org/
K	Websim	Websim Initiative Overview	Wedsim website, http://www.websim.net/
L	VVAG_V0.4	Simulation Verification, Validation and Accreditation Guide, Australian Defence Simulation Office, Department of Defence, Canberra	ADSO Website
M	ISO	?About us/	ISO website
N	IEEE LTSC	?IEEE Learning Technology Standards Committee Mission & Role	http://ltsc.ieee.org/

O	OMG	OMG relationship with ISO	http://www.omg.org/
P	Web3D	Web3D /contact/about.htm	http://www.web3d.org/
Q	AICC	"What is the AICC"	http://www.aicc.org/pages/aicc_faq.htm
R	DMSO	DMSO website	www.dmso.mil/public/
S	CASA	CASA website	www.casa.gov.au
T	SIAA	Simulation Industry Association of Australia website	www.siaa.asn.au
U	Discreet	Discreet website	www.discreet.com
V	alias	Alias website	www.alias.com
W	TENA	TENA Architecture Reference Document Version (2002)	www.fi2010.org
X	SEDRIS	ab_1trpl.htm	www.sedris.org/ab_1trpl.htm
Y	AICC PUB1		http://www.aicc.org/pages/aicc3.htm#PUB1
Z	SPG	Defence Simulation Proposal Guide, Australian Defence Simulation Office, Department of Defence, Canberra	
AA	SAIL	Preparing Standards, Standardisation Guide No.1, Standards Australian, 2 march 2004.	
AB	STE	Simulation and Training Education Version 1, Australian Defence Simulation Office, Department of Defence, Canberra	ADSO Website
AC	SSM	Simulation Security Manual, Australian Defence Simulation Office, Department of Defence, Canberra	ADSO Website
AD	SG	Safety Guide, Australian Defence Simulation Office, Department of Defence, Canberra	ADSO Website
AE	SAIL	ISO 19113:2002 Product Summary	http://www.standards.com.au/catalogue/script

ANNEX D - SIMULATION STANDARDS LIST

Standard Name	Abbrev. Standard Identifier	Organisation -Developer/ Maintainer	Standard Title	Status	Defence POC	References	Notes
Defence Simulation Standard Status: M = Mandatory, R = Recommended, E = Emerging, S = Superseded							
Representations							
Data Standards							
Geospatial Metadata	ISO 19115	ISO/TC211				SDG Annex B	
CSDGM	FGDC-STD-001-1998		Content Standard for Digital Geospatial Metadata			SDG Annex B	
Shoreline Metadata	GDC-STD-001.2-2001		Metadata Profile for Shoreline Data			SDG Annex B	
OpenGIS Reference Model	AS/NZS 19101:2003	ISO IT-004	Geographic information – Reference model			SAIL	Was formerly OpenGIS Reference Model
	AS/NZS 19108:2003	ISO	Geographic information – Temporal schema			SAIL	
	AS/NZS 19111:2004	ISO	Geographic information – Spatial referencing by coordinates			SAIL	Was SA DR 01228
	AS/NZS 19113:2004	ISO	Geographic information – Quality principles			SAIL	Was SA DR 01229
Simple Features	AS/NZS 19125.1:2004	ISO OGC adopted via ISO/TC211	Geographic information – Simple feature access – Part 1: Common Architecture			OGC website	Was SA DR 01230

Standard Name	Abbrev. Standard Identifier	Organisation -Developer/ Maintainer	Standard Title	Status	Defence POC	References	Notes
Defence Simulation Standard Status: M = Mandatory, R = Recommended, E = Emerging, S = Superseded							
Simple Features SQL (SFS)	AS/NZS ISO 19125.2:2004	OGC adopted via ISO/TC211	Geographic information – Simple feature access – Part 2: SQL option			OGC website	Was SA DR 01231
OpenGIS WMS	ISO 19128:2004	OGC adopted via ISO/TC211	OpenGIS Web Map Services (WMS) Interface Specification			OGC website	OGC WMS
OGC's GML	ISO 19136 (Draft?)	OGC GML Submitted	OGC's Geography Mark-up Language (GML)	E		OGC website	OGC GML
ARDG	MIL-A-89007	NIMA	Arc Digitised Raster Graphics Standard			SDG 4.3.1	US National Imagery and Mapping Agency (RPG Compliant)
CIB	MIL-PRF-89041		Control Image Base			SDG 4.3.2	
DCW	MIL-PRF-89039		Digital Chart of the World			SDG 4.3.3	Being replaced by VMAP Level 0
DEM		US Geological Survey (USGS)	Digital Elevation Model			SDG 4.3.4	
DFAD	MIL-PRF-89005	NIMA	Digital Feature Analysis Data			SDG 4.3.5	
DTED	MIL-PRF-89020 STANAG 3809	NIMA	Digital Terrain Elevation Data			SDG 4.3.7	
GeoTIFF	MIL-C-89038					SDG 4.3.8	Extension of TIFF with additional geographic info embedded in it.
IHO S-57	IHO S-57	IHO (International Hydrographic Office)	Transfer Standard for Digital Hydrographic Data (IHO Special Publication 57)			SDG 4.3.12	International Maritime Organisation (IMO) mandated.
VMAP			Vector Smart Map			SDG 4.3.15	
VPF		NIMA	Vector Product Format			SDG 4.3.14	

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Defence Simulation Standard Status: M = Mandatory, R = Recommended, E = Emerging, S = Superseded								
WVS		MIL-W-89012		World Vector Shoreline			SDG 4.3.16	
OpenFlight			Multigen Paradigm Inc	OpenFlight			SDG 4.3.10 & MPI website	Visual Database Standard - OpenFlight Specifications are available for download from Multigen Paradigm.
MetaFlight			Multigen Paradigm Inc	MetaFlight			MPI website	MetaFlight Schema is available for download from Multigen Paradigm
XMFS				Extensible Modelling and Simulation Framework			NPS website	Web based technologies for interoperable M&S
ADF Enumerations	DIS		SIAA Standards Sub-Committee	ADF DIS Enumeration Standard	E			First distributed for comment at SimTect 2004
Fidelity Standards								
Geographic information – principles	Quality	AS/NZS ISO 19113:2004		Geographic information – Quality principles			SAIL	
CASA FSD-1		FSD-1	CASA	Operating Standards and Requirements - Approved Flight Simulators (FSD-1)	S		CASA website	
CASA FSD-2		FSD-2	CASA	Operating Standards and Requirements - Approved Synthetic Trainers (FSD-2)			CASA website	

Standard Name	Abbrev. Standard Identifier	Organisation -Developer/ Maintainer	Standard Title	Status	Defence POC	References	Notes
Defence Simulation Standard Status: M = Mandatory, R = Recommended, E = Emerging, S = Superseded							
MOS Part 60	MOS Part 60	CASA	Manual of Standards Part 60 - Synthetic Training Devices, Version 1.0 Feb 2003	E		CASA website	Replaced CASA's FSD-1 and FSD-2
Distributed Simulations							
Simulation Protocol Standards							
DIS (version 1)	DIS PDU v1.0	SISO-SAC	DIS PDU Version 1.0 (May 1992)	S		DSG 2.2.1 & SISO	
DIS (version 2) Application Protocols	IEEE 1278 - 1993	SISO-SAC for IEEE	IEEE Standard for Distributed Interactive Simulation	S	DSTO AOD	DSG 2.2.1, SISO, IEEE-SA	Initiated by US Army as SIMNET, std developed/maintained by SISO, subsequently adopted as an IEEE Std.
DIS (version 3)	DIS 2.03	SISO-SAC	DIS 2.03 (3rd draft dated May 1993)	S	DSTO AOD	DSG 2.2.1 & SISO website	
DIS (version 4)	DIS 2.04	SISO-SAC	DIS 2.04 (4th draft dated March 1994)	S	DSTO AOD	DSG 2.2.1 & SISO website	
DIS (version 5) Application Protocols	IEEE 1278.1-1995	SISO-SAC for IEEE		S	DSTO AOD	DSG 2.2.1, IEEE-SA & SISO websites	
DIS (version 6) Application Protocols	IEEE 1278.1a - 1998	SISO-SAC for IEEE	IEEE Standard for Distributed Interactive Simulation – *Supplement to Application Protocols - Enumeration and Bit-encoded Values*	R	DSTO AOD	DSG 2.2.1, IEEE-SA & SISO websites	

Standard Name	Abbrev.	Organisation Standard Identifier	Developer/ Maintainer	Standard Title	Status	Defence POC	References	Notes
Defence Simulation Standard Status: M = Mandatory, R = Recommended, E = Emerging, S = Superseded								
DIS Communication Services & Profiles	IEEE 1995	1278.2	SISO-SAC for IEEE	IEEE Standard for Distributed Interactive Simulation - Communication Services and Profiles	R	DSTO AOD	DSG 2.2.1, IEEE-SA & SISO websites	
DIS Exercise Management & Feedback	IEEE 1996	1278.3	SISO-SAC for IEEE	IEEE Recommended Practice for Distributed Interactive Simulation - Exercise Management and Feedback	R	DSTO AOD	DSG 2.2.1, IEEE-SA & SISO websites	
DIS VV&A	IEEE 1997	1278.4	SISO-SAC for IEEE	IEEE Recommended Practice for Distributed Interactive Simulation - Verification Validation & Accreditation	R	DSTO AOD	DSG 2.2.1, IEEE-SA & SISO websites	
Simulation Architecture Standards								
HLA - Framework & Rules	IEEE 1516 - 2000		SISO-SAC for IEEE	IEEE Standard for Modelling & Simulation, High Level Architecture (HLA) – Framework and Rules	R	DSTO AOD	DSG 2.3.1, IEEE-SA & SISO websites	Originally developed by SISO, subsequently adopted as an IEEE Std
HLA - Federate Interface Specification	IEEE 2000	1516.1	SISO-SAC for IEEE	IEEE Standard for Modelling & Simulation, High Level Architecture (HLA) – Federate Interface Specification	R	DSTO AOD	DSG 2.3.1, IEEE-SA & SISO websites	
HLA - OMT Specification	IEEE 2000	1516.2	SISO-SAC for IEEE	IEEE Standard for Modelling & Simulation, High Level Architecture (HLA) - Object Model Template (OMT) Specification	R	DSTO AOD	DSG 2.3.1, IEEE-SA & SISO websites	

Standard Name	Abbrev. Standard Identifier	Organisation -Developer/ Maintainer	Standard Title	Status	Defence POC	References	Notes
Defence Simulation Standard Status: M = Mandatory, R = Recommended, E = Emerging, S = Superseded							
HLA - FEDEP Recommended Practice	IEEE 1516.3 2003	SISO-SAC for IEEE	IEEE Standard for Modelling & Simulation, High Level Architecture (HLA) – Federation Development and Execution Process (FEDEP) Recommended Practice	R	DSTO AOD	DSG 2.3.1, IEEE-SA & SISO websites	
RPR FOM 1.0	SISO-STD-001.1-1999	SISO-SAC	Real Time Platform Reference FOM	S		DSG 2.3.1, IEEE-SA & SISO websites	Facilitates transition of DIS compatible simulations to HLA
RPR FOM 2.0		SISO-SAC	Real Time Platform Reference FOM	R		DSG 2.3.1 & SISO websites	Facilitates transition of DIS compatible simulations to HLA
RPR FOM 3.0		SISO-SAC	Real Time Platform Reference FOM	E		DSG 2.3.1 & SISO websites	Facilitates transition of DIS compatible simulations to HLA
TENA		Foundation Initiative 2010 Project, CTEIP	Test & Training Enabling Architecture	E	ADSO	http;//www.fi2010.org/	
CORBA		OMG	Common Object Request Broker Architecture			OMG website	
MDA		OMG	Model Driven Architecture	E		OMG website	
XMFS			Extensible Modelling and Simulation Framework			http://www.movesinstitute.org/xmsf/xmsf.html	Web based technologies for interoperable M&S

Simulation Communication Standards

Standard Name	Abbrev.	Organisation - Standard Identifier	Developer/ Maintainer	Standard Title	Status	Defence POC	References	Notes
Defence Simulation Standard Status: M = Mandatory, R = Recommended, E = Emerging, S = Superseded								
Link 16 PDG			SISO	Link 16 Simulation Standard for DIS and HLA compatibility	E		SISO website	Currently still under development
		STANAG 4482:1995	NATO	Standard Interface for Multiple Platform Link Evaluation (SIMPLE) for DIS ?			DSG 4.3.1	
		STANAG 4603	NATO	Standard Interface for Multiple Platform Link Evaluation (SIMPLE) for HLA?			DSG 4.3.1	
SIMPLE for Link 11 & Link 16		STANAG 5602	NATO	Standard Interface for Multiple Platform Link Evaluation (SIMPLE) for Link 11 and 16 Simulation			DSG 4.2.1	
Data Exchange Format								
SEDRIS		ISO/IEC 18023	ISO/IEC JTC1 SC24 WG8		E		SEDRIS website	ISO FCD
SEDRIS Language Bindings		ISO/IEC 18024	ISO/IEC JTC1 SC24 WG8	SEDRIS Language Bindings	E		SEDRIS website	
SEDRIS/EDCS		ISO/IEC 18025	ISO/IEC JTC1 SC24 WG8	Environmental Data Coding Standard	E		SEDRIS website	ISO IS
Spatial Reference Model (SRM)		ISO/IEC 18026	ISO/IEC JTC1 SC24 WG8	SEDRIS Spatial Reference Model			SEDRIS website	ISO FCD
EDCS Language Bindings		ISO/IEC 18041	ISO/IEC JTC1 SC24 WG8	EDCS Language Bindings			SEDRIS website	
SRM Language Bindings		ISO/IEC 18042	ISO/IEC JTC1 SC24 WG8	SRM Language Bindings			SEDRIS website	ISO FCD

Standard Name	Abbrev. Standard Identifier	Organisation -Developer/ Maintainer	Standard Title	Status	Defence POC	References	Notes
Defence Simulation Standard Status: M = Mandatory, R = Recommended, E = Emerging, S = Superseded							
GRIM	SISO-STD-001-1999	SISO-SAC	Guidance, Rationale and Interoperability Modalities			SISO website	
DIGEST	STANAG 7074	Digital Geographic Information Working Group (DGIWG)	Digital Geographic Information Exchange Standard				ISO/IEC 1/SC24 B11F? (Refer SDG 4.3.6)
NITF		US Govt. & Industry collaboration	National Imagery Transmission Format				US DoD endorsed (Refer SDG 4.3.9)
RPF	MIL-STD-2411	NIMA	Raster Product Format				US National Imagery and Mapping Agency (Refer SDG 4.3.11)
VPF	MIL-STD-2407	NIMA	Vector Product Format				Refer SDG 4.3.14. (DNC, VMAP, WVS are in VPF format)
IHO S-57	IHO S-57	IHO (International Hydrographic Office)	Transfer Standard for Digital Hydrograhhic Data (IHO Special Publication 57)				Refer SDG 4.3.12 (International Maritime Organisation (IMO) mandated)
IGES - CAD Data Exchange	AS 3643.1-1989		Computer Graphics - Initial graphics exchange specification (IGES) for digital exchange of product definition data - General			SAIL website	Identical to and produced from US Department of Commerce's National Bureau of Standards "Initial Graphics Exchange Specification 4.0-1988)

Standard Name	Abbrev. Standard Identifier	Organisation -Developer/ Maintainer	Standard Title	Status	Defence POC	References	Notes
Defence Simulation Standard Status: M = Mandatory, R = Recommended, E = Emerging, S = Superseded							
IGES - CAD Data Exchange 2D	AS 3643.2-1992		Computer graphics - Initial graphics exchange specification (IGES) for digital exchange of product definition data				A subset of AS 3643.1 - Two-dimensional drawings for architectural, engineering and construction
STEP - CAD Data Format	AS ISO 10303-1:1994	ISO TC184/SC4	Industrial automation systems and integration - Product data representation and exchange - Part 1: Overview and fundamental principles			Standards Australia IT-006-01: Industrial Automation Systems.	Incorporates AP203 (& AP233 SEDRES Version?)
Distributed Learning							
SCORM 2004		ADL	Shareable Content Object Reuse Model			ADL website	Required to conform with Defence Education and Training Development Branch (DETD) e-Learning Project
AICC		AICC	Aviation Industry CBT (Computer Based Training) Committee Courseware			AICC website	Required to conform with Defence Education and Training Development Branch (DETD) e-Learning Project

Standard Name	Abbrev. Standard Identifier	Organisation -Developer/ Maintainer	Standard Title	Status	Defence POC	References	Notes
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Flash (.swf)		Macromedia	Macromedia Flash Version 6 (MX) format				Required to conform with Defence Education and Training Development Branch (DETD) e-Learning Project
Confidence Building							
VV&A Standards							
V&V	IEEE 1012-1998		IEEE Standard for Software Verification and Validation			IEEE-SA website	
DIS VV&A	IEEE 1278.4 – 1997	SISO-SAC for IEEE	IEEE Recommended Practice for Distributed Interactive Simulation - Verification Validation & Accreditation	R	DSTO AOD	DSG 2.2.1, IEEE-SA & SISO websites	
HLA VV&A		SISO-SAC		E		DSG 8.2	
Regulatory/Certification							
CASA FSD-1		as above	Operating Standards and Requirements - Approved Flight Simulators (FSD-1)			http:/casa.gov.au/manuals/regulate/fsd	
CASA FSD-2		as above	Operating Standards and Requirements - Approved Synthetic Trainers (FSD-2)			http:/casa.gov.au/manuals/regulate/fsd	
TAMM	AAP 7001.053		Technical Airworthiness Management Manual				

Standard Name	Abbrev. Standard Identifier	Organisation -Developer/ Maintainer	Standard Title	Status	Defence POC	References	Notes
Defence Simulation Standard Status: M = Mandatory, R = Recommended, E = Emerging, S = Superseded							
ABR 6492			Navy Technical Regulations Manual				
TRAMM			Technical Regulation of Army Materiel Management				
Simulation Engineering							
Australian Defence Simulation Glossary		ADSO					
US DoD Modelling & Simulation Glossary	DoD 5000.59-M	DMSO				http://www.dmso.mil/public/resources/glossary/	
Glossary of Simulation Terminology	IEEE 610.3 - 1989	IEEE	IEEE Standard Glossary of Modelling and Simulation Terminology			IEEE-SA website	
Software Engineering Terminology	IEEE 610.12 - 1990	IEEE	IEEE Standard Glossary of Software Engineering Terminology				
MDA		OMG	Model Driven Architecture	E		OMG	
UML		OMG	Unified Modelling Language			OMG	
CWM		OMG	Common Warehouse Metamodel			OMG	
Software Design & Documentation	MIL-STD-498		Software Design and Documentation				
Systems Engineering	MIL-STD-499		Systems Engineering				

Standard Name	Abbrev.	Organisation - Standard Identifier	Developer/ Maintainer	Standard Title	Status	Defence POC	References	Notes
Defence Simulation Standard Status: M = Mandatory, R = Recommended, E = Emerging, S = Superseded								
System Engineering - System Life Cycle Process		ISO/IEC 15288:2002						
DirectX			Microsoft	DirectX				
Windows NT4			Microsoft	MS Windows NT 4.0 Build 1381 Operating System	S			
Windows XP			Microsoft	MS Windows XP Professional Operating System	E			
Win32 API			Microsoft	MS Windows Application Programming Interface				
OpenGL				OpenGL				
XML			W3C	Extensible Mark-up Language				
X3D Framework & SAI		ISO/IEC 19775:200x (FDIS)	Web3D		E		http://www.web3d.org/x3d/specifications/	Final Draft International Standard
X3D Framework - Part 1		ISO/IEC 19775-1:200x (FDIS)		X3D Framework - Part 1: Architecture and base components	E			Final Draft International Standard
X3D Encodings		ISO/IEC 19776-1:200x (FDIS)		X3D Encodings (XML encoding)	E			Final Draft International Standard
X3D Encodings		ISO/IEC 19776-2:200x (FDIS)		X3D Encodings (Classic VRML encoding)	E			Final Draft International Standard
Dublin Core		AS/NZS ISO 15836:2004		Information and Documentation - The Dublin Core metadata element set				DIE ATSL Table 7.2 r10

Standard Name	Abbrev. Standard Identifier	Organisation -Developer/ Maintainer	Standard Title	Status	Defence POC	References	Notes
Defence Simulation Standard Status: M = Mandatory, R = Recommended, E = Emerging, S = Superseded							
Simulation Management							
System Requirements Development		IEEE 1233-1998	IEEE	IEEE Guide for Developing System Requirements Specifications			IEEE-SA website
Design Reviews		MIL-STD-1521B					
IEEE SW CM		IEEE 1042-1987	IEEE	IEEE Guide to Software Configuration Management			IEEE-SA website
DI(G) LOG 08-4				Defence Policy on Configuration Management			
General Risk Management		AS/NZS 4360:2004	SAIL	Risk Management			
HB 436:2004		HB 436:2004	SAIL	Risk Management Guidelines Handbook			
AS/NZS 3931:1998		AS/NZS 3931:1998	SAIL	Risk Analysis of technological systems – Application Guide			
Software Risk Management		IEEE 1540:2001	IEEE	IEEE Standard for Software Life Cycle Processes - Risk Management			
Security							
Information Security Management		AS/NZS ISO/IEC 17799:2001	ISO/IEC	Information Technology - Code of proactive for information security			SSM

Standard Name	Abbrev. Standard Identifier	Organisation -Developer/ Maintainer	Standard Title	Status	Defence POC	References	Notes
Defence Simulation Standard Status: M = Mandatory, R = Recommended, E = Emerging, S = Superseded							
SECMAN			Defence Security Manual, Parts A, B, C, E, F, I			SSM	
			Defence Construction Security Reference Manual			SSM	
PSM			Protective Security manual			SSM	
DISP			Defence Industrial Security Manual, section 10			SSM	
DSD ACSI-33			DSD ACSI-33 Chapter 7			SSM	
Safety							
TAMM	AAP 7001.053		Technical Airworthiness Management Manual			SG	
ABR 6492			Navy Technical Regulations Manual			SG	
TRAMM			Technical Regulation of Army Materiel Management			SG	
			Materiel Acquisition and Sustainment Framework SAMS Systems Safety Guide			SG	
DEFAUST 5679	DEFAUST 5679		The Procurement of Computer Based Safety Critical Systems			SG	
MIL-STD-882D	MIL-STD-882D		US DoD Standard, Department Of Defence Standard Practice For System Safety			SG	

Standard Name	Abbrev. Standard Identifier	Organisation -Developer/ Maintainer	Standard Title	Status	Defence POC	References	Notes
Defence Simulation Standard Status: M = Mandatory, R = Recommended, E = Emerging, S = Superseded							
MIL-STD-882C	MIL-STD-882C		US DoD Standard, Military Standard, System Safety Program Requirements	S		SG	
Def-Stan-56	Def-Stan-56		UK MoD Standard, Safety Management Requirements For Defence Systems			SG	
FAR 25.1309	FAR 25.1309		Federal Aviation Regulation, Airworthiness Standards: Transport Category Airplanes			SG	
FAR 23.1309	FAR 23.1309		Federal Aviation Regulation, Airworthiness Standards: Normal, Utility, Acrobatic, and Commuter Category Airplanes			SG	
SAE ARP 4761			Society of Automotive Engineers Aerospace Recommended Practice, Guidelines and Methods for Conducting the Safety Assessment Process on Civil Airborne Systems and Equipment			SG	
RTCA/DO-178B			Software Considerations in Airborne Systems and Equipment Certification			SG	
ISO/IEC 15026:1998			Information Technology - System and Software Integrity Levels			SG	

ANNEX E - SIMULATION STANDARDS ORGANISATIONS

Organisation Reference	Organisation Name	Website	Standards Products	/Australian POC	Notes
Defence Simulation - International					
DMSO	US DoD Defense Modelling & Simulation Office	www.dmso.mil/public/	DIS, HLA, SEDRIS	ADSO	Original Sponsor
NATO		www.nato.int/	STANAGS	ADSO	
CCEB	Combined Communications Electronics Board (nations of AUS, USA, UK, CAN and NZ)	http://nc3a.nato.int/website/home.asp	ADatP-34 Volume 4 (NCSP) & STANAGs	Deputy Director – Manager Architecture Interoperability	CCEB Combined Interoperability Standards list Email – die.atsl@defence.gov.au
NPS	Naval Post Graduate School (NPS) - Moves Institute	www.movesinstitute.org/xmsf/xmsf.html	XMFS	ADSO	DMSO are a Primary Sponsor with others, SISO are participating with others
Defence Simulation - Australian					
ADSO	Australian Defence Simulation Office			ADSO	
DSTO AOD	Air Operations Division				
DSTO LOD	Sim				
DSTO MOD	Maritime Operations Division				
DIE Standards			DIE ATSL	Deputy Director – Manager Architecture Interoperability	Email – die.atsl@defence.gov.au
Simulation, Open - International					
General					

Organisation Reference	Organisation Name	Website	Standards /Australian Products POC	Notes
ISO	International Organisation for Standardisation	http://www.iso.org/	OpenGIS®, OGC GML, X3D, SEDRIS, SRM, EDCS, STEP	Standards Australia	Publish numerous standards developed by others. Many published jointly with the IEC
IEC	International Electro-technical Commission	http://www.iec.ch		Standards Australia	Publish many standards jointly with ISO
IEEE (-SA)	The Institute of Electrical and Electronics Engineers Standards Association	http://standards.ieee.org/	DIS, HLA		
Geospatial					
DGIWG	Digital Geographic Information Working Group	http://www.digest.org/	DIGEST		Has working agreement with ISO/TC211 regarding development and joint publication of ISO 19100 series standards
OGC	Open Geospatial Consortium, Inc.	http://www.opengeospatial.org/	OpenGIS®		
NGA (NIMA)	National Geospatial Intelligence Agency	http://www.nima.mil/	ARDG, DFAD, DTED		US National Imagery and Mapping Agency (NIMA) changed its name to National Geospatial Intelligence Agency (NGA) on 24 Nov 2003
USGS	US Geological Survey	http://www.usgs.gov/	DEM		
IHO	International Hydrographic Office	http://www.iho.shom.fr/	S-57		Website hosted by the French hydrographic service (SHOM)
Distributed Learning					
ADL	Advanced Distributed Learning (Network)	http://www.adlnet.org/	SCORM		
AICC	Aviation Industry CBT Committee	http://www.aicc.org/			

Organisation Reference	Organisation Name	Website	Standards Products	/Australian POC	Notes
IEEE LTSC	IEEE Learning Technology Standards Committee	http:/ltsc.ieee.org/			
Software					
OMG	Object Management Group	http://www.omg.org/	MDA, UML, CWM, CORBA, XMI		
Web3D	Web 3D Consortium	http://www.web3d.org/x3d/specifications/	VRML, X3D		
W3C		http:/www.w3.org/	XML		
Simulation					
SISO	Simulation Interoperability Standards Organisation	http://www.sisostds.org/	DIS, HLA	ADSO & SIAA	
Websim		http://www.websim.net/			New Consortium
Simulation, Open - Australian					
SAIL	Standards Australian International Ltd.	http://www.standards.org.au/	IGES	ADSO, SIAA, IEAust.	
SA IT-006-01	Standards Australia - Industrial Automation Systems and Integration - Committee	As above	STEP		IT-006-01 Industrial Automation Systems and Integration, Chairman Mr Martin Jones, SA Projects Manager Mr Michael Langdon michael.langdon@standards.org.au
SA IT-19-01	Standards Australia - Information Technology for Learning, Education, and Training Committee	As above			Information Technology for Learning, Education, and Training Committee
SA IT-031	Standards Australia - Modelling and Simulation Standards Committee	As above			IT-031

Organisation Reference	Organisation Name	Website	Standards /Australian Products POC	Notes
CASA	Civil Aviation Safety Authority - Australia	http://www.casa.gov.au/	MOS Part 60, FSD-1, FSD-2	
Proprietary				
MPI	Multigen Paradigm Inc.	http://www.multigenparadigm.com/	OpenFlight, MetaFlight	
Microsoft	Microsoft		NT, XP, Win32	
SGI	Silicon Graphics	http://www.sgi.com/	OpenGL	

Defence Simulation Standards 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:

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Phone: (02) 6265-4797; Fax: (02) 6265-2223;
e-mail: darrenmcfarlane@defence.gov.au

* * * *

1. **According to your understanding of Defence simulation standards, 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?**

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