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AN ACTIVITY MODEL FOR STANDARDS PROCESS FOR THE DISTRIBUTED INTERACTIVE SIMULATION (DIS)

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ABSTRACT

Recent semi-annual Distributed Interactive Simulation (DIS) Workshops, involving many volunteer participants, have been developing a family of improved Standards for the Interoperability of Defense Simulation. The newly approved Institute of Electrical and Electronic Engineers IEEE Standard 1278, developed by DIS, results from a process of negotiated consensus achieved among a large body of participants.

In this paper, an activity model documents the interactive procedures used by members of the DIS community to develop a family of standards. This effort was accomplished by following the Corporate Information Management (CIM) Functional Process Improvement (draft DoD 8020.1-M, January 1993). The "as-is" model provided the mechanism to clarify ambiguous areas and eliminate possible duplications. The "to-be" model was developed based upon the lessons learned and recommendations of the study.

1 INTRODUCTION

The primary mission of the Distributed Interactive Simulation (DIS) community is to create a synthetic, virtual representation of warfighting environments. In order to operate effectively and to fulfill its mission, DIS needs a family of standards to foster interoperability. The University of Central Florida, Institute for Training & Simulation (UCF/IST) conducts Distributed Interactive Simulation (DIS) Workshops for the US Army Simulation, Training and Instrumentation Command (STRICOM) on Standards for the Interoperability of Defense Simulation. The development of IEEE Standard 1278 through these workshops demonstrated a successful method which should be applied to future interactive simulation standards development projects.

The Department of Defense (DoD) also has a strong interest in standards development. The objective of the DoD Standardization Initiative is to promote the development and use of non-Government (national and international) standards in preference to federal and military standards whenever feasible. The Defense Information Systems Agency (DISA) Information Technology (IT) Standards Management Plan, Joint Interoperability and Engineering Organization (JIEO) Plan 3200 (1993 Draft), reflects this objective and establishes the IT Standards Program as the Department's mechanism to centrally lead, manage, integrate, and coordinate Information Technology standards actions in support of DoD information systems.

The goal of both industry and government is to lay down the foundation and establish procedures such that all future standards development follow a similarly successful process.

2 OBJECTIVES

The purpose of this study was to capture the interactive processes used by members of the DIS community in developing standards during pre-submission, post-submission and adoption phases. The scenario for this study was limited to the actions taken by DIS in the development of IEEE Standard 1278. The objectives driving this study were to:

- Identify standards development improvement opportunities in terms of quality enhancement and increased productivity.
- Define performance measures to ensure process improvement (e.g., time, completeness, usability, etc.).
- Propose a high-level process model of the future standard development process.

3 AS-IS IDEF0 MODEL

New methods of analysis must be employed to comply with the DoD's efforts to reduce the overall cost of services while maintaining a high level of readiness. To maintain consistency and integration, the DoD has launched the Corporate Information Management (CIM) initiative for process improvement (draft DoDD 8020.1-M, January 1993). The primary methodology supporting this effort is activity modeling, which is a structured, analytical method of studying and documenting business activities. Information flows and roles are defined (e.g., inputs, controls, outputs, and mechanisms) for each activity or subactivity. A preferred activity modeling method is the Integration Definition Language for Functional Modeling (IDEF0) modeling. The IDEF0 activity modeling method was used to document the life cycle of standards development from initial position papers through rough draft to formal submission at the national and international standards body level. Additionally, the model

describes the steps for DoD adoption and standards profile development.

DoD 8020.1-M requires two modeling efforts: development of an "as-is" model and a "to-be" model. The "as-is" model documents the processes performed when IEEE Standard 1278 was developed. The breadth of processes included in this model are shown in Figure 1. Complex activities were broken down into smaller, more detailed activities for DIS, IEEE, and DoD Adoption. A "to-be" model was constructed based on findings from the "as-is" model. The CIM process improvement approach was effectively applied in this study to propose standards development process improvements (Huo et al, 1993).

The "as-is" process of "Specify Profile" was decomposed into four different steps. Using the numbering scheme shown in the Node Tree Diagram (Figure 1), the different organizational responsibilities are:

- A1: DIS standards development through candidate standards submittal to the IEEE.
- A2: IEEE from receipt of a candidate standard through the adjudication process to either accept or reject the standard.
- A3: DoD in how they adopt an IEEE standard.
- A4: DoD in developing a standards profile.

The following sections describe the activities of the first-level decomposition diagram (Figure 2) and the breakdown of the first process, A1 - "Develop Candidate Standard" (Figure 3). Detailed descriptions of the remaining processes are provided in the report (Huo et al, 1993). The "as-is" model is based on documents from DIS Workshops, personal experiences gained from the standards development process and discussion with members of the DIS Steering Committee.

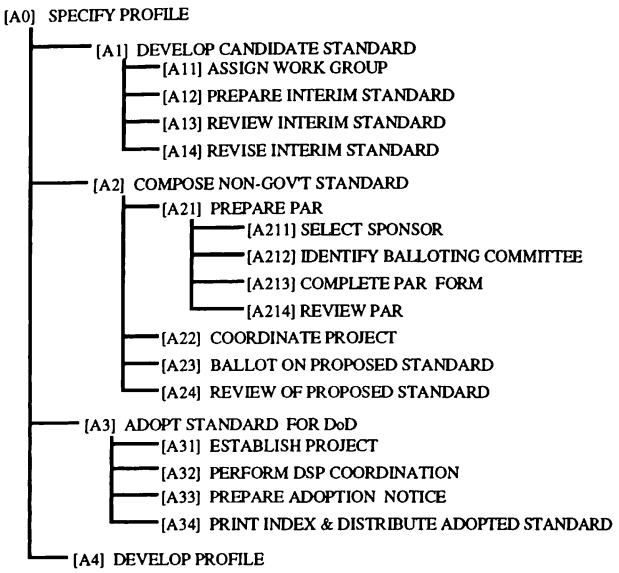

Figure 1: Node Tree Diagram

3.1 Develop Candidate Standard

Whenever a member of the DIS Community identifies the need for a new or modified standard, a Standard Concept is submitted to the DIS Steering Committee which clearly explains its need. The DIS Steering Committee, currently about 30 representatives from the funding organizations, the Defense Modeling and Simulation

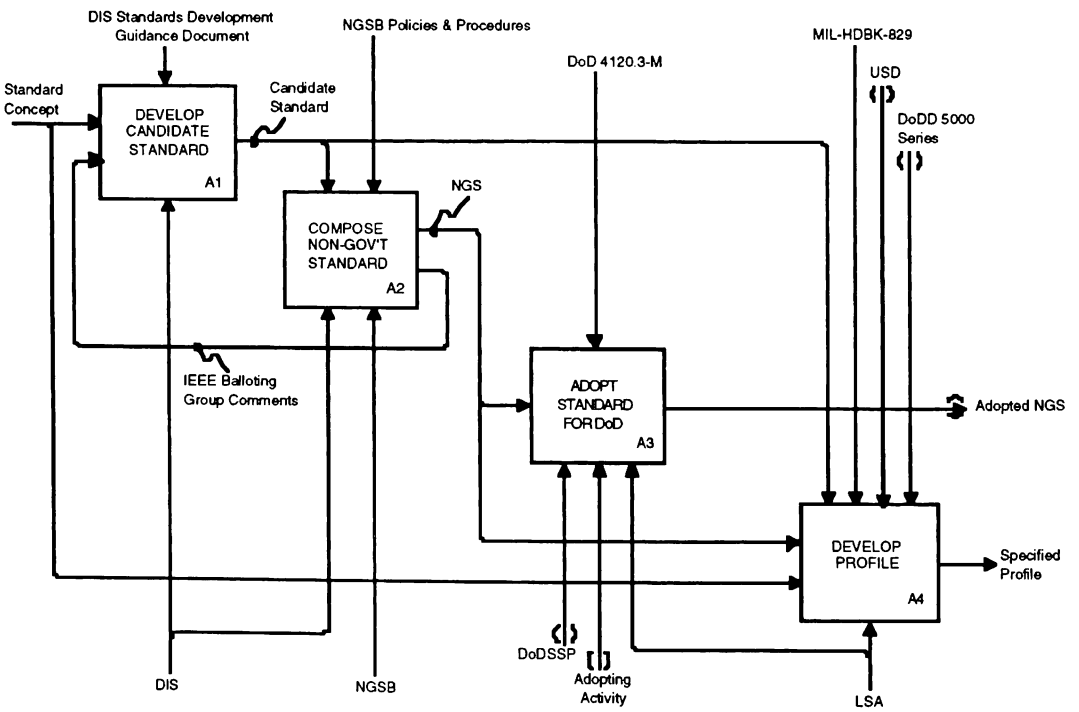

Figure 2: As-Is A0 Decomposition Diagram

Office (DMSO), STRICOM, UCF/IST, and the DIS Working Group and Subgroup Chairperson of military, industry, and academic background, decides if the Standard Concept represents a valid need.

If a new Standard Concept is deemed necessary, a work group under the direction of a Working Group or Subgroup is formed to develop the Standard Concept. The DIS Steering Committee will assign the Standard Concept to an appropriate DIS Working Group or Subgroup in accordance with the DIS Standards Development Guidance Document which provides a brief procedure for standards development.

There are currently six main DIS Working Groups and additional Special Interest Groups: Simulated Environment; Interface & Time/Mission Critical; Communication Architecture & Security; Fidelity, Exercise Control, Feedback Requirements; and Field Instrumentation. There are several DIS Subgroups under each DIS Working Group in order to ensure each DIS Working Group has adequate resources to discuss proposed issues.

Once the Standard Concept reaches the DIS Working Group, advantages and disadvantages are discussed and subsequent modifications are made to the Standard Concept, now known as an Interim Standard. When the DIS Working Group reaches consensus on the Interim Standard, it is submitted to the DIS Steering Committee for approval. Upon approval, copies of the Interim Standard are distributed to DIS workshop attendees. The Interim Standard is adjusted for additional modifications at the next DIS workshop and is resubmitted to the DIS Steering Committee and the DIS workshop attendees. After numerous revisions that span several DIS Workshops (a minimum of 3), the final version of the Interim Standard is sent to the DIS Steering Committee. Upon approval, the Interim Standard becomes a Candidate Standard and is submitted to IEEE for approval.

The Candidate Standard is often returned to the Working Group with recommendations for changes to be made. This process may be repeated several times until the standard passes the IEEE Balloting Group and becomes a Non-Government Standard (NGS). A further breakdown of this activity (A2) and those illustrated in A3 and A4 can be found in a report by Huo et al, 1993.

The A1 process, "Develop Candidate Standard", is decomposed to describe the detailed activities of developing a DIS Candidate Standard, as shown in Figure 3 and narrated in the following subsections.

3.1.1 Assign Work Group

After a Standard Concept is prepared in the form of a Position Paper, approved by the DIS Steering Committee, presented in an open forum, and has obtained consensus from the DIS workshop attendees, a DIS Working Group is formed, comprised of volunteers and chaired under a selected leader. If any additional Position Papers similar to the same Standard Concept are presented during the DIS Workshop and are approved,

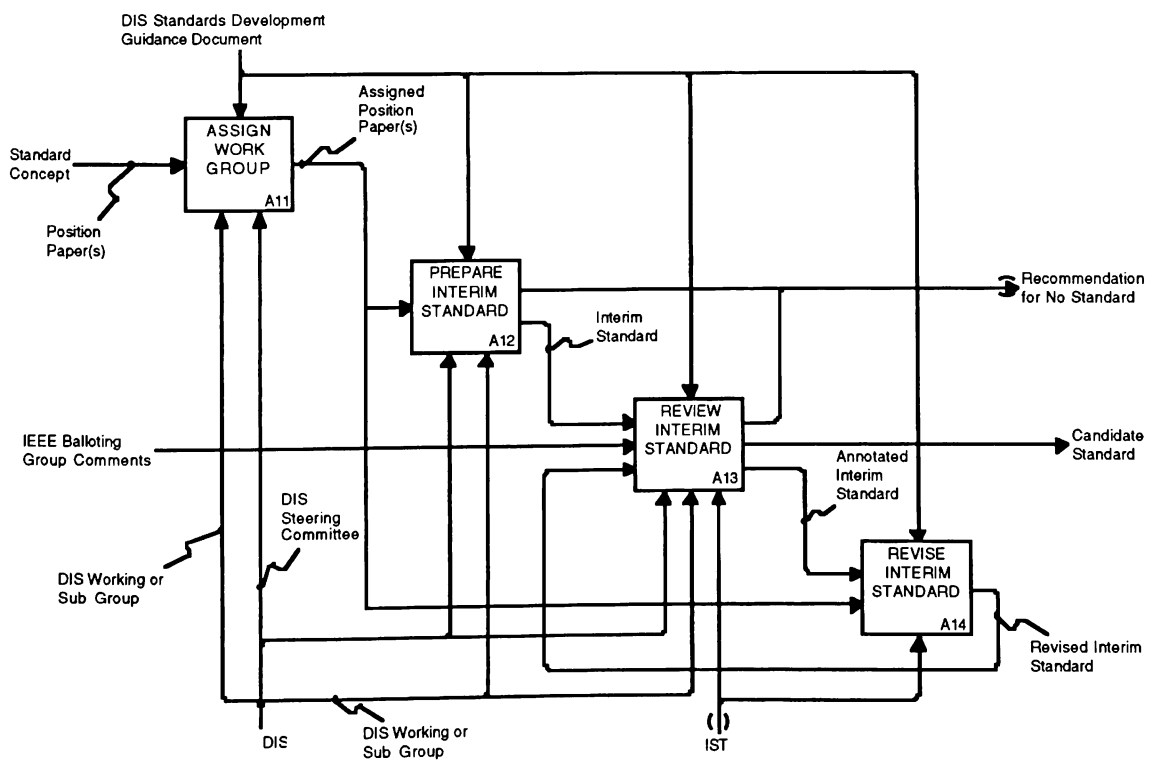

Figure 3: As-Is A1 Decomposition Diagram

they will be given to the same DIS Working Group. If no current group is appropriate, it will be assigned to a Special Interest Group. The objective of this activity is to assign all approved Position Papers of the same Standard Concept to the same DIS Working Group. The result is an Assigned Position Paper(s).

If the Standard Concept is rejected by the DIS Workshop in the open forum, then no more actions will be made for the proposed Standard Concept.

3.1.2 Prepare Interim Standard

When a DIS Working Group or DIS Subgroup is assigned a Position Paper by the DIS Steering Committee, the group is responsible for preparing a draft document, called the Interim Standard, under the DIS Standards Development Guidance Document. The Chairperson and volunteer writers will meet for one or more sessions as necessary to prepare the Interim Standard in the IEEE-style format before the next DIS Workshop. This requirement is recommended for the approval process to a non-Government Standards Body (NGSB), because the IEEE standards approval process is less time consuming than most and receives a stronger reception from industry. The Interim Standard is submitted to the DIS Steering Committee for administrative approval before dissemination in the next Workshop.

If the DIS Working Group deems that the Standard Concept is no longer valid, no further efforts will be conducted. The Working Group Chairperson will then inform the Steering Committee of its disposition.

3.1.3 Review Interim Standard

When the Interim Standard is released by the Steering Committee to the appropriate DIS Working or Subgroup in the DIS workshop, issues and questions may be raised by the members. Most of the questions will be resolved either at the DIS Workshop or at a given time determined in the ensuing Interim Meeting(s). Solutions are voted on before they are to be incorporated into the Interim Standard by the Working Group. Consensus for resolution is obtained through voting, although a full and complete vote is seldom necessary. If consensus is reached, the minority's objections will be noted, but they will not be incorporated in the Interim Standard. The result of this activity is an Annotated Interim Standard. The Chairperson briefs the DIS Steering Committee on the status and schedule, identifying when the incorporation of changes will be completed. IST is responsible for taking minutes and recording the discussion.

If no further issues or questions are raised in the DIS Workshop, this Interim Standard will then be identified as the Candidate Standard. To date, the DIS Steering Committee has not rejected any Candidate Standards based on technical merits.

As in A12, the Working Group has an option to terminate any further activities on the Standard Concept if it is deemed invalid. The Working Group has to inform the Steering Committee of their decision.

3.1.4 Revise Interim Standard

When the Annotated Interim Standard is received, the Chairperson and the volunteer writers will prepare a revised Interim Standard in one or more Interim Meetings. Viable approaches for the unresolved issues which were brought up during the DIS workshop are incorporated, as are any new Position Papers that are approved by the DIS Steering Committee. The revised Interim Standard will then be submitted to the DIS Steering Committee through IST before dissemination in the next DIS workshop (A13). Viable approaches are presented in the DIS Workshop for consensus. This activity will be reiterated as many times as necessary, usually three to four workshops, before the DIS Working Group is ready to submit the Revised Interim Standard to the NGSB.

During the review cycle with IEEE, the DIS Work Group and the DIS Steering Committee are responsible for Balloting Group Comments received from IEEE. When 56% of the IEEE Balloting Group Comments are accepted by IEEE, the Candidate Standard will then be accepted as an official Industry Standard.

3.2 Compose Non-Government Standard

IEEE, a prominent NGSB, cooperates with standards groups throughout the world, such as DIS, in the preparation of standards involving an area of interest within its scope. A Candidate Standard becomes a Non-Government Standard (NGS) when consensus is reached in a NGSB. Approval of a standard by the IEEE signifies that the IEEE believes the document to be consistent with good engineering practice and that it represents a consensus of engineers from all aspects of the involved industries, governments, and public interests.

Once the Candidate Standard has been approved for the ballot, the IEEE Balloting Group reviews the Candidate Standard, and then has the option of approving, not approving, or abstaining from the ballot. A balloting group within IEEE is composed of individuals who have an interest and a commitment to the Candidate Standard. Questions and comments generated during the balloting process are combined into the Balloting Group Comments, and are forwarded to the DIS Working Group or Subgroup for review and possible revision. The balloting process is repeated until consensus is achieved in accordance with NGSB Policies & Procedures.

IEEE consensus is established when, in the judgment of the IEEE Standards Board, substantial agreement has been reached by directly and materially affected interest categories. Substantial agreement means much more than a simple majority, but not necessarily unanimity. Consensus requires that all views and objections be considered, and that a concerted effort be made toward their

resolution.

3.3 Adopt Standard for DoD

DoD standardization policies and procedures are managed centrally by the Office of the Secretary of Defense (OSD) and within the Military Departments and Defense Agencies by the Departmental Standardization Offices (DEPSOs) in accordance with DoD 4120.3-M, Defense Standardization Program (DSP) Policies and Procedures. DISA is the Executive Agent for DoD for Information Technology Standards. The Center for Standards (CFS) serves as the DEPSO for DISA and the Lead Standardization Activity (LSA) for four standardization areas. DIS standards, such as IEEE Standard 1278, fall under the Information Standards and Technology (INST) standardization area.

Normally an individual is selected/nominated by DISA to participate in the standards development activities of the NGSB and serves as the DoD representative. If the Adopting Activity, which is identified by the LSA, determines that DoD will have an interest in the NGS, a standardization project will be established. The Adopting Activity reviews and forwards the draft/published NGS to custodians, review activities, LSAs and other interested DoD activities for comment as part of the normal coordination process within the DSP. If all comments are satisfactorily resolved and the NGS meets DoD needs, the Adopting Activity can then approve the NGS for adoption and submit an Adoption Notice to the DoD Single Stock Point (DoDSSP).

The purpose of the Adoption Notice is to indicate to the standards and acquisition communities that a NGS has been adopted for DoD use. Adopting a NGS is encouraged because adopted NGSs are listed in the DoD Index of Specifications and Standards (DoDISS) and are available to requesting DoD activities from the DoDSSP. Further information regarding the responsibilities of LSA and Adopting Activities can be found in DoD 4120.3-M (July 1993).

3.4 Develop Profile

"Profiles define combinations of base standards for the purpose of identifying the base standards, together with appropriate classes, subsets, options and parameters, which are necessary to accomplish identified functions for purposes such as interoperability; providing a system of referencing the various uses of base standards which is meaningful to both users and suppliers; providing a means to enhance the availability for procurement of consistent implementations of functionally defined groups of base standards, which are expected to be the major components of real application systems; and promoting uniformity in the development of conformance test for systems that implement the functions associated with the Profiles." (TR 10000-1, 1990)

An Acquiring Activity or Program Manager, through the LSA, is responsible for identifying functional requirements in accordance with the Defense Acquisition guidance (DoD 5000.1 & 5000.2, 1991). The Acquiring Activity or Program Manager then describes these requirements in a User Service Description (USD) and reviews the USD to identify applicable standards that will enable interoperability. The Acquiring Activity or Program Manager compares this list of applicable standards to previously defined profiles. If an existing profile satisfies the USD, that profile becomes the Specified Profile. If an existing profile can be modified to satisfy the USD and the modifications do not disrupt the purpose of the original profile, then the profile is modified and becomes the Specified Profile. If there is no existing profile that satisfies the USD, then the Acquiring Activity or Program Manager documents a new profile in accordance with MIL-HDBK-829 using NGSs, Candidate Standards, Standard Concepts, and other types of standards, with options and parameters specified as required.

4 LESSONS LEARNED

Lessons learned from the "as-is" model identify areas for process improvement. The major findings during the study are noted below:

a) Communication. Currently there is only one point of contact between the DIS Steering Committee and IEEE. Lack of written documentation leads to misinformation and miscommunication later on. More formal documentation is needed.

b) Need for a Defined Structure. The lack of a well defined structure outlined in approved policies and procedures has encouraged entrepreneurship and creativity in the development of Candidate Standards. This environment also allows for less qualified Chairs to run the Working Groups and Subgroups. The Steering Committee needs to develop more structured bylaws, policies, and procedures.

c) Lack of DoD Representation. Currently only individual Service representatives are involved with DIS Standards development. Early DoD involvement during the standards development stage will assure DoD interest is present and accelerate the DoD adopting process. The recent approval of DoD 4120.3-M (July 1993) will help to formalize the adoption process.

d) Nonstandard Data Elements. There is very little awareness of data element standardization as reflected in Candidate Standards. Currently the only data element standardization-related project under development is the Enumeration Document Update (Huo, 1993) which is a notable effort, yet inadequate for Modeling & Simulation (M&S) data administration.

e) Need for a Central Information Clearinghouse. A Central Information Clearinghouse is needed to gather, manage, and disseminate DIS information. DIS has reached the stage where dissemination of information is becoming a problem. New documents are constantly be-

ing generated which affect the structure of DIS. Standards and policy changes need to be kept current and transferred to the DIS community as soon as they are passed. This body of knowledge will continue to grow at an increasing rate as the DIS organization expands. DIS needs a mechanism whereby any individual or organization can access this body of information quickly, inexpensively, and with the knowledge that they have the latest version of the information they need.

f) No Central Travel Funding. During the development of the Interim and Candidate Standards through volunteered participation, normal correspondence methods through E-mail and postal service is adequate. At times, emergency situations require face-to-face meetings of certain members on short notice. Currently there are no resources allotted to allow travel for these situations, thus necessary representation cannot be achieved.

5 RECOMMENDATIONS

The following recommendations based upon the lessons learned, were used to construct the "to-be" model. The detailed information regarding the decomposition diagram (Figure 4) for the "to-be" model can be found in (Huo et al, 1993). These recommendations will only serve as a guideline for standards process improvement.

a) Formalized Coordination with IEEE. The IEEE sponsoring committee is the point of contact interfacing with IEEE on behalf of DIS. In the "as-is" model, this position is normally assumed by the Chairperson of the DIS Working Group of the Candidate Standard. In the "to-be" model, this position will be reserved for the Chairperson of the DIS Steering Committee. The Chairperson of the DIS Steering Committee will create a vice-Chairperson of the IEEE sponsoring committee and appoint the Chairperson of the DIS Working Group of the Candidate Standard to that position. Therefore, the Chairperson will be assisted by the vice chair to distribute information pertaining to either technical or general guidance related discussion or decision between IEEE and DIS to the appropriate parties in a timely fashion.

b) Bylaws for DIS Steering Committee. The DIS Steering Committee should have bylaws to clearly define the corporate structure of the DIS organization, and delineate the responsibilities and authority of each group at every level. The draft DIS Standards Development Guidance Document (March 1993) contains some of the above stated areas but is lacking in other important areas. For instance, essential qualifications for a DIS Working Group Chairperson include:

- Broad technical background in order to direct the discussion.
- Previous experience on chairing technical discussions in a large group.
- Ability to maintain an objective but discrete forum.
- Strong leadership qualities to direct the team toward final product.
- Creativity and resourcefulness to enhance standards development.
- Elected by the Working Group and approved by the Steering Committee.

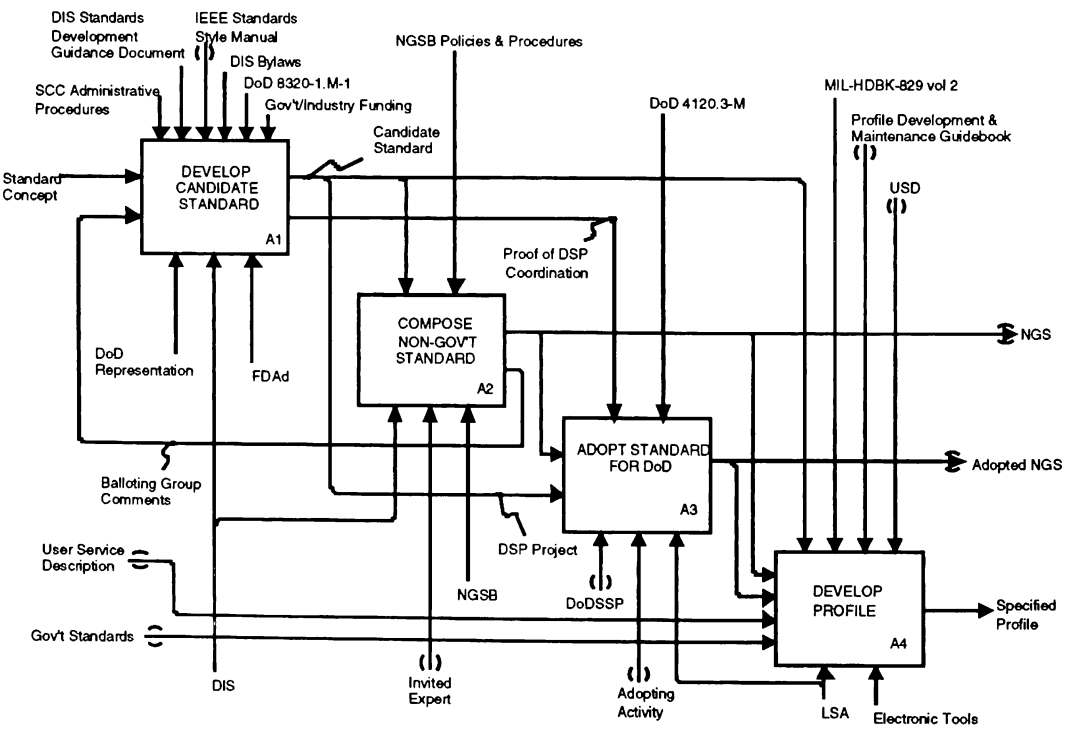

Figure 4: To-Be A0 Decomposition Diagram

c) DoD Representation during Standards Development. Early DoD involvement during the standards development stage will assure the incorporation of DoD's viewpoints and needs. The DoD adoption process can begin earlier and in parallel with IEEE approval efforts.

d) M&S Data Administration (DA). The DoD has established a data administration program (draft DoD 8320.1-M, June 1993; draft DoD 50XX.XX, August 1993) using data modeling and standardization as part as the overall CIM initiatives to ensure data interoperability and sharing. DISA will actively assist OSD and the Joint Staff in a long term effort to transition warfighting systems to the use of DoD standard C^3 data elements in accordance with the DoD Data Administrator and the C^3I Functional Data Administrator (FDAd), and to minimize the impact and costs of that transition to proven operational systems starting in FY94. The objective of M&S DA is to provide the DIS community with process improvement and data modeling procedures compatible with C3 standard data element initiative. Part of the M&S approach is to develop or find and utilize standard process models, data, and data models for pilot project applications in DIS to demonstrate a proof of concept of policy, procedures, and products. Activities include acquiring a repository to support DA standardization, policy and procedures development, identification of DA methodology and tools, and provisions for user-community support.

e) A Central Information Clearinghouse. The Tactical Warfare Simulation and Technology Information Analysis Center (TWSTIAC), a newly formed organization with a specific charter (Draft DoD 50XX.XX, August 1993) to support information development, will be ideal for a permanent information center and clearinghouse for the DIS community. Before TWSTIAC becomes fully operational next year, the DMSO M&S Information System could support the current needs.

f) Industry/Government Central Funding: Programs, such as the Technology Reinvestment Program at the National Institute for Standards and Technology (NIST), provide a mechanism to receive funding support from Government agencies to ensure volunteer representation on standards committees during unanticipated work sessions. A similar arrangement would allow DIS to be more responsive to these situations.

6 SUMMARY

To date, the Department of Defense has instituted a major initiative to strengthen the defense application of M&S (DMSO, 1992) and planned to improve interoperability and standards across many functional areas. The DoD Standardization Initiative is to promote the development and use of non-Government standards (NGS) in preference to federal and military standards whenever feasible (JIEO Plan 3200, July 1993). Under this guideline, examples of potential future improvement identified in this study include:

- Promoting NGSs to allow for more effectual use of time and resources.
- Successful Workshops draw more active and sustained involvement toward developing new standards.
- Early DoD representation accelerates the adoption process and provides the latest standards for use by the acquisition community. The time savings can be from 60 days to a year.
- Use of standard data elements enhances interoperability among DoD information systems, facilitates increased data sharing, reduces data handling costs, and leads to better data accuracy, consistency, and timeliness.

In closing, the key factors directing the success of DIS Workshops are dedication, enthusiasm, commitment and motivation. Volunteer participation makes the final outcome even more exciting. It is important to recognize these factors in order to take advantage of the trend toward distributed interactive simulation in developing standards.

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