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Title: DETERMINING INFORMATION MANAGEMENT NEEDS FOR ENHANCED INTERNATIONAL SAFEGUARDS

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DETERMINING INFORMATION MANAGEMENT NEEDS FOR ENHANCED INTERNATIONAL SAFEGUARDS*

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ABSTRACT

The Safeguards Information Management System initiative is a program of the Department of Energy's (DOE) Office of Arms Control and Nonproliferation aimed at supporting the International Atomic Energy Agency's (IAEA) efforts to strengthen safeguards through the enhancement of information management capabilities. The DOE hopes to provide the IAEA with the ability to correlate and analyze data from existing and new sources of information, including publicly available information, information on imports and exports, design information, environmental monitoring data, and non-safeguards information. The first step in this effort is to identify and define IAEA requirements. In support of this, we have created a users' requirements document based on interviews with IAEA staff that describes the information management needs of the end user projected by the IAEA, including needs for storage, retrieval, analysis, communication, and visualization of data. Also included are characteristics of the end user and attributes of the current environment. This paper describes our efforts to obtain the required information. We discuss how to accurately represent user needs and involve users for an international organization with a multi-cultural user population. We describe our approach, our experience in setting up and conducting the interviews and brainstorming sessions, and a brief discussion of what we learned.

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BACKGROUND

The International Atomic Energy Agency was established in 1957 by the United Nations to promote the peaceful use of atomic energy. The Agency establishes and administers safeguards to ensure that special fissionable and other materials, services, equipment, facilities, and information made available by the Agency are not used to further any military purpose. The cornerstone of the Agency's safeguards system is the Treaty on the Non-Proliferation of Nuclear Weapons (NPT), which came into being in 1968. The Treaty requires that non-nuclear-weapon states, party to it, must accept safeguards on all source or special fissionable material in all their nuclear activities.

The Objectives of Safeguards

Safeguards are a technical means of verifying the fulfillment of political obligations:

- To assure the international community that states are complying with their nonproliferation and other peaceful-use undertakings
- To deter (a) the diversion of safeguarded nuclear materials to the production of nuclear explosives or for other military purposes and (b) the misuse of safeguarded facilities with the aim of producing unsafeguarded nuclear material.[1]

The Department of Safeguards is the technical arm of the IAEA primarily responsible for achieving the political objectives of safeguards. The technical objective of safeguards is the timely detection of diversion of significant quantities of nuclear material from peaceful nuclear activities to the manufacture of nuclear weapons or other nuclear explosive devices or for purposes unknown and deterrence of such diversion by risk of early detection. This objective was clarified through the establishment of precise definitions for significant quantities and timeliness.[2]

Safeguards Implementation

Under the NPT, non-nuclear weapon states renounce the acquisition of nuclear weapons. The declarations of such states with regard to their peaceful nuclear activities are meant to be comprehensive, i.e., states are not to have undeclared or clandestine nuclear activities. Until very recently, the Agency verified a state's declarations by only establishing the truth of statements regarding the amounts, presence, and use of nuclear material as reported by the states to the Agency.

Safeguards Inspections

In order to verify a state's declarations and the correctness of information submitted by the state, the IAEA performs on-site inspections of a state's declared nuclear facilities. Inspectors check to see that operating and accounting records maintained at the facility are consistent with the reports submitted to the Agency. Inspectors also make independent measurements; inventory nuclear material; verify design information; check, affix, and remove seals; collect surveillance records (video tapes); service and calibrate equipment; obtain samples; and perform other inspection duties.

SAFEGUARDS INFORMATION MANAGEMENT

The discovery of Iraq's clandestine nuclear weapon development program was a watershed in the history of IAEA safeguards and has resulted in the Agency undertaking an ambitious program for strengthening its safeguards system. This is being done under a program referred to internally as Program 93+2.

The basis for this strengthening program is the recognition that safeguards must give assurance not only of the non-diversion of declared material or that declared facilities are not being misused but also of the absence of any undeclared nuclear activities in states that have signed comprehensive safeguards agreements with the Agency.

The IAEA has determined that the detection of undeclared nuclear activities and the creation of confidence in the continuing peaceful use of declared material and facilities is largely dependent on more information being made available to the Agency and on the capability of the Agency to make more effective use of this additional information, as well as existing information. Measures to obtain additional information include the following:

- Early provision and use of design information;
- Voluntary reporting by member states (over and above that required in their safeguards agreements) of exports, imports, and production of nuclear material, non-nuclear material, and certain equipment;
- Collection by the Agency of information from Open sources (e.g., the public press) about nuclear activities; and
- The provision by member states of intelligence information obtained from satellites and other means.

Objectives of Enhanced Information Management

The IAEA expects that enhanced safeguards will require the management of a much greater volume of information and that the information may be more qualitative in nature than conventional safeguards data. The data may come from a variety of sources, their accuracy may be questionable, and they may not necessarily be provided in a prescribed format. Thus new and innovative information management systems and techniques will be needed by the Agency to make effective use of the information in meeting its expanded safeguards mission. The Agency's objective is to ensure a coherent and comprehensive approach to the acquisition, management, and analysis of information regarding a state's nuclear activities.

ACCURATELY REPRESENTING USERS' NEEDS

Often software development is the pivotal element in the development of any computerized system, and it is also a common cause of dissatisfaction with a system due to unreliability or inappropriate functionality. Software projects are seldom subjected to the rigorous design, development, and testing cycle of the engineering disciplines, and the philosophy of ignoring this cycle is responsible for most unsuccessful software projects. The alternative is to use sound engineering principles to produce software that runs accurately, efficiently, and reliably. This is the approach we have chosen to take for the Safeguards Information Management System (SIMS) initiative.

The first step in the systematic and complete approach to the planning, specification, design, coding, testing, operation, and maintenance of software is the identification of the projected end user of the system. The user or group of users should be carefully identified and must be involved in each phase of the project if the process is to be successful. Once the end user has been identified, his or her requirements must be determined. User and developer assumptions and expectations must be carefully defined. If a requirements specification is developed in collaboration with end users, formal concurrence on requirements may be achieved. If this is not accomplished, it is unlikely that the users will accept the system, regardless of how many wonderful features it contains. The following must be addressed:

- Statement of the problem,
- Operational requirements,
- Hardware and software considerations,
- Required interfaces (for example, to other systems),
- Types of data to be handled,
- User interface, and
- Environmental considerations

A detailed requirements document is necessary. Interviews with users are a key element in obtaining requirements information. When a cohesive document has been produced, a preliminary draft is given to the users and then critiqued. Without a solid, complete requirements document, the software is almost certainly doomed before any code is even written.[3]

The more thoroughly these issues are addressed, the more complete the end product. However, because of the heterogeneous population at the IAEA, it was exceptionally important that we address these issues, and it was singularly difficult to achieve our goals.

As a first step in determining the information management needs of IAEA safeguards, the Users Requirements group of the SIMS project travelled to the IAEA in Vienna to meet with representatives of the Safeguards

Division, analysts, database managers, computer support personnel, and systems developers as well as a broad representation of potential users of new information management tools. We gathered information about current information management capabilities at the IAEA. This included information about the existing computing environment, the IAEA Local Area Network, the Safeguards Department's Local Area Network, IAEA connections to the outside, available information processing tools, the hardware and software environment, and on-line data bases. See Fig. 1 for a diagram of the Safeguards Department's Local Area Network and Fig. 2 for an overview of IAEA computer systems. We solicited advice and suggestions about information management needs at the IAEA that were being met and those that were not. Our methods included structured interviews, brainstorming sessions, and review of materials obtained before and after the interviews and called upon the subject-matter expertise of various members of the SIMS team. Follow-up visits and communications will be made over the life of the SIMS initiative to further clarify and define emerging IAEA safeguards information management needs. In addition, IAEA staffers demonstrated for us some of the IAEA systems, and we demonstrated a prototype fieldable inspection support system: On Site Inspection Support (OSIS).[4]

After our return to the United States, members of our team compiled and compared notes, impressions, insights, and conclusions. After in-depth analysis of the information management tools that are currently being used by IAEA personnel and those desired, we formulated our draft requirements document.[5] We then travelled to the IAEA again to present this document for feedback from IAEA personnel.

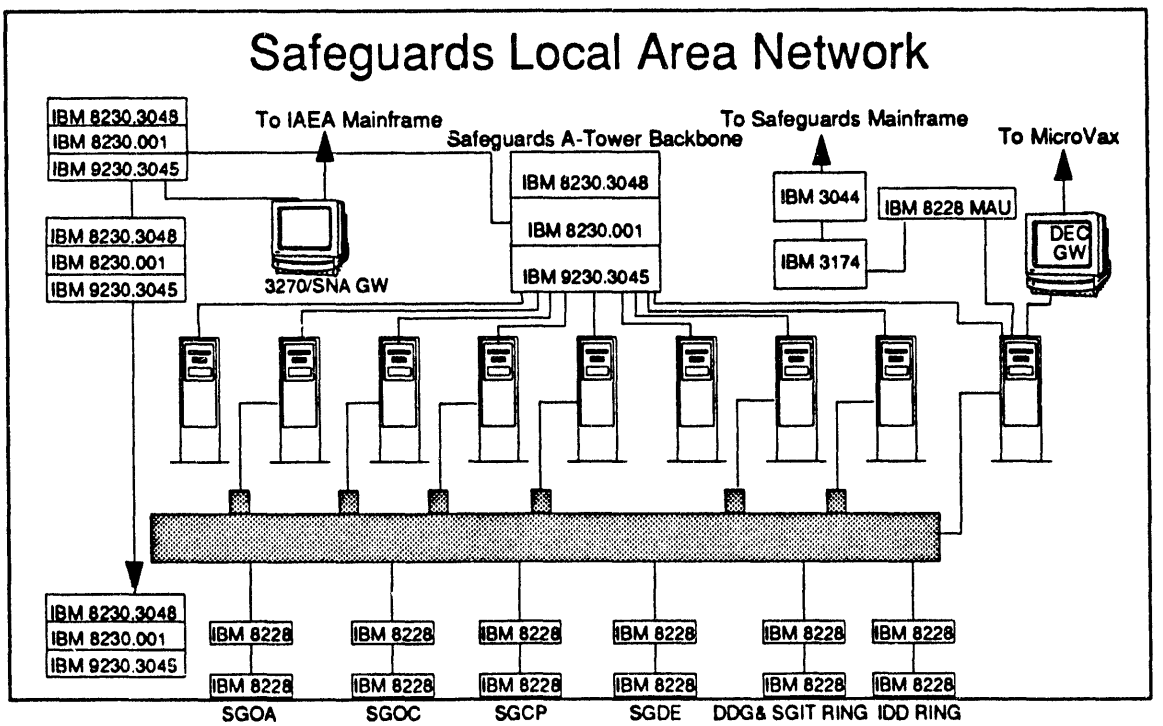

Fig. 1. Safeguards Local Area Network.

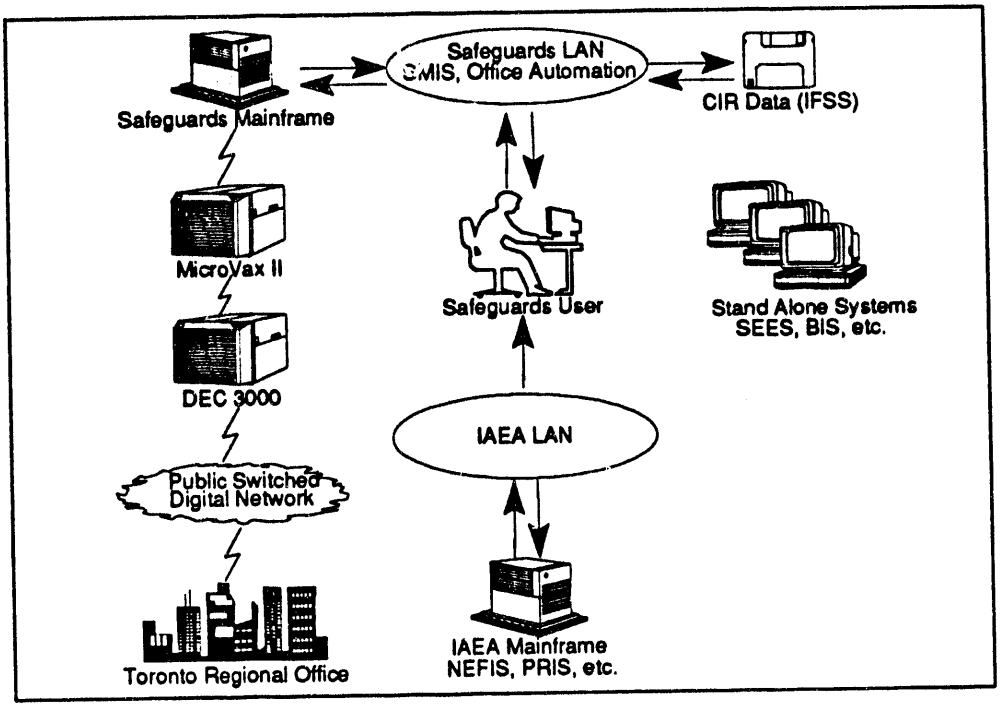

Fig. 2. IAEA systems.

Questionnaire Addressing the Needs of IAEA End Users

The User Requirements Group constructed a questionnaire for use during interviews with IAEA staff. The questionnaire was prefaced with a statement describing the purpose and objectives of the SIMS initiative. It was divided into three major sections: organizational relationship, user requirements, and user profile. The section on organizational relationships covered the interviewee's title, job, organization, and operating procedures. The user requirements section was broken out into five areas: (1) planning tasks, (2) analytical tasks, (3) data, (4) software tools, and (5) computer support tasks. The user profile section was designed to capture information about the projected IAEA end user that would be useful in designing SIMS products that were tailored to user needs and capabilities. Design of the human-computer interface was an especially important consideration here.

Some Considerations In SIMS Development

Results of evaluations to date have resulted in a well-defined set of user requirements and, additionally, have revealed some important factors to consider in SIMS development efforts.

Safeguards Information Management Population

The Agency has not yet determined how responsibilities for systematic analysis will be assigned within the Department of Safeguards. This determination will affect system design objectives for SIMS products. In addition, Agency staff come from a very diverse cultural and technical background, ranging from developed nations to third-world countries.

Although computer literacy in the department has improved steadily over the last three to five years, it is, on average, still quite modest. This fact must be a major

consideration in the introduction of new computer systems in the department. A large portion of the cost associated with the introduction of new computing systems is often attributed to user training. Thus, unless SIMS products are designed to minimize learning time and maximize ease of use, the introduction of SIMS products in the Agency may well pose an unacceptable training burden to the Safeguards Department.

User interface design has a major impact on the usability of computer systems. However, research is sparse on design considerations for a multi-cultural user population. The move towards graphical user interfaces (GUIs) demands appropriate attention be given to cultural stereotypes in the use of images, symbols, and colors in cross-cultural applications.[6]

Operational Environment

IAEA inspections are performed all over the world in a wide variety of environments and under very different circumstances. Computing resources to be used in the field must be designed to be portable and rugged Furthermore, data communications are necessary between IAEA Headquarters, Regional Offices, and the field. Depending upon the nature of the data being transmitted, there may be special considerations for the design of both hardware and software.

Security

The information that the Agency deals with can range from unclassified to safeguards confidential. Information provided to the Director General's Office concerning possible proliferation activities of states may bear a higher classification. Even open-source information, when taken together, may be considered sensitive by the Agency. Therefore, it is essential that SIMS developers consider the security concerns of the Agency for any given application and for processing information in general.

Support

It is essential that any hardware or software systems provided by SIMS be backed by ongoing post-delivery support and maintenance until the systems are handed off to IAEA support organizations. Past deliveries of software to IAEA have caused problems because inadequate documentation was provided. As a result, the Information Treatment Section leaders were extremely interested in documentation. A commitment to high-quality support and documentation must be maintained.

Compatibility with Existing Systems

There are a great many computer systems currently in use at the IAEA. Compatibility with the current IAEA computing environment and the systems that are in use is highly desirable. Development of a System Requirements Specification will assist in the design of SIMS products that can be easily integrated into the IAEA.

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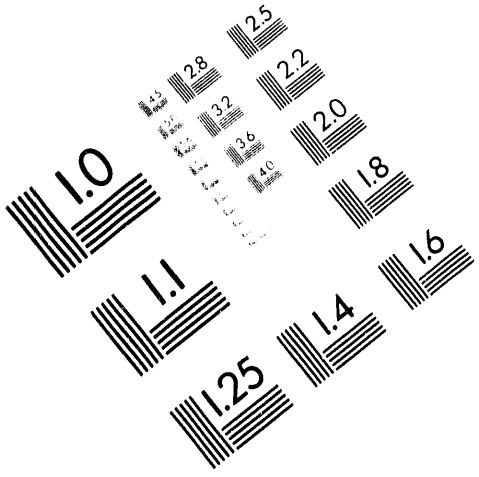
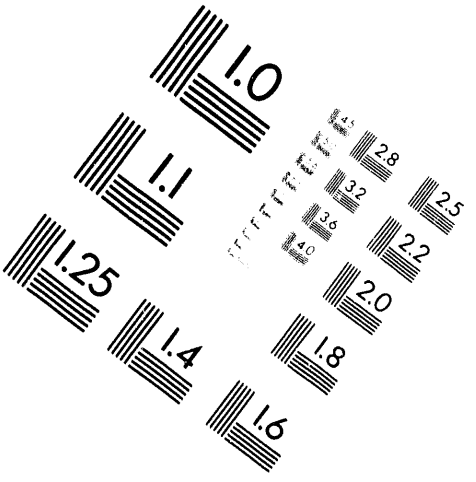


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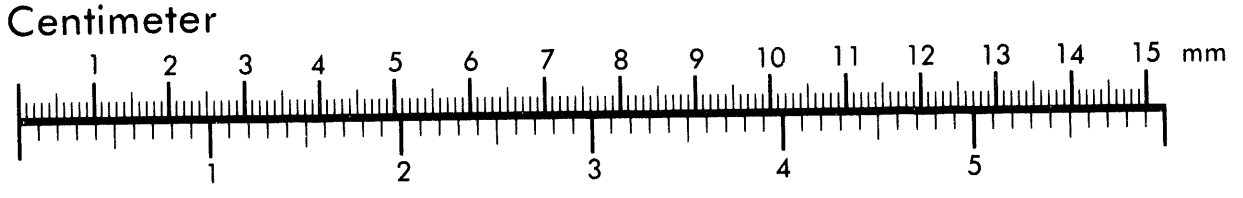

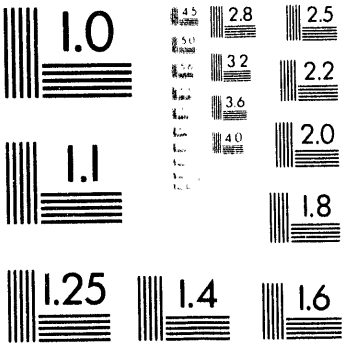
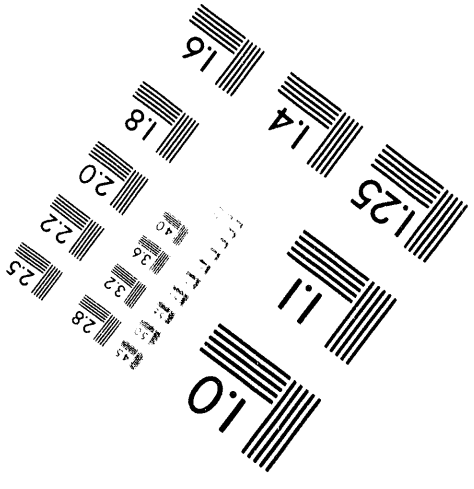
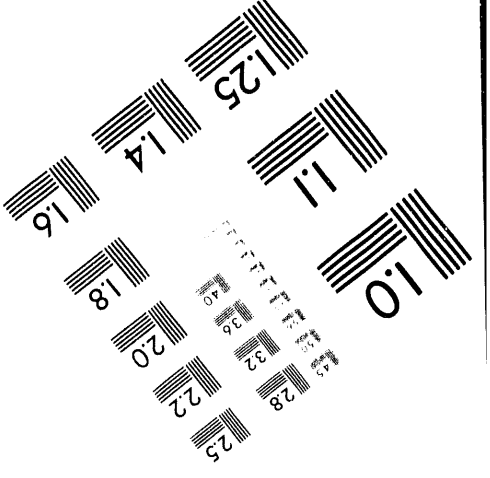

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