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A METHODOLOGY FOR CUSTOMER REQUIREMENTS GENERATION IN COMMUNICATION SYSTEMS PLANNING

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ABSTRACT

In electronic communication systems it is nearly impossible to keep up with changing technology. This problem is further aggregated in the developing countries where the contractor (probably a western company) is expected to develop the system from the ground up. A basic problem which confronts this approach is either: 1) The customer will start adding or rejecting some of the capabilities, or 2) The local operation will never use some of the capabilities. Both of these outcomes are costly in terms of time and resources available to a developing country.

This paper describes a new methodology for requirements generation to be used by those who want to reduce the adverse consequences of such outcomes, based on structured systems methodology.

INTRODUCTION

Requirements definition is an important task in the system life cycle. Requirements are usually determined near the beginning of the system development project. Requirements definition follows a top down approach where it starts by the user defining their needs stemming from the mission down to the point where the contractor details requirements for installation, [1,2,3,4].

Through the years (since requirements emerged as an independent discipline) many authors, with different backgrounds have suggested different approaches for requirements definition, [5,6,7,8].

Authors with software background tend to favor prototyping where a quick and dirty job is quickly developed and deployed. Then, addition, deletion, and optimization take place. This method could lead to many problems such as poor or none existent documentation and tendency to deliver the prototype as the finished product, [9,10].

Many authors with hardware backgrounds prefer defining every bit of requirements before designing the system. This process mandates a lengthy consultation with the customer. Other authors alluded that since that the emergence of Object Oriented paradigms, there might be a possibility of structuring requirements around objects which exist in the problem space, [11,12].

Despite the availability of various approaches, there is still no unified methodology to the problem of defining requirements. In this paper our proposed solution is based on the following concepts:

1. The customer must always be the source of requirements to the extent that they are capable of formulating them,

2. The customer is assisted by a comprehensive list of system details and general concepts from which they can identify what they want.

The remainder of this paper explains how a user can conceptually build a configuration of the needed system based on a prescription of Planning Support System for Communication System (PSCS), an integrated software tool. Although the approach is applicable to any system, the focus here is on military Electronic Warfare (EW) systems.

CONCEPTUAL SYSTEM CONFIGURATION

In this phase three concepts are important and must be developed in order to draw up the general requirements. These are Operational concept, concept of logistics, and the concept of hierarchy of functional equipment (generic equipment by function). Each of these concepts is to be separately and specifically documented. These three concepts are to form the complete overall document of requirements.

The idea is to support the customer and help them to conceptualize the needed system. A main activity here is to allow the customer run modeling and planning sessions based on an automated technique. Such technique is to be centered on PSCS which is an integrated software package including an object-oriented expert system shell, Object-Oriented knowledge bases, a data base management system, and equipment components data bases. Such environment will have an essential capability to guide the customer Systems Engineering group to model the needed system at the highest level by developing a functional and conceptual system information flow. Generic functional equipment is to be used with a focus on Prime Mission Equipment (PME) during the modeling session.

The goal here is to quantify requirements as much as possible. Attributes of antennas, receivers, other equipment in the fields of ECM, ECCM, SIGINT, ESM, SIMULATORS, and other project related component should be integrated into the object archives (knowledge and data bases).

After this session, the customer would have a complete document with requirements as quantified as possible such as: performance measures, personnel, generic equipment by function, and reliability, availability, maintainability, special requirements.

PSCS SYSTEM CONCEPT

The PSCS system, depicted in Figure 1, is to be thought of as a planning support environment. It serves two purposes: 1) Educate the user (customer) about the related aspects/characteristics of the modeled objects/classes, 2) These characteristics listings serve as a wish list; therefore the customer can tick what is needed. The idea is to make it as general as possible. It is the objects system which determine the specific field. In this paper, of course, the objects are in the field of EW and radio communication systems.

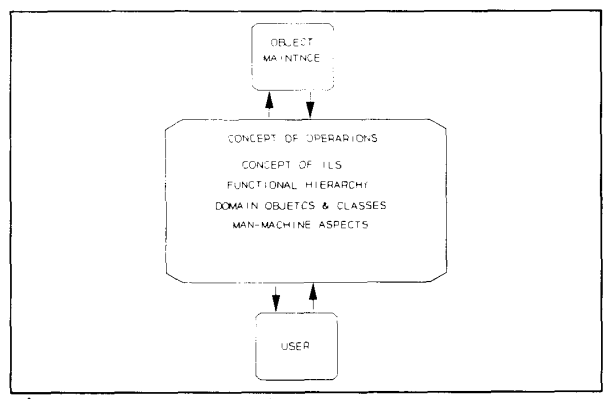

Figure 1 PSCS Concept

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General technical characteristics of operational, logistics and functional sub-fields are to be modeled in Object-Oriented knowledge base or a structure of different knowledge bases. For example, the characteristics of a direction finder position will inherit general characteristics from its parent (EW position) plus its own defined characteristics. Also, the detailed technical attributes, i.e. towards specific generic equipment, are to be modeled in data bases. For example, the direction finder receiver will have its specific attributes from the generic data base plus the accumulated inherited attributes from ancestors. The general inheritance philosophy is better explained in [13].

PSCS is to be interacted with in two ways. First, as a planning support, the user is prompted to supply his needed system functionality by checking on pre-designed screens, in order to enforce consistency. These screens are based on the conceptual scenarios of the needed system. After completion of the functional scenarios, a linkage through the export capability is made to initiate a work and consultation session from the expert system. Such sessions are based on Object-Oriented Knowledge bases. These knowledge bases are generic for all type of projects in the EW field. After the session, the resulting copies of the knowledge bases become the project specific knowledge base which houses all the quantitative and qualitative requirements for this project. The details of the components can then be interactively reviewed and preferences can be entered (checked) thus providing the specific information for a preferred system component. If the default values for the needed information are not accepted, an internal reasoning is performed by the expert system to provide more system options to be considered.

Second, PSCS as a development environment, the maintenance of the inventory objects (housed in the EW Object-Oriented Knowledge and data bases) should be performed before starting the planning sessions, in order to be up to date with technology advances. Therefore, periodic updating is necessary in two places: 1) Updating knowledge structure in regard to philosophical changes in operations, logistics, and functionality. 2) Updating the data bases of the generic equipment components for the specific customer orientation.

PSCS SYSTEM CONFIGURATION

PSCS configuration is depicted in Figure 2. As described in the previous section, the objects are to be maintained and kept up to date in Object Inventory System (OIS) prior to the planning session. Other components of PSCS are the Working Board Engine (WBE), the master mind of PSCS; The Application Network Structure (ANS), extracted from the general to become project specific. The objects in ANS are originally extracted from the OIS and stored with the additional parameters into the Application Object Structure (AOS). Calculations and configuration of requirements of Performance, Reliability, Availability, Maintainability, and Special PRAMS) are handled by the five "handlers" which are based on mathematical models. Demons from the knowledge bases interconnect these activities. Through out this process the user is permitted access only through a User Interface (UI) to protect and preserve system integrity.

USER INTERFACE

The interface subsystem concept is depicted in Figure 3. In this figure, the interface is modeled as if it was an external sub-system of PSCS, for clarity. The three main concepts to be modeled are concepts of operation, logistics, and man-machine interface. The user should be permitted interactively to start a new planning session, edit a previously saved network, and finally extract reports of the desired network, requirement list, and objects.

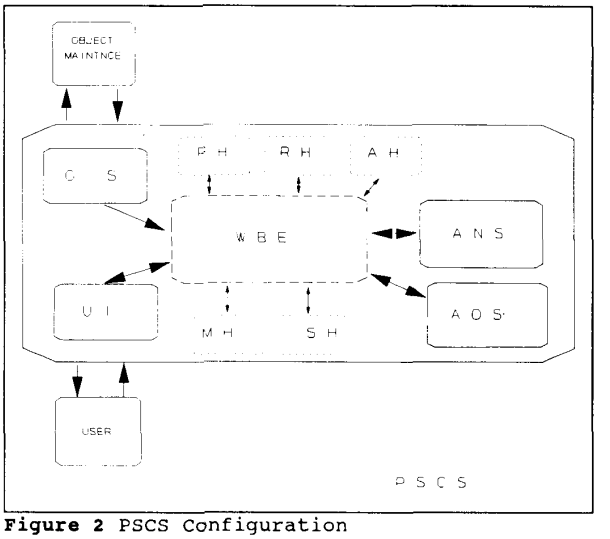

Figure 2 PSCS Configuration

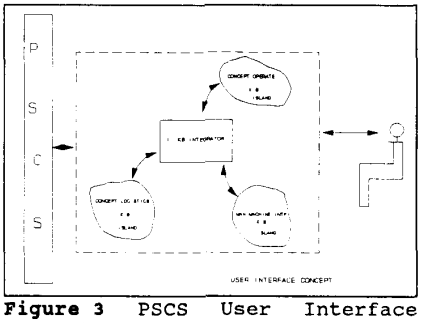

Figure 3 PSCS User Interface concept

OBJECT SYSTEM

At this time the objects to be integrated are not compiled in an extensive list but rather just contemplated to show the possibility of the implementations; as concepts. For example, some sub-fields of EW are modeled as in Figure 4, Semantic Network, and this model is implemented via NEXPERT, an Object-Oriented expert system shell, from NEURON DATA, as shown in Figure 5 (as an Object Network). Other Knowledge bases and class structures are implemented to show the big picture of combining stations, operators, and equipment. However, some specific details should be modeled as objects or classes of objects for the other equipment such as receivers, transmitters, transceivers, antennas, position computers, tape recorders, dummy reports, communication messages, and complete operator positions. Again the list is permitted to grow under the conditions that the objects are supplied in the OIS. The general technical characteristics are embedded in the knowledge bases while the lower technical detail attributes are modeled in data bases.

Another advantage of using NEXPERT, in addition to its graphics capability, is that it has a separate package for building the user interfaces so that PSCS can be more user friendly while keeping the knowledge and its data protected.

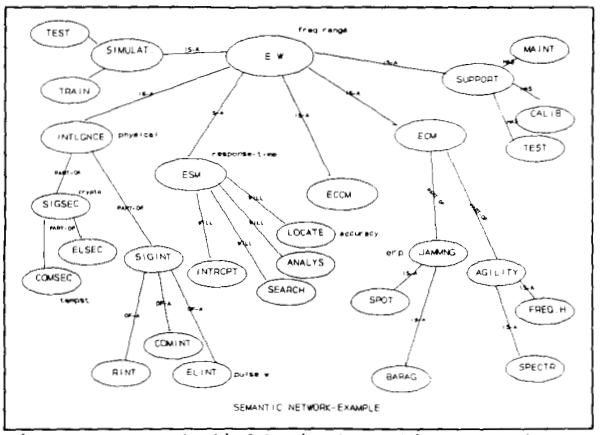

Figure 4 EW Sub-fields in Semantic Network

CONCLUSION

This paper describes a concept where the customer makes the first attempt of conceptually designing the needed system with the help of a planning support system. PSCS takes advantage of structuring the problem around objects in the EW sub-fields. Different objects or classes of objects are modeled in Object-Oriented knowledge and data bases. PSCS serves, for the customer, as an education base and a planning guide. Through the UI and the integration process, the user can develop a detailed and reliable list of his requirements.

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Figure 5: NEXPERT MODEL OF EW SUB-FIELS