DEFENCE STANDARD 00–56 SIMPLIFYING THE LEARNING CURVE

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ABSTRACT

This article describes the concept, development and implementation of an expert system to substitute for the roles of both teaching courses and global queries in providing understanding of Defence Standard 00–56.

Introduction

The *Interim Defence Standard* (IDS) 00–56[1] is gaining widespread acceptance in principle. However, problems remain in interpreting the requirements. It is expected that most of the teething difficulties will be sifted out during the process of consultation and preparation of the second issue, which is to be accompanied by a companion guidance document.

Of all the obstacles the standard presents, it has become apparent that the learning curve is one of the major hurdles. In a previous article in this *Journal*[2] the following appeared: 'The Standard is complex and is not presented in a manner which aids ease of reference . . . The lack of user-friendliness may create unnecessary resistance to its adoption . . .'

Such comments as these were anticipated in the summer of 1991 and for that reason a decision was taken to develop a user-friendly expert system, using an application package geared to run-time copy distribution (Leonardo Version 3).

This article outlines the major features of the developed expert system, the method and adroitness of the design process, the primary and secondary purposes of the system, spin-offs, and the availability of the run-time development.

System Features

The system is built on the principle of a hierarchical tree of knowledge of the Standard. Initially questions are posed by the system with a menu of choices from which the user may select. Subject to the user's reply, another question is posed with another menu or the system will enter a programmed explanation of a topic. These explanations are either simple textual guides or more complex

graphic demonstrations of techniques and problems. At the end of a line of enquiry the user is returned to the opening menu whence more queries may be made.

Typical explanatory programs teach, for instance, the basics of a HAZOP study using a small example system, the use of the tables in the standard to establish risk classes, the fundamentals of a Fault Tree Analysis using the example of 'loss of control of firing arcs', and a selection of problems associated with establishing safety targets. These are graphically demonstrated and in many cases involve a deal of user interaction. Exemplars of items covered by textual description only, as opposed to programs, are cross-referencing of tasks of Hazard Analysis against particular MOD(PE) Lifecycle phases of projects and queries regarding related standards.

The Design Process

The Leonardo application package consists of a user-friendly, high level development system which provides for the creation of objects, the top layer of which are called from the Main Rule Set, with a number of fields of the objects already declared. These fields are similar to the package headers in the Ada language and, though a few are compulsory and unalterable, the majority can be tailored. Some of the fields allow extensive text input. Objects other than programs appear in a standard split screen format (see FIG. 1). Objects may also call programs coded in the procedural language which accompanies the application developer. A graphics package was also attached to this version enabling pixel manipulation.

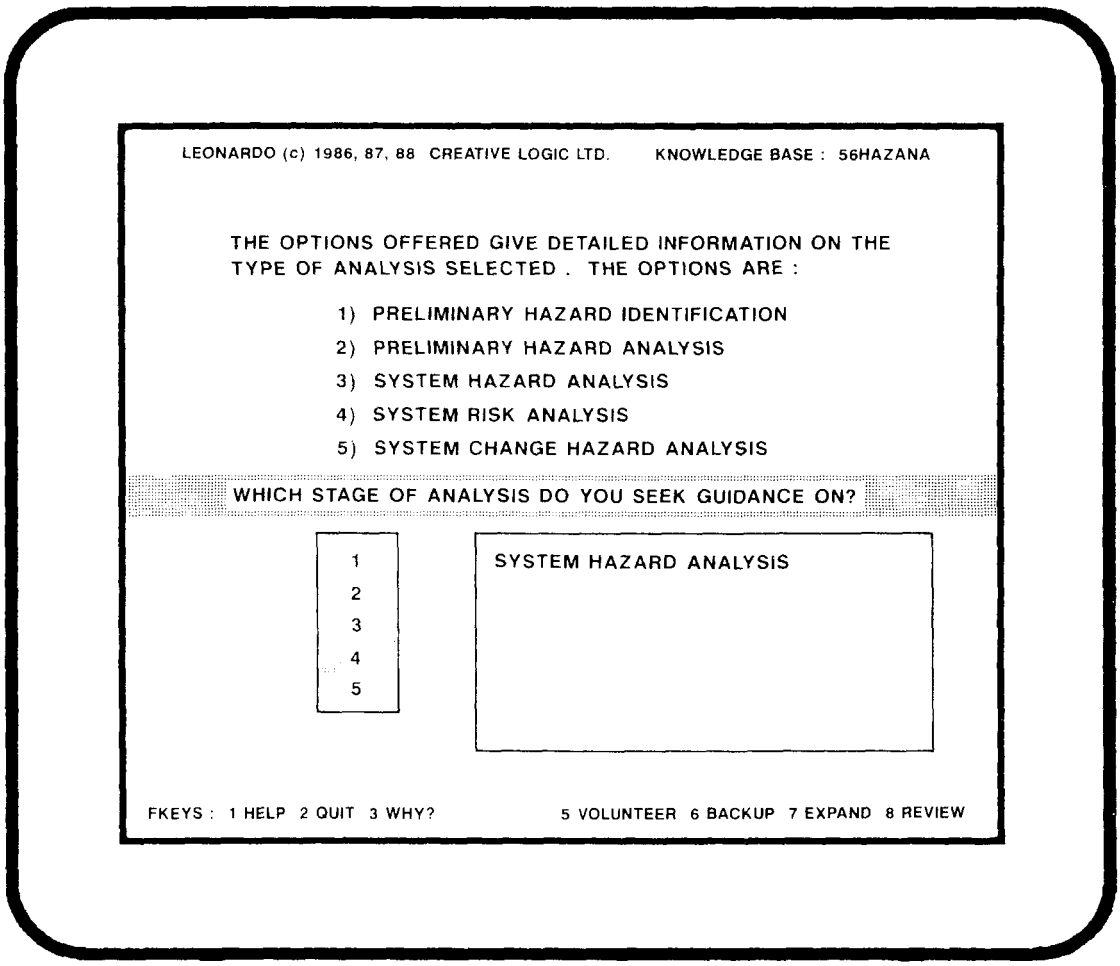

FIG. 1—A TYPICAL SCREEN AS THE USER SEES IT

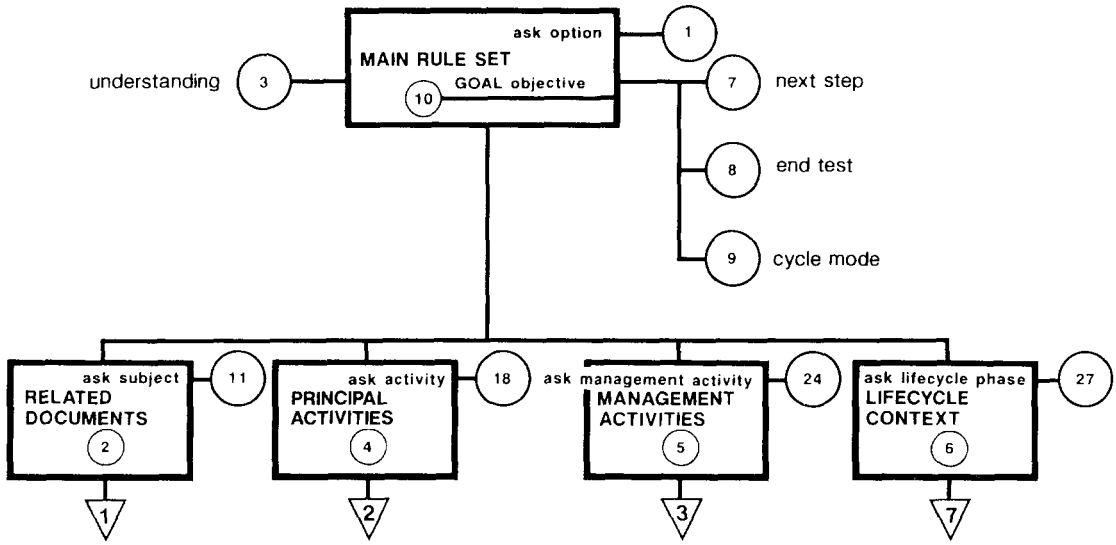

FIG. 2—THE TOP LAYER OF THE HIERARCHICAL TREE STRUCTURE OF IDS 00–56 EXPERT SYSTEM OBJECT LEVEL DESIGN

The package facilitates development by way of incremental prototyping. This makes programming simple for the novice. A top-down approach is facilitated by the ability of objects to call other objects and programs from within themselves. FIG. 2 shows the top layer of the expert system for Management Activities associated with IDS 00–56. As can be seen each object, including the Main Rule Set, has a number of associated objects; e.g. 'Related Documents' is associated with the object 'Subject' by the command "ask subject", the particular user selection indicating which of the objects in the next layer down the tree structure is accessed. A design can begin with basic questions and develop through a natural tree structure to more profound levels of expertise. Modules created in the procedural language can be copied and used by other objects with little difficulty. FIG. 3 shows a typical object; note all the field names on the left-hand side preceding colons, most of them provided automatically.

The only problem that arose was one of 'text overflow'. The package cannot cope with unlimited volumes of text at the checking stage. This problem is solved by dividing the expert system into smaller expert systems which can then be linked by a key word in run-time versions. This development is split into three and they address Management Activities, Hazard Analysis and Risk Classification.

Purposes of the Development

This system offers a number of direct advantages to the MOD(PE) and also a number of spin-offs.

The major advantage for the sponsoring section of Defence Standard 00–56 (SM836) is that, when personnel thoroughly versed in the standard move on to fresh pastures, typical queries by interested parties such as project managers can be answered by new, less experienced staff by reference to the system. The learning curve for the standard has proved to be quite a problem and this system goes some way towards addressing that crimp. A new member of staff in the section felt acquainted and confident about the workings of IDS 00–56 after just one morning using the system. Having the development in house means that the data around which the development operates can be altered as the interim standard develops to reflect any changes. The system may be used by MOD staff holding copies of Leonardo V3 themselves as they will only need to be supplied the data, and the intention is to provide those without the package

with data plus run-time only copies of the software on a library style loan basis. These are much cheaper than the developer's edition of Leonardo. It is intended that a record be kept of all sections holding data so that upgrades can be despatched.

Among the spin-offs of the development is familiarization with the various aspects of expert systems. For instance, it is possible to ask the system how it came to conclusions and it then reverses its thinking for the user. It is apparent that expert systems are dark horses to many MOD personnel. This system has been developed to demonstrate as many of the capabilities of the package as

Object Number: 62 Name: config_control 20-Jan-92 13:13

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 1 :           Name : config_control
 2 :       LongName :
 3 :           Type : Text
 4 :          Value :
 5 :      Certainty :
 6 :    DerivedFrom :
 7 :   AllowedValue : done
 8 :      ForbidUnk :
 9 :    QueryPrompt : Please press return
10 :    QueryPreface : All data and documentation produced during hazard analysis
11 : must be subject to configuration management. All the tools used in the
12 : software sense must also be subejct to CM. The ISA and the haz analysis
13 : authority must agree a plan at some time for control and this must
14 : fully support the objectives of the safety plan. Configuration items
15 : are subject to control from their creation.
16 : Press F7 for further details.
17 :      Expansion :
18 : A configuration system must have the following attributes as minimum.
19 : a) It must meet 05-57 requirements.
20 : b) Only authorised personnel may change or create configuration items.
21 : c) Safety integrity and risk class of items must be recorded.
22 : d) The configuration status of tools must be kept.
23 : Assessment and reviews to ensure changes do not impinge on safety must
24 : be held. Finally, protection against disaster must be made using
25 : separate stores for backup media etc.
26 :    Commentary :
27 :    Introduction :
28 :      Conclusion :
29 :          RuleSet :
30 : ask do_config
31 :
32 :     if do_config is yes then
33 :     run config_prog();
34 :     config_cont is done
35 :
36 :     if do_config is no then
37 :     config_cont is done
38 :
39 :
40 :
41 :
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FIG. 3.—A TYPICAL OBJECT OF THE SYSTEM, WITH AN ASSOCIATED RULE SET (LINES 29 TO 37)

possible. Personnel who use it may therefore be expected to also discover the principles of expert systems, enabling sounder judgement of their capacities and thereby better action in procurement.

Availability

The data is now available, along with brief notes for the user for those with their own versions of Leonardo. At the time of writing (June 1992) run-time versions are on order. Readers are invited to request copies should they have need to hone their own understanding of Hazard Analysis in accordance with IDS 00-56 or if they have new staff in their section whom they would wish to gain a rapid understanding of the principles of Defence Standard 00-56.

References

1. Ministry of Defence: Hazard Analysis and Safety Classification of the Computer and Programmable Electronic System Elements of Defence Equipment. *Interim Defence Standard 00-56*; Directorate of Standardization, Glasgow, 1991.
2. Erskine, P. A. and Giles, P. J.: Defence Standard 00-56 Who needs it?; *Journal of Naval Engineering*, vol.33, no.3, Jun.1992, pp. 637-644.