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EXPERT SYSTEMS SHELLS AND TOOLS

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ABSTRACT

In this study, we investigated expert system (ES)s, ESs usage in responsive manufacturing and ES shells and tools that are used to build reliable, robust and better ESs. We showed the relationship between ESs and responsive manufacturing and listed ESs usage in different aspects of responsive manufacturing fields. Later on, we define the relationsip between ESs and ES shells and tools. We determined that many commercial shells are available today. Our researches show that these shells are ranging in size from personal computers to workstations or large mainframe computers. We see that they range in price from hundreds to tens of thousands of dollars and range in complexity from simple, forward-chained, rule-based systems requiring two days of training to those so complex that only highly trained knowledge engineers can use them to advantage. They also range from general-purpose shells to shells custom-tailored to a class of tasks such as financial planning or real-time process control.

Last but not least, after classifying the shells and tools with respect to their application, we put forward the technical details of some of these shells and tools. And we see that these tools are carried some of the necessary requirements that is needed by responsive manufacturing very well.

KEY WORDS

Expert systems, shell, tool, responsive manufacturing, information technology.

1. INTRODUCTION

Nowadays, all the companies must carry out effective, efficient, productive and serial manufacturing. In order to have these properties they must make information technology (IT) do this job. By using IT, some key points such as reusability, flexibility, reliability, robustness, rapid prototype development, easy update and tracking and handling the methods in manufacturing fields can be easily owned by the companies. As ESs are a subset of IT it does the same job and offers contemporary utilities as mentioned above. As tools and shells are used in building ESs, they are vital part of the ESs and must be used widely in manufacturing systems.

Having done this study, we investigated ES shells and, tools. ES shells are listed according to their platform, knowledge representation, fee construction language, inference mechanism, usage fields and Producer Company. ES tools are listed according to their platform, produce company and usage fields.

Firstly, a brief explanation of the responsive manufacturing will be given and then the relationship between ESs and the responsive manufacturing is explained details. And in Section 2, the researches and the studies of ESs usage in responsive manufacturing will be presented. In Section 3, ES shells and tools will be listed in a table and some of favorite of them is mentioned.

2. USING EXPERT SYSTEMS IN RESPONSIVE MANUFACTURING

In order to be a global competitor in manufacturing industry, manufacturing company must have ability to compete following seven main items [1]:

*abundant availability and distribution of information,
*rapidly expanding technology access,
*accelerating pace of change in technology
*globalization of markets and business competition,
*global wage and job skills shifts,
*environmental responsibility and resource limitations,
*increasing customer expectations.

Next-Generation Manufacturing identifies six integrated attributes that successful firms will require to successfully respond to these drivers [1]:

*Customer Responsiveness
*Physical Plant and Equipment Responsiveness
*Human Resource Responsiveness
*Global Market Responsiveness
*Teaming as a Core Competency
*Responsive Practices and Cultures

ESs are effectively used in responsive manufacturing for planning, selection of manufacturing equipment, diagnosis in automation systems, designing and developing computer-integrated manufacturing, auditing, designing computer networks, stuff training and related other areas. Hence ESs are the subsets of the IT, they play an important role for accelerating pace of information technology, reusability, serial manufacturing, auditing, quick response for customer expectations and resource management. Manufacturer Company can use ESs from designing and developing their yearly plan to accelerate their manufacturing by integrating ESs into the automation and the other mechanical systems. By this way, manufacturing becomes more reliable, robust and flexible.

Some of the studies that is done till today related with integration of ESa into the manufacturing are as follows:

Selection of a computer-numerical-control (CNC) turning center is a difficult decision for a manufacturing firm because of the large amount of information that should be considered. This kind of decision could be aided by an expert support system (ESS). Object-oriented and rule-based technologies help an ESS to handle extensive data while keeping system complexity at an acceptable level. This approach works well for deciding on a CNC turning center and could be used to select or justify any complex equipment [2].

Knowledge Based Systems (KBS) have many applications in industry ranging from decision support and process control to fault diagnosis and repair. KBS can be employed to help experts identify and repair faults within an electrical engineering domain [3].

Computer modeling of operator's cognitive behavior is a promising approach for human factors study in nuclear power plants. To assess the performance or cognitive workload of operators, some task simulation analyzers are developed. SACOM is one of them and consists of Operator Model, Interaction Analyzer and Situation Generator [4].

ESs use prior experiences to solve problems in different domains. The task of designing and configuring large Computer Networks most suited to a certain application and environment is difficult, as it requires highly specialized technical skills and knowledge, as well as a deep understanding of a dynamic commercial market. COMNED is a Computer Networks Expert Designer, an ES for large structured computer networks design, modeling, and simulation [5].

The current manual system for selecting U.S. military uniform sizes is error-prone and labor-intensive for both fitters and soldiers. One of the projects designed as an ES which could save time and money and could be built with technology of the near future. The design calls for three components: a three-dimensional scanner represents a body as a set of 3D points; computer programs convert those points into body measurements; and a case-based reasoning component uses those measurements to predict garment sizes. Using traditional body measurements, the prototype system is almost as accurate as human experts and will be more accurate when equipped with additional measurements [6].

The auditing process consists of a large set of tasks that are performed by teams of individuals with specialized knowledge and experience. One important audit task is audit planning, which has been the focus for research and development of a variety of knowledge-based support tools. The problem solving activity in audit planning exhibits concurrency, a hierarchical decision structure, and the use of multiple forms of knowledge. These characteristics suggest that a blackboard model may be useful for the design of a system to support audit planning. In the blackboard model, separate and independent knowledge sources communicate using a common data store or blackboard. The blackboard contains data objects from the solution space (representing partial solutions) which are hierarchically organized into levels of abstraction. The knowledge sources respond opportunistically to changes in the blackboard. The proposed logical blackboard model utilizes and builds upon prior research in ES based audit planning support systems [7].

In the mid-1980s, business, industry, and government started using ESs to solve practical accounting problems and assist with financial decision making. Today, various industrial companies use ES to prepare complex entries for their accounting records, analyze division performance, help with capital budgeting decisions, analyze variances, and do other accounting tasks. Businesses must be aware of the features and potential of ESs, and informed about competitors' similar systems in order to decide if ES technology is suitable and cost effective for particular tasks. Mapping task taxonomies, task attribute, technology selection, and organizational attributes can be given as examples of applications of ESs in these areas [8].

As it can be seen from upper lines, ESs aren't gave up for responsive manufacturing. It has many application areas in manufacturing. Till here the relationship between ESs and responsive manufacturing is mentioned. It is turn to mention about ES shells and tools as a subset of ESs. Their

main usage in ESs, application fields and definitions will be explained in following lines.

3. EXPERT SYSTEMS SHELLS AND TOOLS

An ES tool, or shell, is a software development environment containing the basic components of ESs. Associated with a shell is a prescribed method for building applications by configuring and instantiating these components.

Knowledge acquisition in ESs can be done by using ES tools. But it is not the only reason to use these tools. The research that we made shows us that ES tools are available for following reasons [9]:

1. They provide very good and well-understood software development environment which assists development of ESs.
2. They include special utilities as assistance such as compilers, the records that track the variation for creating prototype rapidly.
3. These tools and shells supply built-in properties for knowledge representation, inference paradigm and consultation definition.
4. ES tools are used in so much specific domain for knowledge acquisition, domain modeling and system verification.

After classifying the shells and tools with respect to their application in Table 1 and Table 2, we put forward the technical details of some of these shells and tools. We observed the relationship between responsive manufacturing and ES shells and tools. It can be said that these tools are carried out huge amount of the necessary requirement that is needed by responsive manufacturing very well.

After completing our research we had noticed that although shells simplify programming, in general they don't help with knowledge acquisition. Knowledge acquisition refers to the task of endowing ESs with knowledge, a task currently performed by knowledge engineers. The choice of reasoning method or a shell is important but it isn't as important as the accumulation of high-quality knowledge. The power of an ES lies in its store of knowledge about the task domain - the more knowledge a system is given, the more competent it becomes.

There is a great confusion in the definition of ES language, shells and tools. They can be separated and defined as follows [9, 10]:

Language: It is interpreter for commands that is written in special writing rules. An ES language also supplies inference engine that is used to make the language's expression or command chain Works. Depending on the application, inference engine can do forward, backward and both direction chaining. In the light of these definitions, PROLOG is an ES language but LISP is not.

Tools: Programming languages and useful utility programs are all together called tools if they are aimed to assist to develop application programs and maintenance them. Utility programs can include text and graphic editor, debuggers, file management and also code producer. Cross-linkers can adapt the developed code to the different platform. For example, an ES that is developed for DEC VAX can be used for Motorola 68000 by using these cross-linkers programs. In Table 1, ES tools are listed with their some properties.

AGENT_CLIPS is a multi-agent tool for MACINTOSH. Multiple copies of CLIPS run at the same time on MACINTOSH. Each Agent (CLIPS) can send CLIPS commands to other active agents at run time. AGENT_CLIPS handles incoming commands automatically.

The Easy Reasoner (TM) is a Case-Based Retrieval (CBR) tool with reasoning that provides an adaptive associative memory. It retrieves similar cases from memory given a new case, extends Query-by-Example (QBE) by providing Query-by-Similarity(TM) (QBS), indexes existing databases using decision trees, supports xBase, ODBC, and SQL databases, maximizes information while minimizing complexity, automatically filters noise to simplifies decision trees, induces automatically or under explicit control.

Shells: They are special aimed developed tools. They are developed for the application that requires only the knowledge base from the user. They have inference engine, structure of knowledge representation (frame, rules, etc.), different utilitiy programs (editors, plotting programs and etc.) and no information about the field. In addition to these properties, some shells offer the user to create his or her inference mechanism. EMYCIN shell (empty MYCIN) can be given as an example to this. This shell appears by purifying medicine information from MYCIN ES. MYCIN was using for identification the illnesses by using backward chaining. By extracting medical knowledge, EMYCIN is created, and this shell is available for the systems that use backward chaining. Thus, inference engine and user interface that belong to the MYCIN is became reusable. In Table 2, ES shells are listed with their properties. In Japan a lot of studies have already been done for ES shells and tools. ESHELL (lisp based) produced by Fujitsi, ES/KERNEL (written in C for UNIX station) produced by Hitachi and GENZO (diagnostic, classification, interpretation) produced by Shimadzu are some of the shells that developed in Japan. The

list of the shells and tools produced in Japan can be obtained from [11].

Let's have a look at closer some of the shells listed in Table 2. GURU is an expert system development environment and RDBMS that offers a wide variety of information processing tools combined with knowledge-based capabilities such as forward chaining, backward chaining, mixed chaining, multi-value variables, and fuzzy reasoning

Gensym's G2 offers a graphical, object-oriented environment for creating intelligent applications that monitor, diagnose, and control dynamic events in on-line and simulated environments. Featuring a structured natural language for creating rules, models, and procedures, G2 is the foundation of all Gensym application products and end-user applications.

MIKE (Micro Interpreter for Knowledge Engineering) is a full-featured, free, and portable software environment designed for teaching purposes at the UK's Open University. It includes forward and backward chaining rules with user-definable conflict resolution strategies, and a frame representation language with inheritance and 'demons' (code triggered by frame access or change), plus user-settable inheritance strategies. Coarse-grained and fine-grained rule tracing facilities are provided, along with a novel 'rule graph' display which concisely shows the history of rule execution.

4. DISCUSSION AND CONCLUSION

Having done this study we investigated responsive manufacturing, application of ESs in responsive manufacturing and available ES tools and shells. We listed ES shells and tools in tables with their some properties. During our research, we observed that responsive manufacturing has strong relation with adaptation of the new technology. In order to have serial, reliable, robust manufacturing, IT technology must be put forwarded in related fields. To get the customer requirements that changes quickly, to plan for yearly manufacturing, to defect and control the errors in mehanical systems, to budget, to decide quickly with changing circumstances, to design and develop new technology (computer networks and etc.), to choose new manufacturing equipment and to train the stuff, ESs are so suitable. And in order to develop quick and robust systems, ES shells and tools must be used.

Hence ESs are used to develop some utilities and methods for responsive manufacturing, as a subset of ESs, ES shells and tools are very important for responsive manufacturing. They are used to build ESs within shorter time and more reliable way. It implies to produce faster, more reliable, robust responsive manufacturing. So that instead of building ES in different programming languages, ES shells and tools must be developed to create ESs without having too much effort. By this way, development ESs will be very easy and adaptation of new knowledge and technology will be easier.

As the last point, the disadvantages of the ES must be mentioned. Hence ES has no learning capabilities; it has no application field or some weakness in some manufacturing fields. If neural networks and fuzzy logic are used together with ES, stronger, more effective and sensitive ES can be built. By this way ES can have application in all manufacturing field.

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APPENDIX

Table 1 ES tools and properties

Tool's name	Usage fields	Platform	Produced by
Acquire Sdk	An assistant software development package for Acquire Shell	SCO Unix, MS-DOS, Windows NT, OS/2	Intelligent Environments
Activation Framework	Real time data interpretation application	DOS, Windows, Unix	Real-Time Intelligent System Corp.
AngossKnowledge Seeker	Data mining	DOS, Windows	Angoss Software International
Arity Expert Development Package	Integration of rule based and frame based knowledge representation with different certainty factors	OS/2, DOS	Arity Corp.
CBR Express	In a case based systems, used for retrievaling information	DOS, Windows	Inference Corp.
CPR (Case Based Problem Resolation)	C++ library for the solution of case based problems	DOS, Windows	Inference Corp.
The Easy Reasoner	In case based systems, retrieval of information	DOS, Windows	Integrateal System Inc.
Flex	Builds knowledge bases in frame, rule and frames types that is integrated in logic programming environment	Windows, Macintosh	Logic Programming Associates Ltd.
M4	Integrate visula basic, visual c++ codes into the system to have custom control	Sun Sparcotation, Macintosh	Teknowledge Corp.
MailBot	Personal e-mail assistant program	Windows	Daxtron Lab.
ModelQuest 4.0	Modelling systems	Windows 3.x, 95, NT	Abtech Corp.
Object Management Workbench (OMW)	Assistant tool for Kappa Shell. Used for analysis and design	Unix, Windows and MVS	Intellicorps
OPS83	Emerging rules into C programs	DOS, OS/2, Unix, VMS	Production System Technologies
RAL (Rule Extended Algorithmic Language)	Integration of rules and objects into the C programming language	DOS, OS/2, Windows, Unix	Production System
TechMate	Decision and production tool for maintenance engineers and technicians	Windows, Unix/ X Window	IET Intelligent Electronics
VBXpert	Adding expertise for Visual Basic application	Windows	Haley Enterprise
YAPS	Supply rule-based knowledge representation in LISP and make them modular to use in different programming languages.	Apple Macintosh, Sun 3 and Sun 4 (SPARC), DEC VAX	Cogniton Technology Corp.
Agent CLIPS	Multiple agent tool for Macintosh systems	Macintosh	CompuServe
XpertRule	Decision tree building	Windows	Attar Software

Table 2 ES shells and properties

Shell's name	Usage fields	Type	Knowledge representation	Inference engine	Written in	Platform	Fee ($)	Produced by
Gensym's G2	Diagnosis, control and view	Dynamic	Object oriented	Forward and backward chaining	-	-	-	Gensym
GBB	In blackboard based application	Dynamic	KS presentation language and blackboard	Forward and backward chaining	-	Dos, Windows, Mac, Unix Workstation	-	Blackboard Tech. Group
Guru	Diagnosis, control and finance	Static	Production rules	Forward and backward chaining	Prolog	Dos, Windows	-	Micro Data Base Systems inc.
Hugin	In the systems that include uncertainty and modelling	Static	Object oriented	Forward chaining	-	PC Windows, Sun Workstation	-	Hugin inc.
Kes and Snap	Diagnosis, control and view	Static	-	Forward and backward chaining	Prolog	PC , Workstation and IBM Mainframe	10000 – 60000	Software architecture and eng.
Knowledge works	In the systems that is related with databases	Static	-	Forward and backward chaining	-	Unix, SunOS, Solaris, IBM RS/6000, DEC Alpha	1000 – 2000	Harlequin
KEE, ProKappa and Kappa	In object oriented systems	Static	Production rules	Forward and backward chaining	-	PC , Workstation, Lisp machines	2000 – 3000	Intellicorp, inc.
Level5 Object	In object oriented systems	Static	Object oriented	Forward and backward chaining	C	IBM competitive Windows 3.1 and higher systems	-	Information Builders
Nexpert Object	In object oriented systems	Static	Frame	Forward and backward chaining	C	Dos, Windows, Mac, Unix	5000 – 12000	Neuron Data
Rete++	Diagnosis, control and view	Static	Production rules	Forward and backward chaining	C And C++	Sun OS, Sun Solaris, HP UX, Data General, AIX and PC	2000 – 3000	Holey Enterprise
RTWorks	Statistical reasoning and control of data	Dynamic	Object Oriented, Production rules	Forward and backward chaining	-	VMS and Unix	-	Talarian Corp.
Clips 6.0	Diagnosis, control and view	Dynamic	Production rules	Forward chaining	C	IBM PC competitive systems, VAX 11/780 Sun 3/260 and HP 7000/500	500	NASA
Fuzzy Clips 6.02	Problems with fuzzy logic	Dynamic	Production rules	Forward chaining	C	Unix, Macintosh and PC	No fee	NASA
Focl	In machine learning systems	Static	Production rules	Backward chaining	LISP	Dos, Windows, Mac, Unix	-	Cambridge Consultants
Mike	Aimed for education	Static	Frame, Production rules	Forward and backward chaining	Prolog	Dos, Unix	No fee	Open University
WindExs	Diagnosis, control and view	Static	Production rules	Forward chaining	-	Windows	-	AOL