Building Procurement - an Expert System

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KEYWORDS

Building, Expert system, Knowledge acquisition, Knowledge base, Procurement.

ABSTRACT

The building client is the one party to the building process who is in most urgent need of an expert system. He is in the unique situation of having a problem to solve and yet cannot define his problem. Building professionals have methodologies for solving problems - using computers. This use is for well defined, largely mechanistic processes which require decisions at the commencement and termination of each program. Clients cannot all be classified as being of one type. The corporate client is aware of methodologies involving investment analysis, government grants, development areas etc. and will employ professionals to carry out the procurement. The less well informed client with no in-house help will hire professionals to carry out feasibility studies, formation of a brief and the procurement. However, recent studies indicate that building professionals bring their prejudices to the client as solutions! For example, consulting an Architect generally precludes all thought of a design and build approach to procurement. Similarly, approaching a building company precludes competitive tendering.
The solution could be the construction of a computer system which offers a diagnostic approach for the client.

L'obtention de la Construction - Un Système Expert

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MOTS CLES

La Construction, Système expert, Acqisition de Connaissance, Base de Connaissance, Procurement.

ABSTRACT

Le client de la construction est sans aucun doute celui qui, pendant le cours de la construction, nécessite en priorité un système expert. Il se trouve dans la situation unique d'avoir à résoudre un problème qu'il ne peut pas définir. Les professionels de la construction ont - grâce aux ordinateurs - des méthodologies pour résoudre les problèmes. L'utilisation de l'informatique s'applique à des processus largement mécanistes et précisément definis qui demandenet des décisions au début et à la fin de chaque programme. Les clients ne peuvent pas être tous classés dans la même catégorie. Le client appartenant à une corporation est consceint des méthodologies faisant interviner l'analyse des investissements, les subventions gouvernementales, les zones de développement, etc. et emploie des professionels pour réaliser l'obtention. Le client moins bien informé, ne disposant d'aucune aide interne, louera les services des professionnels pour entreprendre l'étude des possibilités, l'élaberation d'un dossier et l'obtention. Cependant, des études recent montrent que les professionnels de la construction apportent leurs préjugés au client en guise de solutions! Par example, le fait consulter un architecte exclut généralement toute possibilité d'une approche conception/construction de l'obtention. De même, le fait de s'addresser à une entreprise de construction exclut l'offre de la concurrence.

INTRODUCTION

Forsyth (1) states that there are four essential components of a complete expert system, namely, the knowledge acquisition module, the knowledge base, the inference engine and the explanatory interface.

KNOWLEDGE ACQUISITION

Knowledge has been said to consist of descriptions, relationships and procedures in a particular domain. Some aspects of these ingredients exist only in the experience of the human experts, others exist as records of the results of that experience. Knowledge acquisition from the human expert is currently undertaken by their interrogation by the person entering the data into the system. This task can be computer assisted using another expert system. Knowledge of a factual nature can be very wide ranging. For example in this research it is intended to adapt the formalised approach of data gathering currently used by BCIS (2) to identify, in past projects, particular factors illustrated in Diagram 1, ie. size of building, internal subdivision and other design ratios plus cost data. Much of that data has not been recorded by BCIS but can be obtained from the same prime source or gleaned from existing data.

THE KNOWLEDGE BASE

The knowledge base of an expert system is a structure of data, relationships and reasoning rules which are capable of linking evidence about the problem to reach conclusions. The reasoning rules may be logical or probabilistic. The rules are traditionally derived by the analysis of the results of interrogating experts. Within the system described here, the knowledge base will comprise data in the form described above and rules which will match the clients requirements with the best whole building and contractual arrangement held in the data base. The methods proposed for the matching process are described below.

THE INFERENCE ENGINE

The function of the inference engine is the derivation of a conclusion by the analysis of the evidence processed by the rules. This can be carried out by either questioning, ie gathering evidence and deriving a conclusion (forward chaining) or by putting forward a hypothesis and testing it (backwards chaining). The system proposed will use forward chaining in the search for the best match to the clients requirements.

THE EXPLANATORY INTERFACE

The explanatory interface is that part of the expert system which generates the reports described below.

CONTRACTUAL ARRANGEMENTS AND THE BUDGET.

The method and terms of the contractual arrangement will have an effect upon the budget and the confidence in the budget. Evidence gathered to date indicates that full design followed by full specification, bills of quantities, tender and construction, leads to the determination of a contract sum in which there is a high degree of confidence. Methods which permit design in parallel with construction eg. management fee and fast tracking - require considerable post contract control to achieve a similar measure of confidence.

Results of other parts of this research demonstrate that many clients require a predetermined and fixed payment schedule. To other clients, the earliest delivery of the building is of paramount importance. The latter is often the case with the refurbishment of rented accommodation. Research in this area to determine the prime cost of any contractual method will proceed using case studies. The results of the case studies will form one part of the knowledge base.

THE REPORTS

Principally, three reports are envisaged. As the first and second reports are produced the client would be encouraged to review the results, perhaps amend his inputs and cycle through this process at each stage until he was satisfied.

The first report will be generated when the system has assessed the clients design requirements. The report will comprise a design proposal together with an appraisal of the confidence that the design will meet the clients requirements. It may seem to the layman that this last is hardly necessary. However let us assume that the client was fairly general in his inputs. The system would have little to work on, could only generalise and would report a low confidence rating that any proposed design would be satisfactory. This should encourage the client to try again and be more specific.

It should also be pointed out that 'design' in this context is not a set of drawings but rather a 'brief' which could be used by a 'designer' to produce a set of drawings.

The second report would be generated following the assessment by the system of the cost implications of the brief. Here the client will be presented with a budget for the optimised design brief obtained by the iterative process described above. Once again confidence in the budget or parts of it will be given and will be linked not just to the inadequacies or otherwise of the brief but also to the confidence in the cost data held.

The third and final report generated by the system will relate to contractual matters and will indicate the clients requirements in terms of speed of procurement and the forecast of spending throughout the project. The system will give a conclusion, reporting on the budget figure, the confidence in the budget and a recommendation on the procurement procedure.

CONCLUSION

It is impossible to give more than a hint of the potential problems and their possible solutions in a short paper of this nature. Research into this area is at an early stage, the authors being engaged in the initiating

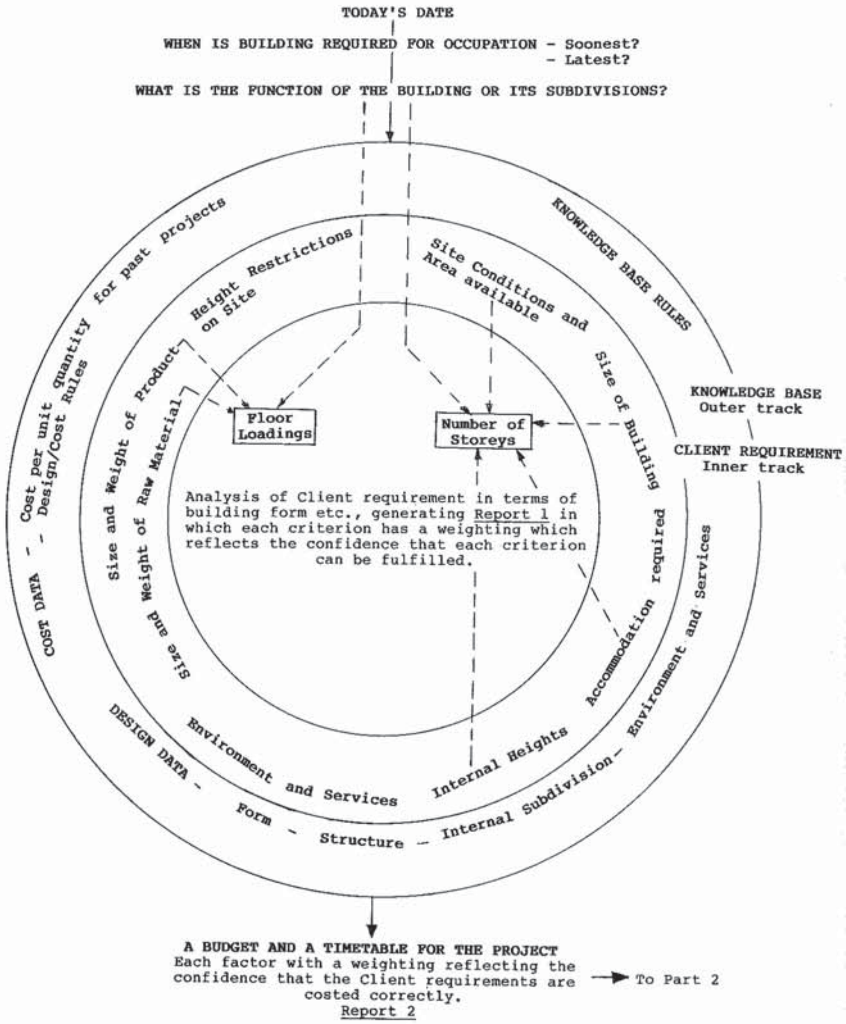

Diagram 1 - Part 1

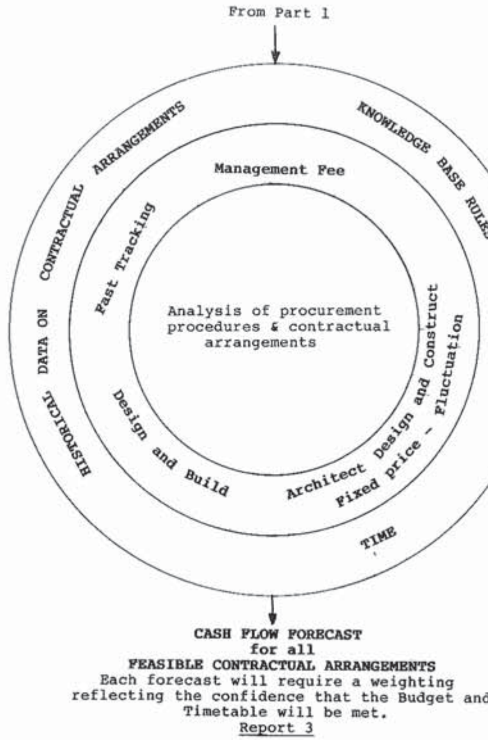

Diagram 1 - Part 2

of contacts with a wide variety of sources of expertise and data. The former are found to be divided on a number of key issues and the latter is far from complete at any one source. The settling of differences and filling of gaps is envisaged to take a considerable period of time. For example cost data is traditionally held as 'Tender data' together with some cost/design information. We feel - although not everyone agrees with us - that what we really need is 'Final Account cost data' and more complete information on cost/design factors. A further factor is the difficulty in obtaining final costs for buildings. These are regarded as confidential by many professionals and clients. While understanding the ethical motive behind this, there is the suspicion that the secrecy is also used to cover up the fact that the final cost exceeded the tender amount and therefore what the client fondly assumed was the budget.

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Anti-Seismic Design Support Expert System

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KEYWORDS

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ABSTRACT

Historically strong earthquakes attacked Japan necessary to construct buildings on soft alluvium with dense population. Despite the recent development of structural designs and construction techniques strong earthquakes provide even heavy damages, almost all of which are lower and medium sized designed by smaller structural design offices. They cannot sufficiently provide appropriate engineering advice at the early stage of architectural design. Mutually contradictory requirements must be solved by junior engineers. The expert system on structural design problem can support them. Herein, the expert system of optimal layout of earthquake resistant elements in frames is discussed. SIM-system is added to ISI-system which provides general structural design tools. PSI-machine contributes to provide the software operating system called SIMPOS in ESP language based on the logical KLO. Thus the knowledge base on the subject includes;A) consistency with the relevant codes, B) consistency with architectural and environmental design requirements, and C) structural design requirements in terms of the grades such as CF, membership level of fuzzy sets, the level factor by MEM.