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Computerisation of Natural Language Work Descriptions

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KEYWORDS

On Site, Work Description, Natural Language, Database.

ABSTRACT

Accounting for construction costs requires various cost models, in which the main variables are: the work package description, the quantity of work, the resources required, and the costs of each resource. Computerisation requires specification of the cost model, assembly of databases relating to work packages, resources needed and resource costs, and the use of standard descriptions of work packages.

Early attempts at computerisation of these descriptions using mainframe computers were not very successful, for a number of reasons. Computerisation was only feasible in offices and not on site for the obvious hardware restrictions.

This paper describes a method of direct computer entry ON SITE of work descriptions and quantities, using a natural language shorthand currently used in the manual operation. A database management system is used to translate freeform shorthand into standard descriptions of work, obviating the need for codes, and requiring little user training. The method is largely independent of the cost model in use, and so can be used for a variety of applications using different cost databases and cost models.

The system is in operation with a firm of British quantity surveyors.

Informatisation des descriptions de travail en language naturel

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MOTS-CLES

Sur place, description de travail, language naturel, base de données.

ABSTRACT

La compatibilité des couts de construction requiert divers modèles de coûts dans lesquels les variables principales sont: la description de l'ensemble du travail, la quantité de travail, les ressources necessaires et le coût de chaque ressource. L'informatisation nécessite la spécification du modèle de cout, l'assemblage de bases de données indiquant les ensembles de travail, les ressources necessaires et les coûts des ressources ainsi que l'utilisation de descriptions standard des ensembles de travail.

Les premières tentatives d'informatisation de ces descriptions à l'aide d'ordinateurs centraux n'ont pas été très réussies pour diverses raisons. L'informatisation était uniquement faisable au bureau et non sur place du fait de restrictions évidentes inhérentes au matériel.

Cette étude decrit une méthode d'introduction sur ordinateur direct SUR PLACE des descriptions de travail et des quantités à l'aide de notation abrégée en language naturel couramment utilisée dans l'opération manuelle. Un système de gestion de base de données est utilisé pour traduire l'annotation abrégée non imposée en descriptions de travail standard évitant le besoin de codes et demandant peu de formation de l'utilisateur. La méthode est, dans une large mesure, indépendante du modèle de coût utilisé et peut donc être employée pour diverses applications faisant appel à différentes bases de donnés de cout et modèles de coût.

Le système est en service dans une firme de métreurs vérificateurs britanniques.

INTRODUCTION

This paper describes how computerisation of work descriptions with on-site data entry was carried out using database techniques. The problem arose as part of a more general computerisation ot quantity surveying work carried out with funding by Science of Engineering Research Council Teaching Group Scheme and C R Wheeler and Partners.

COST MODELS

The accounting systems used for construction costs have been formalised and are so familiar to the industry that they are taken for granted by those who use them. Computerisation has however made it necessary to re-examine and categorise them.

There are two basic accounting systems, or 'cost models' in use in British practice: that used by the builder to establish **cost** and that used by the builder and the client, (and his advisers) to document **price**. It is the latter model with which we are largely concerned here.

All the models require a standard convention for describing the work to be done, the quantity of work, the resources (labour, plant and materials) required, and the costs of each resource. British practice uses the Bill of Quantities as this convention for building up a total price for items of work. Using a 'Standard Method of Measurement', detailed descriptions of work packages can be built up, and listed in a document for pricing. Training and experience is required in using these standard descriptions, but once familiarity has been achieved, descriptions of even non-standard work packages can be easily built up, with little ambiguity, for pricing by others. There are a number of 'Standard Methods', for use accordng to the type of work, and in some cases, lists of work packages are published with their prices, as 'Schedules of Rates'. Use of these priced schedules simplifies the task of pricing repetitive work, or work repeatedly done by the same contractor. To arrive at a price for some work, it is merely necessary to identify the work-package, quantify the amount of work done and produce an invoice. This is a task easily done by computer, and little different from producing invoices for varieties of nuts and bolts, car components, or other many various stock items for which computerised systems abound. Or is it so easy?

COMPUTERISATION IN THE PAST

Early attempts at computerisation of the work package descriptions were not very successful, for a number of reasons. The many attempts began in the 1960's using mainframe computers, without interactive facilities, and with the interposition of the computer programmer and the keyboard operator. The 'Invoice' model was adopted, and each item of stock (work-package) was given a code number, by which the computer could identify the work description and the price, and them print an invoice. The job of describing the work, thus expanded to include coding, so that codes and quantities could be entered into the computer. Coding was seen as requiring a knowledge of the codes, rather than construction processes, and became a separate process. Similarly, keying in the codes and quantities was a clerical job. Thus computerisation changed a technical and typing process into a technical/coding/keyboard process. It goes without saying that the interposition of two additional stages, and separate

'clerical' personnel, not only was costly and slow, but introduced errors into the data. The same problem occurs in many other industries. But in these industries, adequate clerical staff is taken for granted, and the difficulties of coding have been overcome, (or the errors kept to an acceptable level). In the construction industry these problems were sufficient to prevent further applications of computers to this type of work.

The need for site documentation of work packages and quantities could not be met at all. Computerisation was only feasible in offices and not site, for the obvious hardware restrictions, or the alternative unacceptable imposition of carrying books of codes around on site.

The arrival of microcomputers has removed a number of these barriers. It is economically feasible (just) for each quantity surveyor to have access to an interactive terminal, and input and process his or her own work. Portable computers suitable for site data entry are now available at a cost low enough for a surveyor to carry with him or her on site visits. Only the problem of how to enter the data remained to be solved.

MANUAL PROCESS

The manual process to be computerised comprised site measurement of maintenance work for compilation of invoices for to public sector client, according to a fixed schedule of rates. This type of work comprised about 40% by value of the workload of the quantity surveying practice.

The existing process requires the surveyor to visit site and record large numbers of work descriptions by hand, before returning to the office to check the descriptions against the schedule of rates, extracting the prices to compile a handwritten invoice. (Retyping would be too time consuming and unprofitable.)

The work descriptions are recorded by the surveyor in a shorthand, which while personal to each surveyor, is recognisable to similarly trained and experinced colleagues.

THE AIM OF COMPUTERISATION

The construction industry is a conservative industry, and quantity surveyors are amongst the most conservative within it. The inherent reluctance to change working methods has meant that computerisation has been used to increase the detail, and efficiency with which costs/prices can be documented rather than to examine whether the detail is valuable and the expense of computerisation in such detail is justified.

In our case, the fact that the manual process is slow, repetitive, boring and hence variable in quality has not led to questioning of the process itself, (except by us). The detail is considered necessary by the public sector accountants who pay for the work. Hence the aim of computerisation was not to eliminate the time consuming part of the work (site documentation) but to speed up the production of invoices, once data was collected.

Some software already exists for this work, but data is collected manually and entered into the computer in the office, thus duplicating data handling, and adding an additional process.

DATABASES

Analysis of the several tasks and data to be computerised, for the quantity surveyor resulted in a database solution. Databases were required for clients, contractors, contracts, schedules of rates and orders for work. A Commercial database management system, DBMS, was therefore employed.

The standard cost model in use for both Bills of Quantity work and the schedule of rates for maintenance work meant that database structures and programs incorporating these models were easy to set up. Only the work descriptions with 50,000 occurrences in the schedule and considerable length when written out in full remained as a problem.

WORK DESCRIPTION ENTRY

The following methods were considered:

1. Keyboard entry of digital codes from hand held code book,
2. Light pen entry of bar codes from hand held code book,
3. Keyboard entry of natural (English) language descriptions,
4. Keyboard entry of natural (English) shorthand.

Constraints on the choice were:

1. Physical limitations of operator - only two hands to hold key board, light pen, code book, cigarette, tape measure, and ladder while out on site in rain wind and mud,
2. Poor keyboard skills of operators, plus reluctance to spend time 'typing',
3. Need to enter descriptions without further editing in the office,
4. Need to enter 'rogues' *

Of the four methods, the last was preferred, because although typing was required, it was nearest to the manual method, and was flexible enough; provided that natural language shorthand could be satisfactory fitted into the into the database management system

ANALYSIS OF SHORTHAND AND WORK DESCRIPTIONS

In the initial stages of analysis of the work descriptions, they were considered in linguistic terms:- verbs, adverbial phrases, numbers of processes, special modifications etc. The aim was to devise a fixed position syntax eg <verb><process><types><situation><location etc. This approach resulted from the desire to avoid numerical codes. This attempt foundered when it was realised that few surveyors and not all researchers had linguistic skills.

Eventually, the use of the DBMS gave us the idea of treating the shorthand as a (largely) alphabetical code. This could be broken down into 'words' which when stored as fields in the database became the code for identifying the longhand description and the price. Although this was a return to the coding method, there

* Not all work packages can be included in a particular schedule of rates, and therefore computerisation must cope with the inclusion of 'rogue' work packages as they occur.

was no need for a separate coder or keyboard operator and less room for coding error.

Each measured item become a record in the database of items within orders for work, with the words of the shorthand as individual fields in the record. A maximum number of 12 fields was required with up to 4 characters in each field. Each field can have up to 25 possible values.

As long as the order of entry was maintained, the 'translation' of the shorthand into 'longhand' was easily done by a program using a database containing these descriptions. Where no translation could be found (eg errors in shorthand, non-standard shorthand or rogues) this could be edited (if containing errors or non-standard shorthand), or, the full work description added for rogue shorthand.

EXAMPLES

Examples of work descriptions for the painting trade are:-

1. 2 coats emulsion paint to old plaster walls

for which the shorthand is-

< I >	< EP >	< WL >	< 2 >	< OLD >	< PL >
Internal	Emulsion	Wall	2 Coats	Old	Plaster

2. Burn off old soft wood girth not exceeding 150 mm wide-

< I >	< N150 >	< BO >	< OLD >	< SWD >
Internal	Not exceeding 150mm girth	Burn off	Old	Soft Wood

REPEATS

Another way of minimising typing was to build into the program the facility for repeating items already measured, so that only the quantity needed re-entering and where a description had been written already in measurement for a different location at the same site, the facility to copy the description to a new section. This was aided by the hardcopy print out produced by the portable computer.

RIGID/FLEXIBLE SHORTHAND

At first it was felt that surveyors should standardise shorthand and learn to use the 'approved' version by being prompted by the program. However the operators quickly became frustrated at the slowness of the prompt program and had little difficulty learning the shorthand, (they had devised it!). The problem of accidentally omitting data was reduced by the hard copy printout from the portable computer as the program ran.

Consequently the program was revised to allow flexible shorthand, ie any shorthand in any order, limited only by the number of fields and the number of characters in each field. This also meant that the same program could be used for each trade rather than a fixed prompt program for each trade.

This flexible shorthand was made possible by careful analysis of descriptions and choice of fields. It was established that for a given trade, a given shorthand has only one occurrence, and hence has a unique position in the shorthand description. This gives a much greater flexibility of entry of shorthand.

Thus 'raw' flexible shorthand now requires the following translations-

i) for "dialect": a short programme converts non-standard values of a field to standard shorthand,
ii) for position: a short programme rearranges shorthand within a record to the standard order,
iii) for rogues: where no standard record exists for the shorthand the editor must add his or her own work descriptions. All of these transactions are easily carried out within the DBMS.

IMPLEMENTATION

A hand held Epson portable computer with 64K RAM (battery powered) is used on site. Processing capacity and memory restrictions mean that this computer is only used for data entry. Processing of the data is carried out by a 10mB Apricot hard disc micro in the office. Data can be transferred between the portable and the office micro by hard wiring, or by modern and the telephone system The hard disc micro stores all the data required for 'translating', sorting, pricing and invoicing, and carries out this processing, and printing of the invoices. The data is stored using commercial database management system software, which includes a powerful command language, in which the programs are written. The programs for this application are only part of a suite of programs using this DBMS, within the Q S office. The program for the portable is written in Basic, because of RAM limitations.

Speed limitations of the DBMS (written for 8-bit machines) prevented the early change to flexible shorthand. Now that the 16-bit enhanced version of the DBMS is available for the hardware, it is envisaged to add 'translation' features for dialects - (the client has 5 branch offices, where practices and shorthands vary), done by automatic checking with the database.

OTHER APPLICATIONS

The use of the DBMS means that the works description can be combined with any set of price/cost data, the method of combination being determined by the application programme.

Any type of work description can be used, provided it can be easily expressed in a shorthand, since the only limitaions are the number of fields and the numbers of characters in each field. Although these limitations have an upper bound in the

DBMS itself, in practice the number of fields and number of characters in each field will be determined by the enthusiasm for typing.

This means that any construction industry application which uses work descriptions could have direct computer input in English, and the need for standard phraseology is much reduced.

CONCLUSION

Although the task of writing work descriptions in English directly into a computer, under site conditions, appeared to be particularly daunting, a working method has been achieved and tested satisfactorily in practice. The use of natural (English) language shorthand, and a flexible data entry program has enabled the entry of around 50,000 items without reference to coding manuals. The database management software has enabled the method to resemble manual practise as much as possible, minimising training.

The method of computerisation is not restricted to this application but can be applied to other cast models in use in the industry, for many other applications.

A computerised interactive, interogative, analytical decision technique for strategic management in construction companies

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KEYWORDS

Corporate Strategy, Decision Making, Expert Systems, Personal Construct Psychology, Strategic Management, Tendering Strategy.

ABSTRACT

The UK construction industry is one of the largest contributors to the national economy but it is fragmented, with relatively few large firms and little concentration. The fragmentation of the industry means that contracting firms, depending on size, location and service offered, will face different types of business environment and subsequently respond to that environment in different ways. This is largely due to the environment, market strategies, organisation and managerial capabilities. Managers act as a link between the business environment and the construction company and managerial perceptions play an important part in determining the manner in which organisations respond to their environment. In the current recessionary period it is the quality of management's decisions which will determine the survival or failure of construction companies. The paper describes an interactive, computer based, analytical technique which will allow a manager to assess the quality of his assumptions and judgement in a decision making context. Using developments from Personal Construct Psychology, the technique allows managers to make explicit what is implicit and intuitive in their thinking. The decision technique will facilitate the rigorous exploration of agreement, disagreement and misunderstanding between managers in a strategic choice making situation.