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Standardized Input-Output Conventions – State of the Art and Trends

Standardisation des entrées/sorties – Etat actuel et tendances

Standardisierte E/A-Konventionen – Stand der Technik und Trends

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SUMMARY

This paper reviews the findings of the European Community predevelopment study – I/O conventions – for the building industry within the Member countries completed in April 1982. The aim of the study was to assess the feasibility of European Standards for input and output (I/O) conventions for computer programs used by designers and builders in the construction industry.

RESUME

Ce rapport décrit les résultats d'une étude préliminaire portant sur les conventions d'entrées – sorties (E/S) pour l'industrie de la construction dans les pays de la Communauté Européenne. Le but de cette étude est d'évaluer la possibilité d'établir un standard européen pour les entrées/sorties des programmes utilisés par des ingénieurs dans l'industrie de la construction.

ZUSAMMENFASSUNG

Dieser Bericht beschreibt das Ergebnis einer EG-Studie – E/A-Konventionen – für die Bauindustrie innerhalb der EG-Mitgliedstaaten. Das Hauptziel der im April 1982 fertig gewordenen Studie war die Untersuchung der Durchführbarkeit des europäischen Standards für E/A-Konventionen für die Computerprogramme, die von Entwerfenden und Bauunternehmern der Bauindustrie benutzt werden.

1. INTRODUCTION

In 1977 a report was published by CIAD Consortium: "The effective use of computers within the building industries of the European Community", EEC Study Projekt T/1/77. In this report several recommendations were made, one of which was to establish some input and output (I/O) conventions for computer programs used by the building industries of member countries. Accordingly the Commission appointed Rechen- und Entwicklungsinstitut für EDV im Bauwesen - RIB e.V., Stuttgart to discover whether international agreement about I/O conventions was feasible, and, if so, to describe a framework in which such conventions could be defined and implemented.

This predevelopment study on I/O conventions was controlled by a Technical Committee appointed by the Commission; the committee representing every member country. An international study team assembled by RIB made a preliminary survey of computing in the building industries of all member countries and presented its findings as an interim report.

The findings of the interim report were then analysed; the analysis being presented as the final report which led to firm conclusions - and set out recommendations - as summarized below.

2. FINDINGS

There are different I/O conventions among member countries. There are different conventions among firms in each member country. There are also internationally used systems such as ICES and GENESYS which employ still other conventions. Yet this report concludes that universally acceptable I/O conventions are still feasible. The reason for this fortunate conclusion is that computer-aided design (CAD) systems are currently in a state of development from the old fashioned "batch" to the more modern "interactive" approach to presenting input data. Such I/O conventions as are well established - and in which there is conflict between originators - are mostly conventions concerned with batch usage.

That is not to say that batch usage is dead. On the contrary when immediate response is not essential designers may prefer to present original data in the conventional way, using an interactive approach only for modifying and refining the original design. For every aspect of the proposed framework in this report, each interactive facility has its corresponding batch facility. This philosophy is tenable because at the fundamental level of input there is seldom much difference between the syntactical requirements of an entity (say an integer) regardless of country, company, or proprietory system.

Small but irritating differences between I/O conventions in programs originating from different sources have hitherto made interchange of programs - even the marketing of well established programs - difficult if not impossible. Definition of a very few standard conventions of syntax (integer, real, keyword etc.) would make marketing and interchange much easier. In a small office that gains initial experience using, say, a cheap turn-key CAD submitting data would have to be relearned when that office graduated to a bigger system.

Computing is now an essential element in the design and construction of buildings. Therefore some conventions - at very least the definition of syntax of fundamental items of data - are essential to the building industries of member countries. The obvious advantages (in terms of costs avoided and time saved) are:

- there would be less learning time for users in mastering each new system
- the documentation explaining the use of each new system would be shorter, and simpler both to read and to write
- by using standard I/O modules there would be less programming statements to write when developing each new system
- because of standard I/O procedures the use of each new system would be easier to explain, hence the system easier to market

A framework for such conventions is proposed.

3. CONVENTIONS

The report describes four "levels" of I/O convention. Levels are hierarchical in the sense that conventions at each level encompass these at lower levels.

As well as describing levels at which I/O conventions should be defined the report proposes input and output modules be written to handle data prepared by the user according to these conventions.

The four levels are briefly exemplified below, where AP stands for Applications program and IOM stands for Standard Input/Output Module:

Level 1. At this level a call to the IOM causes a single value to be input. The programmer of the AP may compose a prompt for the IOM to issue when the AP is being used interactively:

SECTION WIDTH (mm)?

Level 2. The user issues a "command" (one of a set of words defined by the applications programmer) making the IOM cause entry to a corresponding section of the AP. Necessary data are then input by calls to the IOM precisely as at level 1:

READY?

When the program is being used interactively the command may be selected from a menu displayed by the IOM:

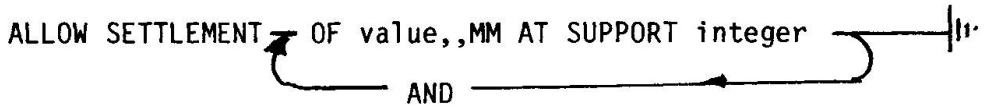
```
TYPE 1 FOR INPUT
     2 FOR ANALYSIS
     3 FOR OUTPUT

READY?
```

Level 3. The user may issue commands modified by parameters. It is not necessary for the AP to call the IOM for each item as at levels 1 and 2

```
BEAM 115,,225 (default assumed for 2nd parameter)
DELETE BEAM1 THROUGH BEAM5
```

Level 4. At this level the applications programmer has a command-definition language. Examples of level 4 are seen in GENESYS and ICES where the command-definition language of GENESYS is the more sophisticated. Examples from the user's point of view are limitless in scope, but below is a command as defined in a manual describing an AP of GENESYS. Below that is a possible input of that command by a user

Command definition



Command input

```
ALLOW SETTLEMENT  OF 1.5,,MM AT...
      SUPPORT 2 AND OF 2,,MM AT...
      SUPPORT 5
```

4. RECOMMENDATIONS

The report makes no recommendations about conventions for graphical I/O because an international standard on this subject was being prepared at the same time as this study. However, the report concludes that I/O conventions for alphanumeric data are feasible and should be defined. The four levels described are enough to cover the design and construction processes of the building industry (Fig. 1), and there is adequate expertise in member countries to define these conventions and produce corresponding IOMs of technical excellence.
The recommendations are:

- I/O conventions and corresponding IOMs should be implemented to level 3 starting as soon as possible

- During implementation of the first two levels the conventions at level 3 should be defined so as to ensure upward compatability

- When level 2 conventions are established - and feedback obtained from use in the field - level 3 conventions should be revised (if necessary) and implemented

- All conventions and corresponding IOMs should be made as independent of proprietory machinery and software as possible

- Conventions should aim at compatability with the work station specified in a parallel EC Predevelopment study (CICA, April 1982)

- As for as possible the project should be funded by the EEC. Benefits are expected to exceed costs very soon

- The IOMs should be distributed to those who require them against a low fee to cover costs of maintenance and distribution

- The IOMs should be written in three programming languages: Fortran, BASIC and Pascal

- Assuming success of level 3 in the field work should continue on a unified approach to I/O conventions (including those for gaphic I/O) in the building industry by definition and implementation of level 4.

Relevant stages in the Building Process / Area of Computer Application	I/O Level needed: Level 1	Level 2	Level 3	Level 4	1 Initial brief	2 Preliminary design	3 Costumer's approval of preliminary design	4 Scheme design	5 Approval of licensing authorities	6 Detailed design	7 Preparation of tender documents	8 Preparation of specialist constructors' tenders	9 Preparation of constructors' tenders	10 Analysis of tenders	11 Awarding of contract	12 Plan construction	13 Monitor project costing,planning,cash flow	14 Schedule/order resources	15 Site co-ordination and management	16 Monitor project performance - constructor	17 Preparation of interim valuations	18 Modifications to project	19 Completion of project	20 Final settlement of accounts	21 Documentation of completed project	22 Historical analysis of project	23 Monitor customer satisfaction
Design	●	●	●	●		X		X		X											X				X	
Structural analysis	●	●	●	●				X		X											X					
Drawing production and registr.	●	●	●	●		X		X		X											X			X		
Building codes and regulations	●	●	●	●		X		X	X	X	X	X	X								X					
Specifications and bills of quantities	●	●									X										X					
Estimating	●	●				X		X		X	X	X	X	X												
Planning and monitoring of activities		●	●			X		X		X	X					X	X		X	X	X				X	
Material and resource management	●	●	●															X		X						
Commodity information	●	●	●			X		X		X	X	X	X			X		X			X			X		
Financial																	X	X	X	X	X	X	X	X	X	

Figure 1 Areas of Computer Application v. Stages in the Building Process with I/O levels

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