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COMPUTER AIDED MATERIALS SELECTION

M.I. Qureshi[1], K.M. Ghauri[2], L. Ali[2], A. Ahmad[2], R. Ahmad[3], H. Waqas[4] & I.A. Chaudhary[5]
[1]Vice Chancellor, Hamdard University.
[2]Professor, Department of Metallurgical and Materials Engineering, University of Engineering & Technology, Lahore.
[3]Principal, College of Engineering and Emerging Technologies, University of the Punjab, New Campus, Lahore.
[4]Pinstec (PAEC), Islamabad.
[5]Professor, Department of Mechanical Engineering, University of Engineering & Technology, Lahore.

ABSTRACT

The materials engineers, while selecting a material for a given application, is faced with an almost endless number of possibilities. Inappropriate materials selection can cause serious consequences. Some systemisation of procedures is therefore indispensible if the choice is to be made with economy of time and efforts but also with the assurance that no possibility is overlooked.

The current trend is to use computer-based systems (i.e. Computer and Peripherals, Data banks, and appropriate software) in order to optimise the selection. A beneficial approach in such an optimization of materials selection is to define a demand profile for the product to be developed and from that select a material with corresponding property profile. The demand profile has generally to be revised several times during the product development and sometimes new materials must be selected. Materials selection thus becomes a very time consuming and complex procedure. Therefore a well designed computerised materials selection system is potentially of considerable value. The present paper outlines the salient features of such a system.

Keywords: *Inappropriate Material Selection, Systemization of Procedures, Computer-based Systems*

INTRODUCTION

In all types of product development, the selection of materials is a critical, time consuming and expensive exercise [1-8]. Premature decisions may have serious consequences for the producers as well as for society. The task is complicated by ever increasing demands on optimization of products with respect to weight, cost, energy requirements, aesthetic appeal etc., and by the proliferation of material types and grades. A strategy for optimization in selection of materials is therefore essential, as indicated by Hanley and Hobson (1973), Nordon (1974), Moore (1974). Appoo and Alexander (1976) and Reid and Greenberg (1980).

Most designers work with very few materials "in their heads". It has been noted that many professional designers work not more than 5-6 materials at a time. The human mind is not able to handle the complex property profiles for most materials. In the initial stages of the design process many alternative concepts of shape, processing and materials are evaluated. Despite much of the required materials information is in-fact available in standards and handbooks, actually digging it up is time-consuming and further many prospective materials do not get a fair chance to be involved in these creative steps C.S. Barrett (1985), R. Froth et al (1994) and Jack W. Bray (1995) [9-11].

The only way to rationalize the materials selection is to make materials property information, more easily accessible. This is the perfect situation for the computer. This paper describes a computer based system which may be used for efficient materials selection.

Computer-Aided Materials Selection

Figure 1 depicts the scenario for Computer-aided materials Selection (CAMS) in the 80s and 90s. On the personal computer terminal, the engineer has direct access to a company data base which not only contains materials property data but also routines for calculation, design of sub-elements graphic routines, and routines for production planning (CAD-CAM coupling). In this company data base, the materials are limited to the company's regular suppliers, assortments, including in-house stock and delivery times from regular suppliers.

A Scenario for Computer Aided Materials Selection

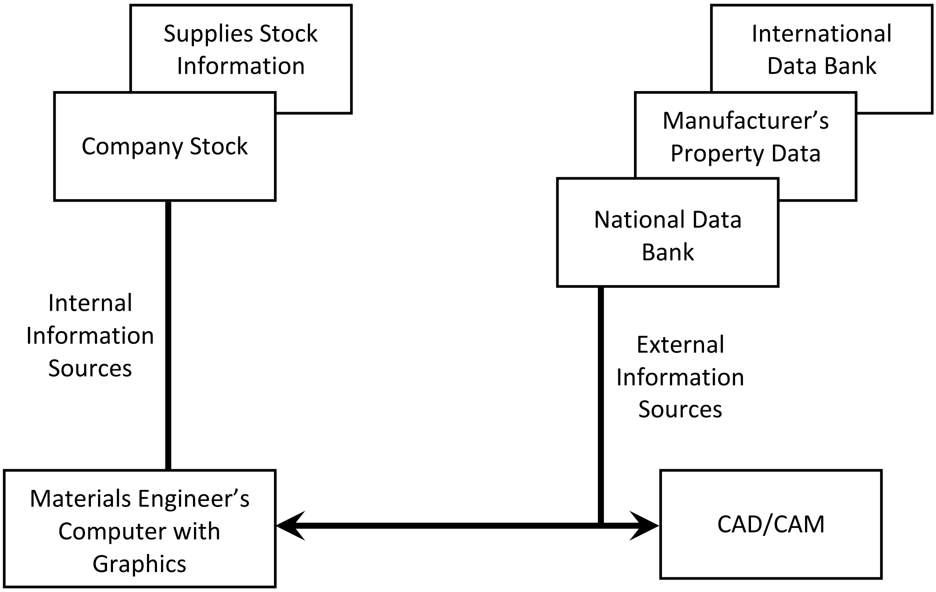

Figure: 1

Several back-up levels are accessible to the designer; firstly the national standards, secondly the data from national suppliers for materials outside the company's normal assortment (again, joined with stock lists, shape and dimension lists etc) and thirdly the national/regional or international data base.

Data originating outside the company data base must be labelled so that at any moment, by a simple command, one could let all 'foreign' data to disappear from the screen, or set them blinking in a screen window. This label would remain attached to a given value through the selection process, and it must not be possible to quit the programme without a final warning display and print-out of 'foreign' data being made. In this way, it would be possible to broaden the scope of materials as dictated by the specific design problem, while keeping tighter or looser reigns on the designer's appetite for exotic materials. The custom tailoring of company data base could become a useful activity for national service or for private enterprise.

This scenario may appear in topic. However, in view of many recent developments in the materials data base field that are active in various parts of the world, in rapid growth of data transmission networks, the availability of the back-up stems is becoming a "real thing".

Following Organizations have already established themselves in this particular area:

i) Fulmer Research Institute (UK).
ii) Computer Harmonized Application Tailor (CHAT): Materials Division, Engineering Research, International Harvester Company, Illinois (USA).
iii) Minitech Ltd., Ontario, Canada.
iv) Oakridge National Laboratory, Oakridge (USA).
v) Battelle Memorial Institute, Ohio (USA).
vi) Metals Properties Council, New York. (USA).

The computer data management system devised by metals property council is [shown in figure 2. This block diagram indicates the data process route initiating from sources and ending up at users. The intermidiatory steps of Data evaluation constitute the most important part of the route.

Computer Data Management System

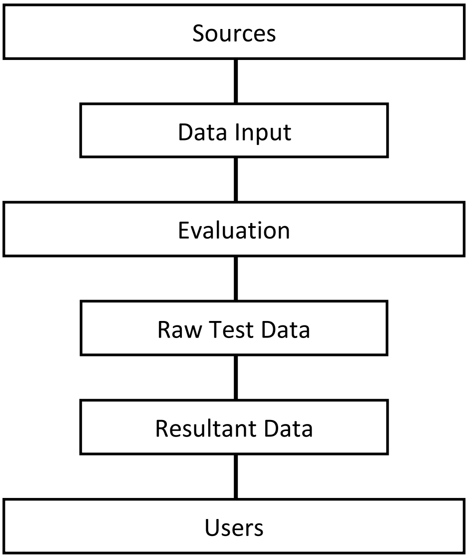

Figure-2: Metal Property Council Data Base

Presentation of Data

The computer-based system shown in figure 1, offers the designer a base for decisions so that he can concentrate on the essential evaluations. This puts great demands on the system's ability to present and compile data. The system should be capable of performing following tasks necessary in efficient materials selection and evaluations.

a) Presentation of tables and graphs.
b) Display data as histograms or in other graphic shape.
c) Rank data in sequence of better or poorer fulfillment of selection criteria.
d) Comparison between columns of a data matrix.
e) Comparison of property profile versus a demand profile. A polar sensation system as indicated in figure 3 can be devised.
f) Labeling of data categories.
g) Warnings.
h) Automatic screening of materials by set criteria.
i) Interactive dialogues.
   - Training
   - Working on a case study.
   - Beginner's working dialogues for materials selection.
   - Advanced (Fast) dialogues.
   - Checklist dialogues.

(j) Documentation.

Materials for engineering product design and other engineering applications can be grouped in a database. This database will contain information on structure property relationship of materials and their performance in different service environments. This information stored at the backend can be enriched and updated as and when required. The same information can be linked up with a software written in Visual Basic or JAVA at the fore-end. The icons made available at the fore-end, after satisfying conditions imposed can come up with appropriate material selection required for some specific engineering products.

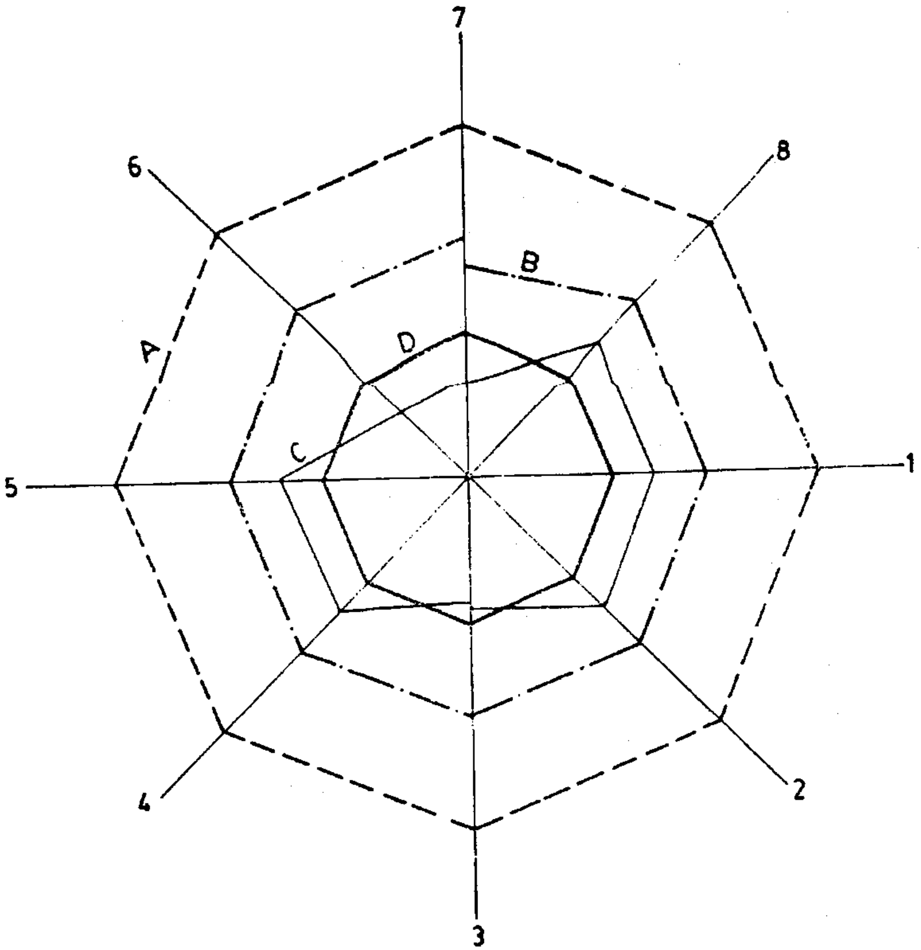

Figure-3: Polar Representation of 8 Normalized Demands
The Properties of A, B & C Fit Differently well to the Demands D

CONCLUSIONS

The Computer-Aided Materials Selection system suggested in this paper assists in relieving the designer from the evaluation of irrelevant or hard-to-understand data. The system is capable of not only sorting out the relevant information but also of presenting a bird's eye view of large groups of materials. Further it focuses on selective areas of materials property matrix.

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