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MODELS TO EVALUATE THE STATE OF COMPUTER FACILITIES AT SOUTH AFRICAN UNIVERSITIES

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Computer technology has grown exponentially in the course of the past decade in terms of sophistication - not only with regard to hardware and networks, but also with regard to mainframe and micro-computer systems. A university environment has unique needs in terms of computer facilities. Here it is not only a case of transaction processing systems with the concomitant higher levels of making available information for purposes of management, but primary activities at a university which have to be supported are research and teaching. In this research project an attempt was made to determine where the biggest problems lay with regard to adequate computer facilities at South African universities, and to propose possible solutions.

1. INTRODUCTION

The variety of activities which have to be supported by the computer services department at universities makes it very difficult for some universities to provide for these needs with their available capital. Training in computer science is, for example, a component where provision should be made for a minimum level of facilities.

Research at any university is a matter of high priority and special equipment and program material are essential in many cases. Administratively a specific level of availabilty and turn-around time are expected of the computer, so that it becomes a complex management task to determine priorities and to maintain an acceptable level of service.

With this research project it was decided to make a survey of the following by means of questionnaires:

- the status of computer support for research, teaching and administration at the universities;
- the level of satisfaction with computer facilities and the factors determining this (among others the availabilty of resources), with a view to make some recommendations.

The purpose of the project therefore was to develop a model which will bring the total success rate of computer services at a university in relation with the factors influencing it. It was felt that apart from the important role played by the availabilty of resources, there are other internal factors which can influence the success. An example is to be found in an orderly POLICY centring on the development of computer facilities, and other such factors may exist.

As it cannot be expected of the State to finance internal incompetence by the universities, it was decided to try and determine how the maximum level of success can be attained for any given level of availability of resources.

2. COLLECTION OF DATA

A questionnaire of reasonably wide scope in which 70 aspects are covered in three sections was developed. In Section A in the questionnaire we concentrated on questions around computer support of teaching and research. In the second place the questions dealt with administrative support. All the questions in this section had to be evaluate to on a seven-point scale. This type of question has been used with great success in past research projects.[1,2,3,4] The questions in section B dealt with general information related to computer services at the universities. These were factual questions involving the number of personnel at a university, the number of students,

General Information on Computer Services

From the responses to Section A of the questionnaire it emerged that an average of 14 300 students had been enrolled per university. This number was somewhat inflated by UNISA's high numbers. (Without UNISA's students taken into account this average drops to approximately 9000). More meaningful is perhaps the average number of personnel (academic 581 and administrative 521)

There is, furthermore, an average of 87 separate micros per university while an average of 140 terminals had been linked to the mainframe computers. Intelligent work stations linked to the mainframes came to an average of 31.

The average expected increase in computer work by consumers for the next five years is 5,8, that is, 5,8 times more than at present. The leasing and management expenses have increased by 22% between 1984 and 1985, while personnel expenditures increased by 20%. Less capital, R374 000 in 1985 as against R484 000, in 1984 was spent. The total subsidy of the state only increased by 11,4% from 1984 to 1985.

4. DEVELOPMENT OF THE MODEL

The last few questions in each questionnaire were questions aimed at a composite evaluation by each university. In this part of the questionnaire three copies were provided so that three persons at each university could provide views of evaluation. The purpose of this was dual. The first was to base the evaluation not simply on the view of one person. The second was to obtain more data so that the model could be rendered more reliable.

It was decided to develop a model through the use of restricted regression methods. In Bruwer and Hattingh (1985) the methods and the philosophy are outlined in detail. For the sake of clarity the steps involved are outlined below.

STEP 1. Identification of Variables

It was decided to study the total success of Computer Services at a University (dependent variable).

The variable was evaluated in a question in the questionnaire and we call this SUCCESS (for the sake of brevity). Apart from this it was accepted that (for the purposes of this study) the following variables (independent variables) can have a significant influence on SUCCESS:

- The satisfaction with the way in which budget perspectives are provided (indicated as SATISFIED).
- The availability of resources at a University (indicated as RESOURCES).
- The ability of a university to recruit and to keep expert personnel (indicated as EXPERT).
- An orderly policy centring on deployment of computer facilities (indicated as POLICY).
  The extent to which there is success in obtaining the support of key persons at a University (indicated as SUPPORT).
- The extent to which a university succeeds in transmitting computer technology to the community by providing, amongst others, consumer training (indicated as CONSUMER TRAINING).

By mean of regression methods it was discovered that a linear regression equation can be found which offers a good application by linking SUCCESS with the following variables:

- SATISFIED
- RESOURCES
- POLICY
- SUPPORT

The data (averages where possible) are indicated in Table 2.

CASE	SUCCESS	SATISFIED	RESOURCES	POLICY	SUPPORT
1	5,0	3,0	2,7	5,3	4,7
2	4,3	5,0	3,7	4,7	5,0
3	7,0	1,0	6,5	6,0	7,0
4	6,0	5,0	6,7	6,3	5,3
5	6,0	6,0	5,5	6,5	5,5
6	5,5	4,0	4,0	4,5	6,0
7	4,3	4,0	3,3	5,7	5,0
8	5,3	1,0	4,0	3,3	5,0
9	4,0	4,0	3,7	4,3	4,7
10	4,5	4,0	3,0	3,0	4,0
11	4,0	3,0	5,0	2,3	4,0
12	5,0	3,0	2,0	4,0	4,0
13	5,0	4,0	5,0	3,7	4,7

table 2
Average Value of Variables

The obtained regression equation is

SUCCESS = 2,19 - 0,19 (SATISFIED) + 0,19 (RESOURCES) + 0,26 (POLICY) + 0,13 (SUPPORT)

The inclusion of SATISFIED in the regression model was not really significant, but was included for the purposes of this analysis.

STEP 2. Restricted Regression Model

At the various levels of the variable RESOURCES, minima and maxima of SUCCESS were determined and outlined by means of linear programming techniques[2] as shown in figure 1.

The interpretation of this figure for this specific case is the following: At each given level of RESOURCES indicated on the horizontal axis both the minimum and the maximum values of SUCCESS can be read off, as well as the levels of the other variables which give the mentioned maxima and minima. These minima and maxima are those which were realised in the information.

Example:

Suppose the level of resources at an university is found to be 4 (on the 7-point scale). Suppose furthermore the level of success is 4.21 (fig. 1). This level can be raised to 5.65 by changing the levels of the decision variable accordingly i.e. SATISFY, POLICY and SUPPORT from the minimum levels (3.50, 2.70 and 4.00) to the maximum levels (2.32, 5.50 and 5.50).

5. DISCUSSION OF THE RESULTS

It is clear from the figure that:

- In general more SUCCESS can be attained for higer levels of RESOURCES.
- The universities (those involved in the analysis) generally attain average or above-average success (4 or higher on the 7-point scale).
- Some universities do significantly better than others (for a given level of RESOURCES) because they have a healthy POLICY and enjoy good SUPPORT).

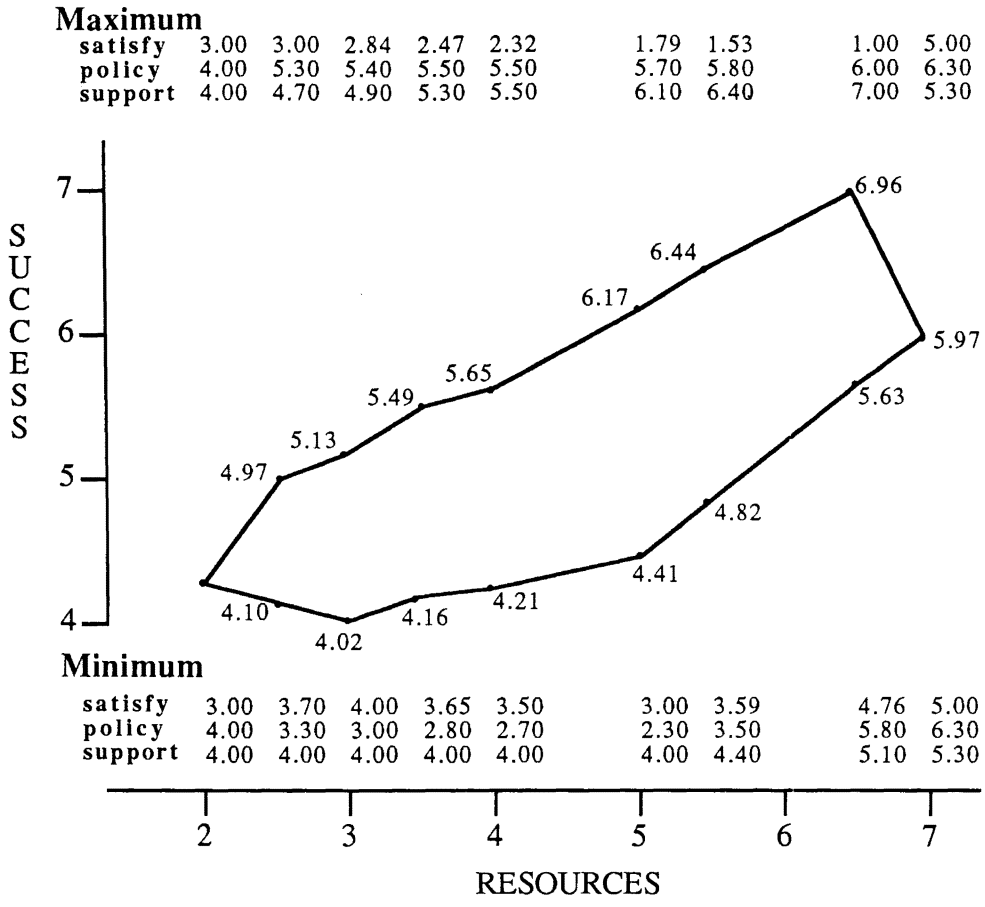

figure 1

Maximum and Minimum Values for Dependent Variable Success and Decision Variables Satisfy, Policy and Support

Some universities have indicated how much they intend to spend on computer facilities (1985) and when this is expressed in terms of Rand/student it amounts to R212,00. The Rand/student expenditure which the State contributed in terms of subsidy was R166,00 for this group. It is clear that this group of universities (if their own contribution of about 20% is taken into account) spends practically exactly what is provided for in the norms.

From Figure 1 it then emerges clearly that (as far as their own perception of the matter is concerned) in general they achieve a fair amount of SUCCESS in the cases where internal POLICY and SUPPORT are sound.

The dramatic decrease in the value of our currency with regard to other monetary units will dramatically change the perception about the availability of resources at universities for computer facilities, because our dependence on computer technology overseas countries.

6. RECOMMENDATIONS AND CONCLUSIONS

With regard to the above findings the following recommendations can be made:

6.1 That with the buying power of the Rand applicable at the end of 1984 reasonable levels of service could be maintained, especially by the universities where an orderly policy with regard to computer deployment is in operation and where Computer Services receive the

support of key persons.

6.2 That the Committee of University Principals should make representations to the state to increase the average provision of funds for Computer Services by at least 50% in the subsidy formula in order to effect reasonable levels of service at universities in view of our weak currency.

6.3 That individual universities will use the results of the model above as an internal management instrument to ensure maximal utilisation of resources.

Many further analyses are possible of the data obtained. Some questions, however, were not responded to fully enough and not all universities co-operated.

It is also clear that most universities are still in their infancy when it comes to the most important aspects of computerization. It is curious to note that this has not, in many cases, had a negative influence on the perception of the success obtained. This indicates that universities often resign themselves to mediocre situations as a result of conditioning. It would be possible for an appointed group to look individually at each situation and to evaluate its SUCCESS more objectively.

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2. Bohm C. and Jacopini G., Flow Diagrams, Turing Machines and Languages with only Two Formation Rules., *Comm. ACM*, **9**, 366-371, 1966.
3. Ginsburg S., Mathematical Theory of Context-free Languages, McGraw Hill, NewYork, 1966.

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