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Data, Information and Knowledge Visualization in Decision Support Systems

Decision Support System for resource allocation in Brazil public universities

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ABSTRACT

This study aims to present the design of a Decision Support System (DSS) for internal resource allocation in Brazil public universities, once, currently, there aren’t any kind of general DSS for such a problem. To do so, the analysis is carried out by identifying the general model from the Ministry of Education and the models from every Federal University, finding similarities between each model, and, dividing the models into categories, according to their similarities. The perspectives are to contribute to the decision problem of how to allocate resources properly faced by Brazilians public universities, take safer and reliable decisions, seeking to reduce uncertainties and to maximize their results.

Keywords: Decision Support System, Design, Resource Allocation, Budgeting
INTRODUCTION

One of the ongoing challenges faced by universities in general and especially in Brazil, where public universities perform an important role, it is to improve the provision of beneficial results for the society interest, considering an increasingly complex and changing environment. Therefore, the design of a Decision Support System (DSS) for resource allocation it is an important tool to respond to this ongoing challenge.

A Decision Support System can be defined as a computer-based information system that supports decision makers use data and models to solve semi-structured and unstructured problems. It helps decision makers to make better decisions and to answer complex questions [1, 2].

Generally, considering different definitions for a DSS, they all share the idea that a DSS is essential to support the decision-making process [2] and that is the reason its applicability will be considered for this study.

Thus, this work aims to present the design of a Decision Support System (DSS) for internal resource allocation in Brazil public universities, once, currently, there aren’t any general DSS for such a problem, and this can contribute to the decision question of how to allocate resources properly faced by Brazilians public universities, enabling them to take safer and reliable decisions. Also, it should be considered that public universities in Brazil use their taxpayers' money to provide education services. As a result, there is significant societal interest (or at least should exist) in the way such money is allocated, where the cost of a failure is seen as something unacceptable [3].

Within this context, it is important to clarify that the main decision of each model (not the problem situation of this study) it is how to allocate resources correctly, and the Decision Maker is considered as each Federal University.

It is known that the correct use of a DSS can improve the competences of the Decision Maker in understanding better the considered problem, how to select efficient alternatives, cost and time savings [2].

SURVEY

The design of the DSS will consist, at first, in analysing possible courses of action for the case [4]. It will involve the process of understanding the resource allocation models in public universities in Brazil, comparing them and finding similarities between the models, with the aim of generating solutions and testing feasible solutions in the future for the problem.

The general resource allocation model in Brazil is based on the “OCC Matrix” (Others, Costing and Capital Matrix). This matrix has the purpose of establishing criteria for resource allocation in Brazil’s Federal Universities, and it has equitable, qualitative, inductors, measurable and auditable criteria. The model is common for all federal Universities and the structure of the budget is programmed the year before [5].

The parameters are legally defined by the Brazilian Ministry of Education (Department of Education - MEC), and the basis of the matrix is the number of students (equivalent students) from each Federal University (FU) [6]. The general model is described in Figures 3, 4 and 5.

There are 55 Federal Universities in Brazil that receive resources from the OCC Matrix, and each one of them has their own resource allocation model.

Therefore, the resource allocation process could be described by Figure 1.
It is important to point out that the DSS prototype proposed in this study is focused on the process described in STEP 4 (Figure 1), once the general model applicable for Steps 1 and 3 already exists (OCC Matrix). To do so, this survey was divided into three steps, that are shown in Figure 2.

**Figure 2: Steps of the survey**

1. **Identify the general model and the models from each FU**
2. **Find similarities between each model**
3. **Divide the models into groups, according to their similarities**

**Figure 3: General model – part 1**

- **PART**
  - $h_1(\text{PART}) + h_2(\text{OUI})$
- **TAE**
  - $\text{TAEG} + \text{TAERM} + \text{TAEM} + \text{TAED}$
  - $h_1 = 0.9$
  - $h_2 = 0.1$

- **TAEG**
  - $\text{TAEG} = \text{Total of Equivalent Students in Undergraduation}$
  - $\text{PTAE} = \text{TAEG} / \text{TAE}$
  - $\text{NACG} = \text{Total of students that finished Undergraduation Studies}$
  - $\text{PG} = \text{weight of the undergraduation course}$
  - $\text{BT} = \text{bonus for having nightly undergraduation courses}$
  - $\text{BFS} = \text{bonus for having an undergraduation course outside the main campus}$

- **EQR**
  - $\text{EQR} = \text{Efficiency and Scientific Academic Quality from the FU}$
  - $\text{DQG} = \text{Dimension from the undergraduation course}$
  - $\text{DQM} = \text{Dimension from the master courses}$
  - $\text{DQD} = \text{Dimension from the doctorate courses}$

**Figure 4: General model – part 2**

- **DEAE**
  - $\text{DEAE} = \text{Efficiency Dimension of the teaching activities in the FU}$
  - $\text{CCM} = \text{CAPES concept of the master course}$
  - $\text{CSG} = \text{SINAES concept of the undergraduation course}$
  - $\text{NCG} = \text{Number of undergraduation courses evaluated at the FU}$

- **DQG**
  - $\text{DQG} = \text{Quality Factor from the undergraduation course}$
  - $\text{FCG} = \text{SINAES Concept of the undergraduation course}$
  - $\text{NCG} = \text{Number of undergraduation courses evaluated at the FU}$

- **DQM**
  - $\text{DQM} = \text{Quality Factor from the master courses}$
  - $\text{FQM} = \text{Quality Factor from the master course}$
  - $\text{NCM} = \text{Total number of master courses at the FU}$

- **DQD**
  - $\text{DQD} = \text{Quality Factor from the doctorate courses}$
  - $\text{FQD} = \text{Quality Factor from the doctorate course}$
  - $\text{NCD} = \text{Total number of doctorate courses at the FU}$

- **RAP**
  - $\text{RAP} = \text{Relation Factor between equivalent student and professor}$
  - $\text{FCM} = \text{CAPES Concept of the set of FU's of the master courses}$
  - $\text{FCG} = \text{SINAES Concept of the set of FU's of the master courses}$

- **FRAP**
  - $\text{FRAP} = \text{Relation Factor between equivalent student and professor}$
  - $\text{NGC} = \text{Number of undergraduation courses evaluated at the FU}$
  - $\text{CCG} = \text{CAPES Concept of the set of FU's of the doctorate courses that have the same area}$

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- **FCM**
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  - $\text{CCG} = \text{SINAES Concept of the set of FU's of the master courses}$
  - $\text{NGC} = \text{Number of undergraduation courses evaluated at the FU}$

- **FCG**
  - $\text{FCG} = \text{SINAES Concept of the undergraduation course}$
  - $\text{FCM} = \text{CAPES Concept of the set of FU's of the master courses}$
  - $\text{CCG} = \text{SINAES Concept of the set of FU's of the master courses}$

- **NCG**
  - $\text{NCG} = \text{Number of undergraduation courses evaluated at the FU}$
  - $\text{CCG} = \text{SINAES Concept of the set of FU's of the master courses}$
  - $\text{CCG} = \text{SINAES Concept of the set of FU's of the master courses}$
When analysing the available models (only 30 models were available for consulting or the university doesn’t have a defined model) and their similarities, it was possible to divide them into three main categories: Model 1, based on the general resource allocation model, Model 2, based on some indicators suggested by the Brazilian audit office (Tribunal de Contas da União - TCU) [7], and, Model 3, based on some indicators that will be shown next.

**MODEL 1**

Model 1 is based on the general resource allocation model presented in Figures 3, 4 and 5, but some universities vary or adapted a few parameters from it.

**MODELS 2 and 3**

Model 2 is based mainly on indicators like costing; the amount of hour of each course; the number of students in every course; the number of professors and their workloads in teaching, research and extension activities; publications from every academic department; the number of laboratories and qualification of the academic staff.

Model 3 is based basically on the following indicators: number of professors; the number of technical employees; the number of students from each department; the total area from the laboratories; the total area from the departments; scientific production from the...
departments; extension activities and others.

**DSS PROTOTYPE**

The DSS Prototype from the main three models found by this study is presented next. The models were divided into categories, according to their similarities. This initial prototype was designed in a Microsoft Excel file and it was the first step of a bigger research, that aims to improve the design of this DSS, by transforming the prototype into a web-based system, with a programming language, developing the data basis for the model and for the users, implementing the program, and, finally, tested by the users. The research also will include a project portfolio selection approach as an appropriate model to analyze the resource allocation process of the universities.

**Model 1**

![Figure 8: DSS Prototype – Model 1](image)

**Model 2**

![Figure 9: DSS Prototype – Model 2](image)

**Model 3**

![Figure 10: DSS Prototype – Model 3](image)
PERSPECTIVES AND CONCLUSIONS

The purpose of this study was to present the design of a Decision Support System (DSS) for internal resource allocation in Brazil public universities. To do so, the survey was divided into three steps: identify the general model and the models from each FU; find similarities between each model; and, divide the models into categories, according to their similarities. This initial prototype was the first step of a bigger experiment. The system still must be improved to be useful for the users.

The next step is to transform the DSS prototype into a web-based system, with a programming language, constructing its data basis for the model and for the users, implement the program, and, finally, tested by the users. Also, the DSS could have potential expansions in the future, expanding its general prototype to be used by the Ministry of Education in Brazil or others public institutions with the similar decision problem.

The perspectives are to contribute to the decision problem of how to allocate resources correctly faced by Brazilians public universities, take safer and reliable decisions, seeking to reduce uncertainties and to maximize their results. In addition, it could be used to provide background for the Federal Universities strategic resource allocation planning.

It is worthwhile to note that the DSS prototype has no production intention but to deal with as an experiment with only research purposes.

REFERENCES


