

Linear Programming: An Alternative Enterprise Resource Planning (ERP)

in Higher Learning Institution

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Abstract: This field seeks to find out whether the linear programming application able to assist higher learning institutions in allocating sufficient resources and maximise the available facilities to carry the educational program at cost effectively. Local private higher institution from the Melaka state was studied by applying the linear programming method to copy the needed resources for the coming semester. The PHP simplex, Management Science 6.0 and Mathlab R2013b software are utilised to simulate the optimal outcomes. The outcome indicates that the resource usage in private higher institution able to optimize by using linear programming. This study is only focusing on the enterprise resource planning. The supply chain management and customer relationship management which is division of enterprise resource planning was dropped out.

Key words: linear programming; enterprise resources planning; higher learning institution

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1. Introduction

In the millennium, almost every private institution of higher learning is self-sustain business entity. They required to generate their own revenues as in any other business enterprise and thus should be very innovative in their programs, fee requirement and the ever-changing needs of student (Arokiasamy L., Ismail M., Ahmad A., & Othman J., 2009). Their main problem is the budgeting factors (Sullivan L., 2009). Therefore the higher learning institution must be effectively harnessed at minimum cost possible in order to achieve the desired result void of wastage in the educational outcomes (Campbell, Omolara, & Ayotunde, 2005). Staffing, resource allocation and acquisition of third party software solution (Sullivan L., 2009) are the areas where the private institution is able to avoid wastage and endeavour their facilities to optimal use (Okemakinde T., Adedeji S. O., & Ssempebwa J., 2005).

The demand for public higher education in Malaysia is very strong (Ahmad A. R., Farley A., & Naidoo M., 2012). According to Index Mundi, the educational expenditure which refers to the operating expenditures in education, including the wages and salaries and excluding capital investments in buildings and equipment, has fluctuated from US\$ 208.8 million in 1970 to US\$ 11.6 billion in 2011 in Malaysia. That clearly shows the operational expenditure in education is required, some attention to convey back to the right route.

This paper's objective is to see whether the linear programming application able to assist private higher

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institution in allocating sufficient resources and maximise the available facilities to carry the educational program at cost effectively. The remaining objectives of this study are still underway:

(1) To develop the management constrain into linear programming.

(2) To develop the management maximum utilization into linear programming.

(3) To supply a solution for maximum usage of resources using various software.

The result of this survey will offer a resolution for the private higher learning institution to establish exercise of available management science tools for their day to day functioning. On the long run, the private higher learning institution able to manipulate the operating expenditure, particularly in reduction on visiting lecturer cost.

The residue of paper will present the related review of enterprise resource planning and linear programming in part II, Case analysis in part III, Discussion of the results in section IV and conclusion on section V.

2. Enterprise Resource Planning

Even though, enterprise resource planning is developed from manufacturing industry, now its scope wider to almost all manufactures. The education industry is not barred from carrying out this enterprise resource planning. Many inquiries were carried within this industry to study the challenges and the success factor of the enterprise resource planning.

Higher learning institutions were required to purchase the ERP software from the third party solution provider. Some higher education is unable to subscribe the markets ERP software due to the low budget. Besides, the problem with these applications is that they are not integrated, they are not communicating with each other, leading to extensive use of paper, lack of real-time information, redundancy in information in- puts and lack of transparency (Bologa A. R., 2007).

Even though, if the higher learning institutions able to subscribe to the ERP software. One of the critical successful factors for implements this software, the customisation (Rabaa'i A. A., 2009) of the software. Based on the review made, the software is needed to fit the existing business processes. But, the customisation shall be made minimal to help the success of implementation (Bhamangol B., Nandavadekar V., & Khilari S., 2011).

The most important and meaningful success factor in enterprise resource planning implementation in higher education sector is project management and system selection (ALdayel A., Aldayel M., & Al-Mudimigh A., 2011). Beside the user satisfaction of the software is a critical part of success (Davis M., & Huang Z., 2007). For that reason, it must be carefully evaluated and selected (Sabau G., Munten M., & Bologa A., 2009). The universities are lack in adopting technologies and reluctant in changing the operating system which may raise risk on their operation (Seo G., 2013; King P., 2002).

In summary, these surveys reveal that the available enterprise resource planning systems are expensive, not user friendly and not feasible. This composition is trying to find any alternative method which much cheaper, able to work the problem easily and used in day to day functioning.

3. Case Analysis

Head of Engineering Department of a private higher learning institution in Melaka was requested by the management to provide the number of students for coming July 2014 intake. The management wanted to utilize all available resources to catch maximum number of students. In society to maximize the number of pupils for the coming intake, analyze of the trainers' load as well as the number of courses needed.

The core program of that department is the Diploma program. This is a 3-year sandwich program. Students will undergo 1st and 3rd year studies at the Academy and the 2nd year on industrial training. Each year consists of 2 semesters. This means that the students spend semester 1, 2, 5 and 6 at the Academy and semester 3 & 4 on board ships. Beside the centre program, there is a special program which will be transmitted on demand basis.

The administration recommends a maximum of 32 students per class. The management has limited the lecture hours to 24 hours per week for each lecturer. The trainers are classified as non-academic and academic lecturers. Non-academic lecturers will teach all engineering related studies and academic lecturers will cover subjects' related fundamental sciences (English, Thermodynamic, and so on). Presently there are 11 non-academic lecturers and 9 academic lecturers.

Cohorts	Expected number of classes
Semester 1	≥ 0
Semester 2	= 0
Semester 5	≤ 4
Semester 6	= 2
Special program	≤ 1

Table 1 Summary of the Departments' Forecast for Next Semester

Table 2	Summary	of the	Loads R	leguired	and Deli	verable f	for Norma	al Semester

Trainers	Le	ecture hours	required p	er class per	week	Total	Max deliverable lecture hours per week
	Semester	Semester	Semester	Semester	Special	resources	(resources x 24 hours)
	1	2	5	6	Program	resources	(resources x 2 r nours)
Non-academic	18	20	20	30	21	11	264
Academic	21	22	18	7	10	9	216

3.1 Designing the Problem Using Linear Programming (LP)

The objective function here to determine the number of classes can be run on next semester.

$$Max Z = X_1 + X_2 + X_3 + X_4 + X_5$$
(1)

 $X_1 =$ Number of semester 1 classes

 $X_2 =$ Number of semester 2 classes

 X_3 = Number of semester 5 classes

 X_4 = Number of semester 6 classes

 X_5 = Number of special program classes

Where, X₁, X₂, X₃, X₄ and X₅ are non-negative.

Constraints 1 & 2: The required lecture hours into number of classes shall meet the maximum deliverable lecture hours.

$$18X_1 + 20X_2 + 20X_3 + 30X_4 + 21X_5 \le 264$$
⁽²⁾

$$21X_1 + 22X_2 + 18X_3 + 07X_4 + 10X_5 \le 216 \tag{3}$$

Simplified as:

$$18X_1 + 20X_3 + 21X_5 \le 204$$
------ Constraint 1 (4)

$$21X_1 + 18X_3 + 10X_5 \le 202 \text{------ Constraint } 2 \tag{5}$$

Constraints 3 & 4: Number of classes expected.

 $X_3 \leq 4$ ----Constraint 3 (6)

$$X_5 \le 1$$
 ----Constraint 4 (7)

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4. Discussion of the Results

There are diverse methods to solve the linear equation. For the aim of proving the reliability of the outcomes, the survey used three widely used methods. PHP simplex, management science 6.0 and Matlab R2013b software was employed to solve the linear equation. The institution which the case taken having Matlab R2013b software which was recently set up in the computer laboratory. The answers from all three methods are represented in this report.

Table 3 Results							
variable	PHP simplex	Management science 6.0	Matlab R2013b				
X ₁	5.7143	5.714	5.7143				
X ₃	4.0000	4.000	4.0000				
X ₅	1.0000	1.000	1.0000				
Ζ	12.7143	12.7143	12.7143				

The result for the linear equations is represented by the Table 3. The operational objective for this linear equation is to limit the maximum number of programs able to conduct on the next intake for semester 1, semester 5 and special program. The answers indicate that X_1 is equal to 5.7149, X_2 equal to 4 and X_3 equal to 1. These suggest that the institution able to run 5 classes of semester 1, 4 classes of semester 5, 1 class of special program and 2 classes of semester 6 which was supported in the first place.

Above results also indicate that with the available resources and the constraint the institution is capable of run total 12 classes with the new academic year with 5 new classes as semester 1. If the institution needs for more intakes, the foundation has to employ more resources.

5. Conclusion

This survey is to distinguish the usability of linear programming as a choice to enterprise resource planning in higher learning establishment. Above example shows that the linear programming is capable of providing a decision making solution to the foundation for resource planning. For the institution with low budget for putting through the enterprise resource planning system can apply the linear programming to solve today operational issues.

This survey does not appraise the other portion of the enterprise resource planning such as supply chain management and client relationship management in higher learning establishments. The issue of this survey may guide in the future to identify an alternative to the supply chain management and client relationship management.

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