End-User Training Programs Planning Model Based on Information Technology and Information Systems (IT/IS) Impact on Individual Work

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ABSTRACT

Increasing number of service and manufacturing sectors are investigating the impact of IT/IS on organizations. Also, IT training programs and their role in IS environment are being investigated. Previous studies suggested IT impact measurement for planning and assigning IT training programs. This article develop and implement an integrated model to plan IT training programs based on past IT training programs success results specially IT impacts on individual works. Data Envelopment Analysis (DEA) and integer programming techniques are used to achieve the objective of this study. The Result of implementing model showed its superiority and applicability.

Keywords: End-User, Training, IT Impact, IS, DEA, Integer Programming

1 INTRODUCTION

Growing amounts of intellectual and financial capital are being invested to collect, process, store, and disseminate information. [1] Traditionally, managers have only focused on the economic returns of IT/IS investments [2, 3]. However, many researchers believe that traditional appraisal techniques are myopic for the appraisal of complex technology investments [2, 4]. To evaluate IS success, MIS researchers have measured a variety of constructs [5-11].

DeLone and McLean's [12] model considered the most comprehensive information system assessment model available in the information system literature [13]. In original model of Delone and McLean [12], there are links between system use and individual and organizational impact. But in the updated model [14], they added a relationship between net benefits (egg. organizational and individual impacts) and use, in which based on variance view, higher use will result in higher net benefits and higher perceived net benefits will result higher system use. On the other hand, Torkzadeh et al [11]'s suggestion for using IT/IS impact on work instrument by IS managers to budget their end-user training programs is considered in this study. We introduce a model which allows organizations to budget and assign their end-user training programs based on the effectiveness of IT/IS applications and their impact on organization's personnel work.

The remaining part of the article is as follow. First literature review of the IT/IS impact on work is reviewed, then IT/IS success, and end-user training related factors and evaluation are discussed, and finally DEA technique is presented. In section 3 the proposed model and its steps are demonstrated. In section 4 conclusions and suggestion for future research are provided.

2 LITERATURE REVIEW

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2.1 IT/IS Impact on Work

Based on an exploratory study, Torkzadeh and Doll [5] recommend a 12-item instrument for measuring the impact of IT on work (see appendix A). Relying on a review of the literature in MIS, social and economic impact of IT, and white collar productivity, they defined the following impact dimensions:

- Task productivity
- Task innovation
- Customer satisfaction
- Management control

Torkzadeh and Doll [5] also reported significant correlations between the impact measures and other theoretically related constructs such as user involvement, user satisfaction, and system usage [11]. Torkzadeh et al [11] stated that "Information system managers may use these measures to more carefully budget their end-user training programs" [11, p.116].

2.2 IT/IS Success

DeLone and McLean's [12] model is considered the most comprehensive information system assessment model available in the information system literature [13]. Attempting to bring synthesis to the numerous IS success measures used over the years, DeLone and McLean proposed six dimensions representing the three levels of IS success: system quality, information quality, use, user satisfaction, individual impact, and organizational impact [15].

In their recent paper, they discuss many of the important IS success research contributions of the last decade, focusing especially on research efforts that apply, validate, challenge, and propose enhancements to the original model and propose an updated DeLone and McLean IS Success Model [14]. They stated that emergence of *End User Computing* in the mid-1980s placed IS organizations in the dual role of *information provider* (producing an information product) and *service provider* (providing support for end user developers), based on Pitt et al [16] and other researchers [17, 18] added a service quality measure to their IS success model [14]. They also stated however additional IS impact measures, such as work group impacts, inter-organizational and industry impacts being proposed. They preferred to move in the opposite direction and group all the "impact" measures into a single impact or benefit category called "net benefits." [14].

2.3 End-User Training Related Factors and Evaluation

In 1959, in a classic analysis, Donald Kirkpatrick, a pioneer training and education researcher, proposed that training programs be evaluated at four levels: reaction; learning; behavior; and result [19, 20]. Radhakanta and Vincent [19] proposed a framework for evaluating end-user training programs which has two dimensions:

- The evaluation dimension, which suggests what to evaluate, and has five levels: (1) technology; (2) reaction; (3) skill acquisition; (4) skill transfer; and (5) organizational effect.
- The evaluator dimension, which identifies the person or group responsible for doing the evaluation and has three major constituencies: (1) training providers, (2) trainees, and (3) business managers

They stated that when implementing the framework several factors need to be evaluated [19] as shown in Table 1.

Table 1: Factors to evaluate end-user training programs [19]

Evaluation level	Evaluator	Factors to evaluate
Technology	Training Provider	• Effectiveness of IT in supporting training-related tasks • Ease of use and usefulness of IT-based tools used by training providers

	Trainee	• Delivery and presentation of training materials • Ease of use and usefulness of communication tools
Reaction	Trainee	• Relevance of the course to the trainee's job • Satisfaction with course content and presentation • Quality of instruction • Effectiveness of instructor • Overall satisfaction with the training experience
Skill Acquisition	Trainee	• Knowledge and skill learned
Skill Transfer	Trainee	• Ability to apply the skill learned at work
	Manager	• Effect of the training on the trainee's performance
Organizational Effect	Manager	• Effect of the training on organizational goal achievement

Sang et al [21] developed an extended end-user training model and a detailed end-user training causal model and empirically studied the factors that are essential for successful end-user training. They found:

- The higher end-user abilities, the higher end-user IS acceptance
- The higher end-user abilities, the higher system utilization

Surprisingly, few consistent findings have resulted from empirical studies that have sought to find a direct effect between user training and acceptance or actual use of IT. Several studies showed that user training *does* influence users' skills and their acceptance of IT [23, 24]. Harrison and Rainer [25] found that user training had an effect on IT usage, but users' prior computer experience and age were more important determinants of IT acceptance and use.

2.4 Data Envelopment Analysis (DEA)

DEA is a non-parametric method that uses linear programming to calculate the efficiency in a given set of decision-making units (DMUs). In this section we only describe the DEA model used in our model. The original DEA model (e.g. BCC) is not capable of ranking efficient units.

CCR model assumes constant returns to scale (CRS). However, variable returns to scale (VRS) can be incorporated in it by appending the constraint ($el = \sum_{j=1}^{n} lj = 1$) and the resulting model is called BCC model. However, BCC model does not allow for ranking of efficient units as it assigns a common index of one to all the efficient DMUs. Therefore, this model is modified by Andersen and Petersen [26] for DEA based ranking purposes. In this study there are r outputs (Y_{rj}) and m inputs (X_{ij}) to be utilized by DEA for j = 1,…,n units or DMUs. Therefore, our original DEA model is as follows:

$$\text{Max } q$$

s.t.

$$x_{io} - \sum_{\substack{j=1 \\ j\neq 0}}^{n} l_j x_{ij} \geq 0 \qquad i = 1,2,...m$$

$$\sum_{\substack{j=1 \\ j\neq 0}}^{n} l_j y_{rj} \geq q y_{r0} \qquad r = 1,2,...s$$

$$\sum_{\substack{j=1 \\ j\neq 0}}^{n} l_j = 1$$

$$l_j \geq 0 \text{ , } j \neq 0$$

This model is an output-oriented super-efficiency model that assumes variable returns to scale and gives a full ranking of DMUs which are sub organizations in our case, here. For more information please see these [27, 28, 29, and 30].

3 THE PROPOSED MODEL

Empirical studies show that end-user training influences user acceptance of IT and IT usage [21-25]. On the other hand, IS success models imply that system use influence or impacts individuals and organizations and vice versa [12, 14]. Therefore, end-user training influences IT/IS impacts on individuals and on organization. On the other hand, as end-user training evaluation literature suggests [19], designing training programs and allocating resources to them must be done based upon the plan which considers past programs evaluation data. This idea is enforced by Torkzadeh et al [11] suggestion about using IT impact measure by managers to assign resources to different users training programs. Therefore, there is need to develop a model for using IT/IS success measures such as IT impact on work for planning and allocating end-user training programs. The proposed integrated model shown in Figure 3 is as follows:

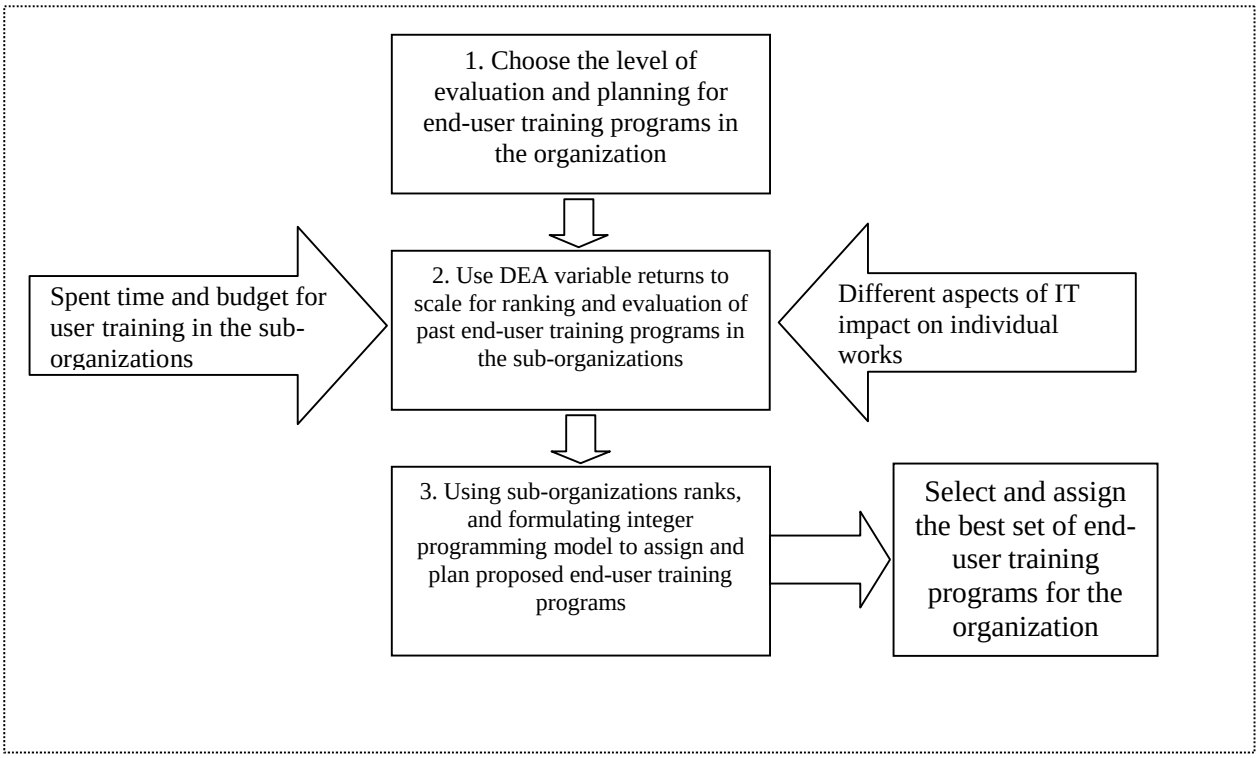

Figure 1: The proposed integrated model for planning and assigning end-user training programs in organizations

1. First, organization planners and managers must choose the level of the organization which can monitor and collect the needed information (e.g. conducted end-user training programs, assigned resources to them, etc). In most organizations, this level will be the first or second level of organizational structure.
2. In second step, the DEA output-oriented variable returns to scale must be formulated and solved to determine the sub-organizations ranks with respect to IT/IS success. Indicators such as sum of the spent time and budget for user training in the sub-organizations may be used as input indicators. IT impact on individual works instruments such as the one which was proposed and validated by Torkzadeh and Doll [5, 11] can be used as measure of IT/IS success as output indicators. But those measures are questions, and thus they must be converted to quantitative values. For this purpose, Likert-scale such as following can be used.

Table 2: Five point Likert-scale

Without impact	1
Small impact	2
Moderate impact	3
High impact	4
Very high impact	5

Then 12 item questions of IT impact on work must be distributed and collected among the sub-organizations users and according to the Likert-scale, the responses are converted, summed and averaged for each sub-organization separately.

Table 3: Responses to different aspects of questions for different sub-organizations

Output indicator or IT impact on work aspects	Response	Number of sub-organization responses					
		X (50 users)		Y (30 users)		Z (70 users)	
Customer satisfaction	Without impact	33	Sum: 405 Average: 81	24	Sum: 216 Average: 43.2	63	Sum: 501 Average: 100.2
	Small impact	45		36		66	
	Moderate impact	30		9		36	
	High impact	18		12		27	
	Very high impact	24		9		18	
Management control	With out impact	21	Sum: 492 Average: 98.4	21	Sum: 228 Average: 45.6	48	Sum: 498 Average: 99.6
	Small impact	27		24		15	
	Moderate impact	30		30		57	
	High impact	33		6		51	
	Very high impact	39		9		9	
Task innovation	With out impact	12	Sum: 555 Average: 111	27	Sum: 279 Average: 55.8	24	Sum: 762 Average: 152.4
	Small impact	15		6		27	
	Moderate impact	21		12		9	
	High impact	60		21		93	
	Very high impact	42		24		57	
Task productivity	With out impact	63	Sum: 333 Average: 66.6	6	Sum: 270 Average: 54	18	Sum: 702 Average: 140.4
	Small impact	27		36		18	
	Moderate impact	39		18		96	
	High impact	6		12		45	
	Very high impact	15		18		36	

In evaluating efficiency of the spent resources on end-user training programs in sub-organizations and their impact on individual's work, due to this fact that increase in inputs (in this case which are spent time and budget on end-user training programs) will results in variable increase in outputs (IT/IS impact on individual works) for different quantity of inputs, we selected the DEA variable returns to scale for modelling and assessment purpose. End-user training needs is not continues and by achieving to the some level, after that IT impacts on work will not increase as past. For example, consider that a sub-organization spent 50 hours and 3000$ on its end-user training program, and their users scored different aspects of IT impact on their work as 40, 30, 60, 20 in a 100 scale. If we increase the mentioned sub-organization end-user training inputs to 100 hours and $6000, then their users scored different aspects of IT impact on their work as 60, 70, 65, and 50 in a scale of 100. Increasing to 150 hours and 9000$, their users scored different aspects of IT impact on their work as 65, 75, 70, 60 in a 100 scale. Reason for using the output-oriented model is that we are seeking to determine the spent input and resources efficiency in creating IT/IS success in individual level.

3. Finally, by using sub-organizations ranks which is determined in step 2, and considering other factors in selecting and assigning end-user training programs, an integer programming model is formulated and solved to assign and plan proposed end-user training programs. In organizations, stakeholders may assign the criteria to some sub-organizations due to their role or position in organization value chain (e.g. Production department etc). Those criteria and other constraints such as budget can be applied in the following integer programming model:

$$\text{Max } Z = \sum_{i=1}^{nc}\sum_{j=1}^{np}(wr_i + wp_i)x_{ij}$$

s.t.

$$\sum_{i=1}^{nc} b_i x_{ij} \le B$$

$$\sum_{i=1}^{nc} x_{ij} \ge lb_j \qquad \forall j,\ j = 1,2,...np$$

$$x_{ij} = (0,1)$$

In which $x_{ij} = \begin{cases} 1 & \text{if the course i for sub - organization j selected} \\ 0 & \text{if the course i for sub - organization j is not selected} \end{cases}$

Also wr_i is the respected weight for course i from ranking sub-organizations and wp_i is respected weight for course i from other criteria defined by stakeholders and *lbj* is lower bound for number of courses which must be assigned to the sub-organizations *j* and *B* is the limited budget for overall IT training programs in the organization. For clarifying the proposed model, we applied model in a gas refinery discussed in the next section.

5 CONCLUSION AND RESULTS

An integrated model for planning and assigning IT training attempts in organizations based on IT impacts and productivity in sub-organizations was presented. The model is very easy to implement and compatible and is based on the end-user training planning and evaluation, IT/IS success and IT impact literature. Also, the model is easy to understand, learn and adopt in organizations. This model is provide a good tool to apply for planning end-user training programs in organization and it can be integrated with other sections of IT budget assignment such as maintenance projects, new systems developments, updating systems.

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