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Optimal Information Technology Purchase Decision: A Factor Rating Approach

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ABSTRACT

With the amount of resources dedicated to information technology (IT) expenditure today, we need to have a systematic way to assess the elusive benefit of all IT purchases. This paper proposes a modified Factor Rating approach that separates the subjective benefit assessment from objective cost-benefit analysis. Due to the advancement of computer technology, using this method, we often discover that for most users, the cheapest computer may be the optimal computer in the market today.

INTRODUCTION

IT expenditures in the United States have grow phenomenally. In the fourth quarter of 1999 alone, although the annual comparison shows that the growth of Personal Computer (PC) sales has slowed down to *only* 19%. In the US, PC markers shipped 12.6 million units (5). Even if the process is improved only marginally, the public can realize tremendous gains.

Hardware technology has advanced so much that consumers begin to realize that today's products have more capability than they actually need. Intel, for example, has recognized that graphics performance is not important to most PC users, so it proceeds to integrate 3D graphics to its 810E chip set instead of using discrete 3-D chips that have better performance (4). In terms of CPU speed, Intel's own testing shows little difference between the Pentium II and III when it comes to running most office-type programs, but the newer chips command hundreds of dollars more (14).

The sheer number of choices that are available in the market presents the first difficulty. Since component technology has allowed PCs to be "assembled" rather than massive "manufactured" (9), each company uses a wide variety of components for their products; and the permutations make product comparisons more difficult. The proper assessment of cost and benefit presents the other obstacle. Ignoring all intangible costs for the time being, costs of equipment purchasing can be defined by what the vendor charges; however, benefits are usually in the eyes of beholder. Consumers and IT managers alike often rely on product reviews of trade journals to determine the "best" products for them. Unfortunately, the so-called Editor's Choices may not be the best fit for a purchaser's unique environment. This paper focuses on alleviating these two problems. We will use PC purchasing as an example to illustrate an evaluation process that can help purchasers identify the optimal IT products.

QUALITATIVE FACTOR ANALYSIS

Qualitative Factor Analysis is used in Operations Management for comparing the desirability of multiple locations on an economic basis, particularly focusing on the relevant costs that vary from one location to another (2,5). Especially when there are no dominant or clear economic criteria available for quick decision, Factor Analysis injects values into a decision-making structure in a relatively formalized manner. Laudon & Laudon (6) use a similar approach in making IT implementation decisions. Their scoring model gives alternatives a single score based on the extent to which the alternatives meet selected objectives

This approach can also be applied to evaluate software solutions. Yerxa (10) evaluated Netscape Enterprise Server 4.0, Microsoft Internet Information Server 4.0, and Apache Software's Apache Server for *Network Computing*. Using performance, development, configuration, management, platform support, and stability as decision criteria, his results are summarized in Table 1.

Both models are helpful to decision makers, but they either ignore the cost or include the cost as one of the factors to produce one single value. While one single value makes decision making easier, it masks the interactions of cost and benefit. In the next section we will introduce a procedure to incorporate a modified factor rating methodology to evaluate PCs.

A FACTOR RATING APPROACH TO PC PURCHASING DECISION

Although features do not equate benefit, features (i.e., computer components) do generate different degree of benefit for users. The

Table 1: Network computing's evaluation of Web servers

Feature	Weight	Netscape Enterprise Server 4.0		Microsoft Internet Information Server 4.0		Apache Software Apache Server 1.3.9	
Performance	0.30	4	1.20	5	1.50	3	0.90
Development	0.20	3.8	0.76	4.2	0.84	4.2	0.84
Configuration	0.15	5	0.75	4	0.60	4	0.60
Management	0.15	4	0.60	5	0.75	4	0.60
Platform support	0.10	5	0.50	2	0.20	5	0.50
Stability	0.10	4	0.40	2	0.20	5	0.50
Final score			4.21		4.09		3.94

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value of the factor rating process is that the purchaser is able to selectively assemble a set of computer components based upon an individualized benefit value. For example, for a liberal arts student majoring in English an entry level PC will be sufficient. On the other hand, an MIS student will require a faster computer to do homework.

Our proposed process includes the following steps:

(1) Assign weight to each component of the system according to the perceived importance by the purchaser. The sum of all the individual weights should be 100(%).
(2) Assign benefit points, ranging from 0 to 100, for each alternative presented in each component categories. It is acceptable for multiple alternatives to receive the same benefit points.
(3) Calculate the weighted average for benefit scores.
(4) Use the price of the system as the cost and the result in (3) as benefit and construct the cost-benefit Chart.

Thus, this approach includes the price as a separate factor and allows us to create a two-dimensional chart for cost-benefit analysis. Below we will use a limited system that contains only CPU, RAM, hard drive, and monitor for a simplified demonstration.

- System 1: Athlon 1.2 GHz CPU, 128 MB RAM, 40 GB hard disk, and 19” monitor. Cost: $1700.
- System 2: Athlon 1 GHz CPU, 128 MB RAM, 30 GB hard disk, and 17” monitor. Cost: $1200.
- System 3: Athlon 800 MHz CPU, 64 MB RAM, 20 GB hard disk, and 15” monitor. Cost: $900.

Suppose we are purchasing for business school students who live in dorms, we first need to know how these students use their computers. It will be necessary to conduct interviews or surveys to determine the usage patterns and the perceived importance for each component and any alternatives. A possible scenario of weight and benefit assignment is shown in Table 2.

Note that the most expensive features may not receive the highest benefit scores, and a “lesser” alternative may have equal or even higher benefit to a user. For example, even the best of the soundcard may score a zero if the computer is purchased for a computer lab where no speakers or earphones are allowed.

OPTIMAL PURCHASING DECISION ANALYSIS

Depending on the level of sophistication needed, decision makers may devise means such as total benefit points, cost per benefit points, to analyze Table 2. The importance is that a relatively subjective decision is now quantified. In the next section we will elaborate the use of graphical Analysis.

Table 2: Prospective PC systems

Components and Alternatives	Weight	Benefit Points	System 1	System 2	System3
CPU	35%				
Athlon 1.2 GHz		100	35.0		
Athlon 1 GHz		100		35.0	
Athlon 800 MHz		90			27.5
RAM	10%				
128 MB		100	10.0	10.0	
64 MB		80			8.0
Hard Disk	30%				
40 GB		100	30.0		
30 GB		100		30.0	
20 GB		90			27.0
Monitor	25%				
19”		70	17.5		
17”		100		25.0	
15”		80			20.0
Weighted Benefit Points			92.5	100.0	82.5
Price			$1700.00	$1200.00	$950.00
Cost per Benefit Point			$18.38	$12.00	$11.52

GRAPHICAL (PARETO CHART) ANALYSIS

By using price as x-axis and benefit points as y-axis, we can develop a benefit-cost diagram. Fundamentally, we will be looking at the northwest corner (highest benefit with the lowest cost) for our better choices.

A Pareto diagram is a special type of vertical bar chart in which categorized responses are plotted in descending rank order of their frequencies and combined with a cumulative polygon on the same scale. Studies on the Pareto Principle (also known as the 80/20 Rule) use a modified Pareto Curve that aggregates items of the same number of usage into subgroups and then shows only the subtotal of that group (3). For example, the price data (from http://www.xtechnology.com) of AMD’s Athlon CPU chips we can generate a Pareto Curve in Figure 1. A similar chart created about two months earlier showed a much shorter linear section, implying that chips with higher speed demanded a premium back then.

If the full price reflects the full benefit, then there is a small fraction of expenditure that represents the major portion of benefit. The mission then, is to identify this optimal point. Recall that in microeconomics, to maximize total profit, the optimal production level is where marginal revenue equals marginal cost, MR=MC (8), we should choose the alternative that is at the point where slope equals to 1.

Unfortunately, the x-y chart never yielded a perfect Pareto diagram; but if we construct the x-y chart using (0,0) as the origin, it may surprise us that often the new diagram does show a pattern similar to a Pareto chart and indicates that the cheapest computer is the optimal choice today! Instead of requiring this x-y chart to be a tool for selecting the “best” computer for the money, we may use to eliminate “worst” choices and provides a short list for decision makers.

The advantages of using this optimal purchasing heuristics are described below:

- Separate Subjective from Objective Processes. The assignment of weight and benefit scores is where the expertise and subjective needs of decision makers are captured. Beyond that, the work can be delegated to assistants to calculate measurements described in Section 3.
- Allows Automation: Any structured decision making process can be automated. The weight and benefit scores can be incorporated into a spreadsheet to simply calculation.
  - Simplify Committee Work: Though without formal quantitative analysis, our experiments with students show that the weight and benefit scores assigned by a committee is relatively close to the averages of those assigned by individual committee members. This result implies a more efficient way to generate “consensus” of a group in making IT purchasing decisions.

CONCLUSION

Operational definition is used to quantify qualitative attributes, and Qualitative Factor Rating method has been used to quantify site selection decisions for decades. In this paper we propose improvements that (1) separate cost from benefit quantification to allow a two dimensional graphical analysis, specifically allow the application of Pareto Principle, and (2) separate subjective view of “benefit” from a relatively objective “cost” that at least allow a part of process to be delegated to assistants.

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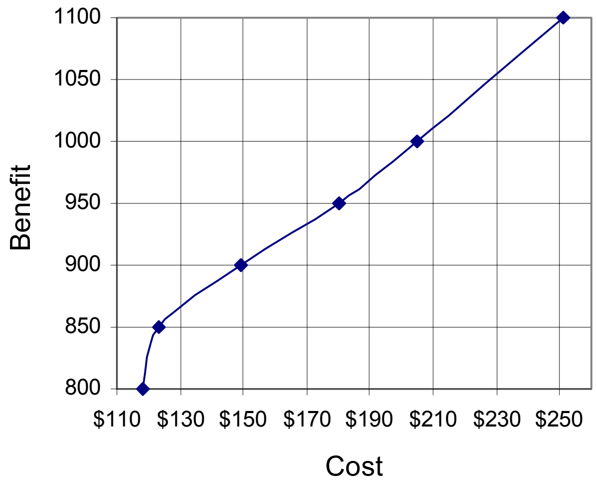
Figure 1: Pareto curve for Athlon Chip pricing



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