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Linking the benchmarking tool to a knowledge-based system for performance improvement

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ABSTRACT

In this work, a knowledge-based system for the benchmarking of public university libraries was developed in order to provide more useful information for decision-making and process benchmarking. This knowledge-based system converts numerical data into information that can be used to evaluate relative efficiency of public university libraries in Taiwan. We propose an integrated framework for the benchmarking wheel and knowledge-based system, including a database management subsystem, model base subsystem, knowledge acquisition subsystem, and dialogue subsystem. In the model-base, we use the DEA models, including the CCR and BCC models, in order to shed new light on the operational efficiency of public libraries in Taiwan. Finally, we provide strategies for improving inefficient public university libraries.

1. Introduction

The goals of a public or academic library are to aid students and teachers, and to provide research for academic research. A library can accomplish these goals by providing functional services, such as data searching in library databases. In response to the rapid changes in information technology and to better meet the needs of users, more and more libraries are providing E-library services. Traditional library services offered to users are based on existing print collections. But to meet the needs of students and teachers, public university libraries need to improve their performance. Many tools and techniques could be used to improve the performance and effectiveness of public libraries, and benchmarking is a very versatile tool that can be applied in a variety of ways to meet a range of requirements for improvement.

In recent years, many reports in the literature have proposed approaches that libraries or firms can use to improve their performance. One of these approaches is benchmarking, and several studies have focused on its theory and implementation, including those by Laeven and Smit (2003), Ruthven and Magnay (2002), Favret (2000), and Loessner (1999). Another approach is to use DEA models, and several have been proposed by Wang, Lu, and Chen (2008), Anderson, Daim, and Lavoie (2008), Shim (2003), Kao and Liu (2000), Chen (1997a, 1997b, 1997c). A third approach is to adopt decision support systems or knowledge-based systems, several of which have been proposed by Gleeson and Ottensmann (1994), Ottensmann and Gleeson (1993), Dubey (1984), and Chorba and Bommer (1983).

Shim (2003) applied an analytical technique called Data Envelopment Analysis (DEA) to calculate the relative technical efficiency of ninety-five academic research libraries that are members of the Association of Research Libraries. Kao and Liu (2000) adopted the concept of a membership function used in fuzzy set theory to represent imprecise data with missing data, and discussed an application to university libraries in Taiwan. Chen (1997a, 1997b, 1997c) employed a DEA model to evaluate the relative performance of 23 university and college libraries in Taipei. University libraries need to be productive so that they can provide better service under certain constraints and attract more readers. Given these circumstances, the DEA model is a mathematical model especially suitable for application to non-profit institutions like university libraries. Ottensmann and Gleeson (1993) developed a decision support system (DSS) to assist budgeting for acquiring public library materials and other areas of library management decision making. But no similar studies on benchmarking and DEA models for public university libraries have yet been done.

Because of the complexity and importance of benchmarking for public university libraries, decision support systems or knowledge-based systems are frequently used as tools to support

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decision-making. Decision support systems are computer-based tools that aid managerial decision-making by presenting various effective alternatives. Since the 1990s, knowledge-based intelligent systems have been playing an important role as decision support tools. Thus, in this study, a knowledge-based system for the benchmarking of public university libraries was developed in order to provide more useful information for decision-making. A case study was carried out to verify the effectiveness of the system and illustrate its use. Our KBS can be used as a tool to improve the efficiency and performance of public university libraries.

The rest of the paper is organized as follows: Section 2 briefly reviews the literature on benchmarking and knowledge-based systems. Section 3 describes the architecture of our knowledge-based system for process benchmarking. Section 4 presents the system implementation and results of empirical analysis. Finally, some concluding remarks and a summary are given in Section 5.

2. Benchmarking

2.1. Benchmarking for libraries

Benchmarking is "a process of measuring and comparing to identify ways to improve processes and achieve higher performance" (Keehley, Medlin, MacBride, & Longmire, 1997). Xerox Corporation first adopted benchmarking in the late 1970s. Since then, managers in different industries have used it to evaluate and improve the quality of their products, as well as work processes and work procedures. Benchmarking is a very versatile tool that can be applied in a variety of ways to meet a range of requirements for improvement. Benchmarking allows an organization to objectively and thoroughly evaluate its processes to see if and how they can be improved (Kline, 2003).

Juran (1994) suggested that a benchmark is a point of reference from which measurements and comparisons of any sort may be made. Elmuti, Kathawala, and Lloyed (1997) divided the benchmarking types into four different types, including internal benchmarking, competitive benchmarking, functional or industry benchmarking, and process or generic benchmarking. Process benchmarking is used when the focus is on improving specific critical processes and operations. Benchmarking partners are sought from the best practice organizations that perform similar work or deliver similar services. Process benchmarking invariably involves producing process maps to facilitate comparison and analysis. This type of benchmarking can result in benefits in the short term.

Benchmarking is the practice of being humble enough to admit that someone else is better at something, and being wise enough to learn how to match and even surpass them at it. For some companies and organizations, benchmarking is synonymous with survival. It provides them with a way to assess their business performance. Through benchmarking, they gain a better understanding of their relative position in their industry. Benchmarking works because it helps them to understand their own processes and enables them to learn from others.

Benchmarking also equals innovation. Real innovation comes from looking for the best examples outside one's industry. This enables one to learn from other companies and achieve quantum leaps in performance that otherwise might take years to achieve. The purpose of a benchmarking process model is to describe the steps that should be performed when conducting a benchmarking study (Watson, 1993). Consequently, numerous studies about benchmarking processes have been done, such as Spendolini (1992), Young (1993), Anderson (1995), Anderson and Pettersen (1996), Atkin and Brooks (2000), Hacker and Kleiner (2000), Gohlke (2001).

In those descriptions of benchmarking process, Spendolini (1992) divided the benchmarking process into five phases: (1) determine what to benchmark; (2) form a benchmarking team; (3) identify benchmarking partners; (4) collect and analyze benchmarking information; and (5) take action. Young (1993) identified four steps in the benchmarking process: (1) planning; (2) analysis; (3) integration; and (4) action. Anderson and Pettersen (1996) identified five distinct phases: (1) planning; (2) searching; (3) observation; (4) analysis; and (5) adaptation. Atkin and Brooks (2000) identified the benchmarking steps: (1) identify the subject of the exercise; (2) decide what to measure; (3) identify who to benchmark both within your sector and outside; (4) collect information and data; (5) analyze findings and determine gap; (6) set goals for improvement; (7) implement new order; and (8) monitor the process of improvement. Hacker and Kleiner (2000) proposed 12 steps to avoid dysfunctional practices and improve benchmarking. The 12 steps are: (1) determine what to benchmark; (2) identify key performance indicators; (3) identify benchmarking partners; (4) determine the data collection method; (5) collect data; (6) understand performance gaps; (7) predict future performance levels; (8) communicate findings and gain acceptance; (9) establish functional goals and implementation plans; (10) implement and monitor progress; (11) measure results against stakeholder wants and needs; (12) recalibrate benchmarks. Gohlke (2001) used a library benchmarking model to improve the performance of public libraries. It includes five steps: (1) conducting a preliminary analysis; (2) developing process measures; (3) identifying partners; (4) collecting and analyzing data; and (5) presenting results to management.

Nevertheless, a benchmarking wheel is a benchmarking process model that synthesizes advantages of a large number of existing benchmarking models (Anderson, 1995). Therefore, the author focuses on a study using the benchmarking wheel to study the benchmarking process. A benchmarking wheel, as Anderson (1995) presented, is shown in Fig. 1. The benchmarking processes are described as follows:

Step 1. Plan:
- (1) Determine the process to benchmark based on the organization's critical success factors.
- (2) Understand and document the process.
- (3) Measure the performance of the process.

Step 2. Find:
- (4) Identify benchmarking partners.

Step 3. Collect:
- (5) Understand and document the benchmarking partners' performance and practice.

Step 4. Analyze:
- (6) Identify gaps in performance and the root causes of the gaps.

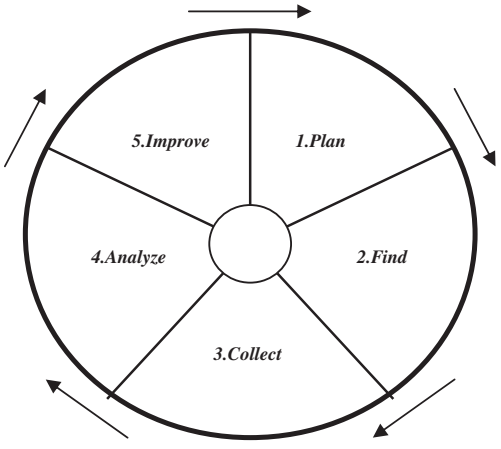

Fig. 1. A benchmarking wheel.