



An AHP approach in benchmarking logistics performance of the postal industry

Felix T.S. Chan and H.K. Chan

*Department of Industrial and Manufacturing Systems Engineering,
University of Hong Kong, Hong Kong, People's Republic of China*

Henry C.W. Lau

*Department of Industrial Systems Engineering, Hong Kong Polytechnic
University, Hung Hom, Hong Kong, People's Republic of China, and*

Ralph W.L. Ip

*Department of Manufacturing Engineering and Engineering Management,
City University of Hong Kong, Kowloon Tong, Hong Kong,
People's Republic of China*

Abstract

Purpose – To develop a new benchmarking process for continuous improvement against the market leader, and report a case study in the postal industry by employing the proposed benchmarking process.

Design/methodology/approach – A double AHP methodology is developed in this paper to divide benchmarking process into two main parts: performance evaluation and continuous improvement. Both qualitative and quantitative factors have been taken into consideration. The first phase aims at evaluation of the performance of the benchmarked company and its competitors. The second phase aims at finding the best practice from a list of improvement alternatives based on the first phase.

Findings – The proposed framework can evaluate the performance of the case company against its competitors. It can also help the company to select the best improvement alternative for implementation in order to enhance its performance on the weakest measures.

Originality/value – The proposed benchmarking process in this paper can help the case company to identify its weaknesses and then select the best improvement alternative in order to improve its performance against the market leader. Although the postal industry is used to demonstrate the proposed framework, it can be applied to other industries with a little modification.

Keywords Benchmarking, Analytical hierarchy process, Postal services

Paper type Research paper



1. Introduction

Postal service plays a significant role in the development as a leading commercial and financial region, providing communications between individuals, business and government. In the past, the postal industry used to involve physical transportation of physical communication, like package and mail delivery (Grünert and Sebastian, 2000). However, the industry has evolved to include traditional post, courier services, freight services and e-services in recent years. Emerging technology based on the convergence

of telecommunications, broadcasting and publishing has and will continue to change the landscape of physical communications globally. Therefore, postal organizations nowadays, be they large or small, are faced with the challenge of new technologies; with operating in the same way as private corporations, understanding what products are profitable and which are not, and dealing with almost constant change. Postal organizations need to change in the face of deregulation and private/postal competition to become competitive, market-oriented and customer-driven. In the global environment, price is obvious not the only determinant of the postal industry (Gouvêa *et al.*, 2001). Qualitative factors, however, have also been included in several studies (Bard *et al.*, 2003).

Taking Hong Kong as an example, The Hongkong Post is the first postal service provider in Hong Kong since 1841. During the past decade, the growth rate of annual postal volume has been dramatically increased by 52.5 percent with the rapid development of business and financial activities. Although after the financial crisis in 1997 the rate of increase became less promising, the total volume maintained at a steady growth rate. Thus, the postal service provider should be more competitive and providing higher quality service at a competitive price. This benefits commercial, financial and other industries so as to promote Hong Kong in global market. The companies in this case study are Hong Kong-based companies which provide various postal services.

As the potential market and sales volume in the postal industry is very large, a benchmarking process needs to be carried out to increase the service level of the industry. Postal companies around the world have been seeking methods to support their operational practices in order to keep or increase their market share (Borenstein *et al.*, 2004). In fact, benchmarking can be used as a quality improvement tool to increase the competitiveness of the postal industry. It can enable postal service provider to find out its current position among its competitors and the performance gap. Analytic Hierarchy Process (AHP) based methodology is employed to support the whole benchmarking process. A double AHP approach has an advantage of separating benchmarking process into two main phases. The first phase is to measure the performance levels of the company to be benchmarked and its competitors. AHP can facilitate the complex measurement system into hierarchy of criteria, so as to give a clear view on performance levels with respect to each individual criterion for the postal companies. For the second phase, selection of improvement alternative can be done by AHP so that each criterion can be considered one by one to find out the optimal solution.

Although AHP allows both qualitative and quantitative attributes to be included, the measurement of qualitative attributes may be different for various postal companies. Therefore, a measuring system is defined for all the qualitative and quantitative attributes to ensure consistent judgment. Below is the outline of this paper. Section 2 provides literature review in the concept and methodology of benchmarking. Moreover, the application of AHP in benchmarking will be reviewed. The methodology used in this paper will be explained in Section 3, following by the framework for the first and second phases of the AHP in Sections 4 and 5, respectively. Application of the postal company will be demonstrated in Section 6 and finally conclusion will be given in Section 7.

2. Literature review

It is commonly believed that benchmarking can be widely used as a key element of continuous improvement, therefore large number of leading companies such as Xerox and Kodak (Bhutta and Huq, 1999) found that it is useful to enhance their performance to identify areas which are necessary to be improved. Most researches are focused on the manufacturing industry. According to Zairi and Whymark (2000b), Xerox carried out a competitive benchmarking with Japanese companies selling printer because it realized that its market share is eroded by them. Finally, it could successfully find a strategy to regain its market share by learning from its direct competitors. Since then, benchmarking has been widely used, especially in manufacturing sectors. However, benchmarking is not only confined to manufacturing sector; according to Smith (2000), service sector can also be beneficial using consumer benchmarking to increase competitiveness. It should be expanded to service industry as customer-oriented is increasingly concerned nowadays. For example, international roaming service (Chin *et al.*, 2001), hotel service (Min and Min, 1996) had applied benchmarking to improve the performance in the particular service industry.

Benchmarking has been carried out by various methodologies. Malcolm Baldrige National Quality Award (MBNQA) (Evans, 1996) addresses all aspects of competitive performance in an integrated and balanced way and forms a basic sequence of managerial processes towards total quality management. According to Lobo and Zairi (1999), competitive benchmarking has been conducted in the air cargo industry among nine competitors. The areas applied for benchmarking were based on the MBNQA and benchmarking analysis focuses on quality management and service excellence aspects. Zairi and Whymark (2000a) use total quality management as a basis for benchmarking Royal Mail in the UK. The methodology applied was based on plan-do-check-act cycle. Good practices have been used to vet against basic criteria so as to perform pre-screening to identify the best practice. Moreover, a measuring system is carried out to evaluate the benefits from the good practice. TQM is another useful methodology in benchmarking for both manufacturing and service sectors (Sinclair and Zairi, 1995). It fundamentally offers reliance on factual data that can make management processes towards the goal of customer satisfaction. Landeghem and Persoons (2001) use causal model to benchmark the logistical operations. The model is composed of four main logistics objectives and relates the use of best practices to the resulting performance regarding the objectives. Based on the casual model, a framework of logistic audit is provided to compare logistics performances. Using the resulting score, gaps can be detected which in turn trigger action deduced from the best practice score.

Although some researches used benchmarking as a tool to improve the quality of product or service, only a few could work with a particular service industry. Most often, they discussed the methodology of benchmarking using some approaches such as total quality management (Sinclair and Zairi, 1995), casual model (Landeghem and Persoons, 2001), which cannot provide a consistent measuring system, thus result may be biased by personal judgment.

AHP is a problem-solving framework and flexible, systematic method employed to represent the elements of a complex problem. It is based on the three principles: decomposition, comparative judgment and synthesis of priorities (Korpela and Tuominen, 1996). The general structure of AHP is shown in Figure 1. The characteristic of AHP is allowing both qualitative and quantitative attributes to be

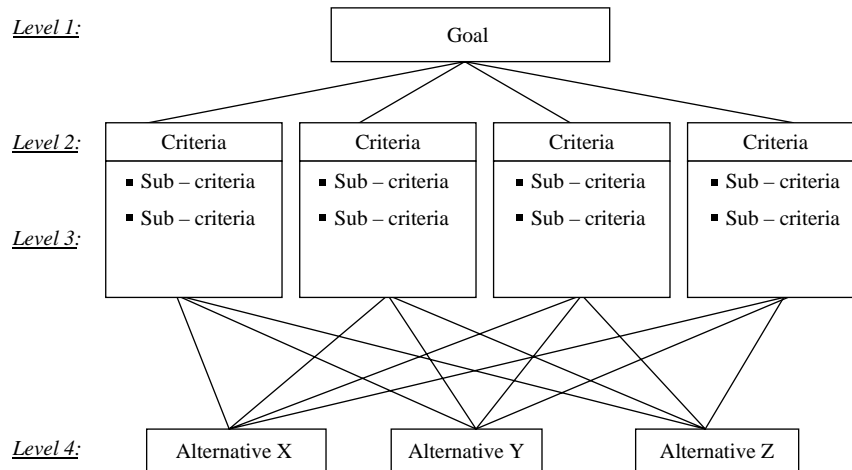


Figure 1.
General structure of AHP

included to carry out evaluation. For each sub-criterion, ratings are necessary to provide a basis and ease for the comparison of the performance of a large number of companies to be evaluated. The priorities of criteria and sub-criteria are synthesized to establish the overall priorities for decision alternatives.

AHP is a theory of measurement for dealing with tangible and intangible factors. It has been extensively used for selection process such as bank selection decision (Ta and Har, 2000), flexible manufacturing systems models selection (Hasin and Bohez, 1994), and evaluation and selection of simulation software (Davis and Williams, 1994). According to Korpela *et al.* (2001), they demonstrate the potential of AHP in supply chain development. Korpela and Tuominen (1996) demonstrate the use of AHP to support logistics strategic management. The AHP-based approach is explained to identify and prioritize logistics critical success factors (CSF) so as to evaluate the performance levels. Consequently, competitive advantage and disadvantage can then be highlighted for continuous improvement. AHP can provide a framework for competitive benchmarking of hotel service (Min and Min, 1996). It synthesizes the hotel customers' judgments for both qualitative and quantitative attributes into an overall quality measure of each hotel. Principal competitors of hotel to be benchmarked and performance gap can be easily obtained by using AHP.

This paper aims to provide a complete framework for benchmarking logistics performance of postal industry in Hong Kong, so that CSF can be identified. Based on these CSF, their performance can be measured and evaluated against the best-in-class company so as to find out their competitive advantage and disadvantage. Learning from the leading company, they can select the best practice that is most suitable for their improvement. This paper is based on benchmarking logistics operation using AHP. The focus is to ensure a comprehensive study of how the logistics performance of postal service is benchmarked using a consistent measuring system.

3. Research methodology

Recently, many postal service providers have extended their scope of business in order to secure more sources of income and increase resources utilization. Bill payment is an

example of the value-added services. In this research, the main focus is the logistics operation of core services, which can generate a large proportion of revenue. Therefore, it is assumed that the postal companies are offering local and overseas of mail and parcel services, accordingly, the attributes used in the AHP are also based on this content. Figure 2 shows a general logistics flow of postal industry.

As mentioned in previous section, the development of the benchmarking framework is based on AHP. Benchmarking is a complex decision problem, which can be broken down into hierarchy. The principle of the proposed methodology is basically a double AHP method. The first phase of the AHP is devoted to performance evaluation between the company and several competitors. The company to be benchmarked and its competitors would become the alternatives in the AHP structure as shown at the level 4 in Figure 1. Their total scores would be evaluated by the performance criteria defined. Results in the first phase cannot only provide the benchmarked company about its performance relative to its competitors in the industry, best practices can be learned from the industrial leader and this will form the basis of second phase of the AHP. Without the input from the first phase, contribution from the second phase is impossible. This is also one of the contributions of the proposed benchmarking process.

Most of the benchmarking methodologies only provide an insight how well a company in the industry relative to its competitors. Not much literature discusses how

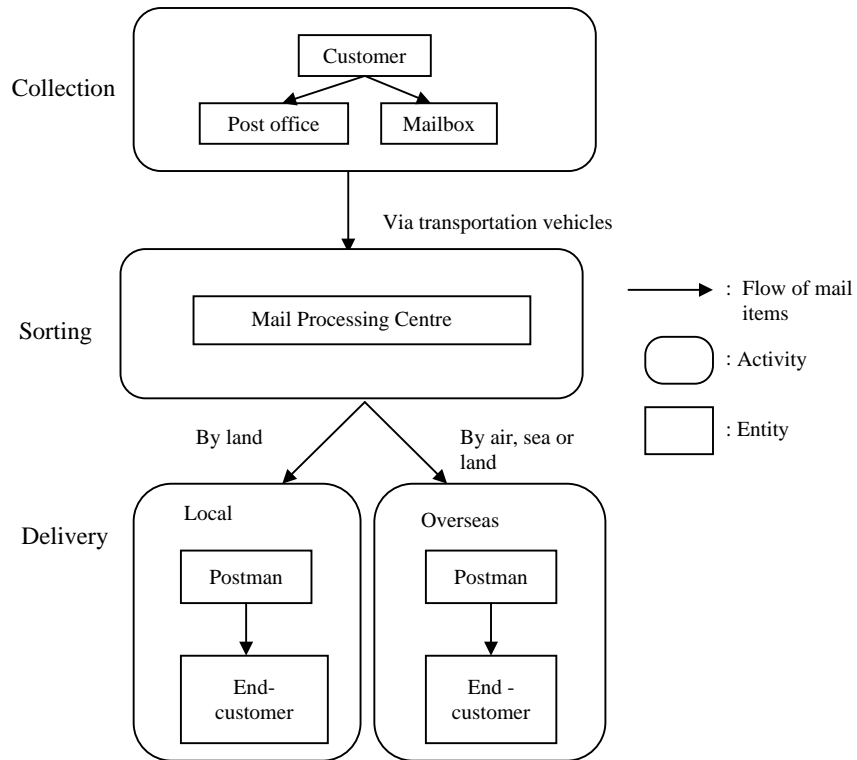


Figure 2.
Flow of mail items in
logistics operation

to improve a company's performance based on the benchmarking result. The goal of the second phase is to achieve continuous improvement by selection of the best practice, which is learned from the market leader from the first phase of the proposed benchmarking process. Some criteria and sub-criteria will be defined into hierarchy in order to select the best practice, which is the most suitable one for the benchmarked company for implementation in order to enhance its performance.

In short, following the proposed benchmarking process, a company can learn who the market leader is, and what can be learnt from the market leader in order to improve the performance of the company. The following sub-sections describe the framework of the first and second phase of the proposed process in more details.

3.1 Framework of the first phase – performance evaluation

As outlined in the Section 2, a complex problem in AHP is first decomposed into criteria and sub-criteria. For the first phase of AHP, performance evaluation is broken down into a various kinds of criteria (level 2) and sub-criteria (level 3) in Figure 1. Then, a pairwise comparison among criteria within the same level and among sub-criteria within the same level should be carried out to obtain their relative weights before performance evaluation. Finally, their relative weights are synthesized to get the overall scores of the performance levels for each company.

Most often, priorities of criteria and sub-criteria are derived by using questionnaires based on a pairwise comparison with respect to the goal using a nine-point scale. The template of questionnaire on the relative weights of criteria (level 2) respect to the goal for the first phase of AHP is based on the pairwise comparison between reliability and other criteria within the same level only, so further pairwise comparisons are necessary to obtain the relative weights of the remaining criteria. Consistency ratio (CR) is used to indicate the consistency of pairwise comparison and less than 0.1 is acceptable. A commercial software, called expert choice, provides the calculation of priorities and CR from the results of questionnaire. Figure 3 shows an example of the graphic interface of the first phase of AHP performance evaluation.

The overview of the definitions of each criteria and sub-criteria is given in Table I. It is mainly divided into eight criteria: reliability, lead time, convenience, flexibility, cost, return on assets, relationship, and innovativeness. For each criterion, it is further decomposed into sub-criteria. The performance level of the benchmarked company and its competitors are measured against the criteria and sub-criteria as defined in order to find out the best-in-class company. The definitions of all criteria and sub-criteria are explained as listed in the table to increase awareness and knowledge of readers and potential users. Their understanding can facilitate them to obtain relevant information during benchmarking process; thus a more effective group interaction leads to an optimal decision. A brief description on how the criteria affect a company is listed as follows.

3.1.1 Reliability. Poor reliability can definitely decrease customer satisfaction and their repeat consumption in both short- and long-term. It may also damage the image of the company from customer point of view and even reduce the sales revenue.

3.1.2 Lead time. Short lead time is an advantage for both customer and logistics company. Customers are not necessary to make a prompt delivery decision. For postal company, it can be viewed as a feature distinguished from other competitors, hence promoting sales and image. As the entire operation is carried out in mass production

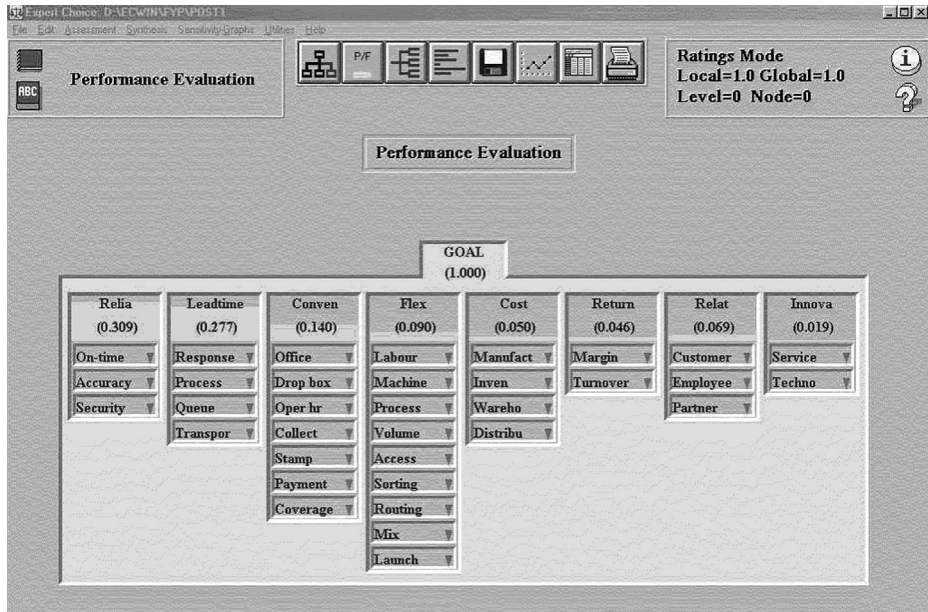


Figure 3.
Performance evaluation
(first phase of AHP) –
expert choice display

and difficult to trace the time used in all steps by a particular item, so the lead time of each batch of item will be used.

3.1.3 Convenience. Both customer and postal company can be beneficial from high degree of convenience. Customers can obtain postal service within an easy reach that leads to high satisfaction. In this connection, postal company can attract more sales. Usually, high level of convenience enhances the customer relationship indirectly. In a long-term, satisfactory sales performance and excellent image may result from the high level of convenience.

3.1.4 Flexibility. According to Vickery *et al.* (1999), flexibility has a close relationship with environmental uncertainty, overall firm performance and functional interfaces; therefore it should be understood by managers and all employees of company when making decision in all aspects.

3.1.5 Cost. Needless to say, lower cost of production can enhance their competitiveness and organization should have an abundant amount of capital for continuous operation. Measurement is based on the ability to provide an adequate sum of capital for continuous operation.

3.1.6 Return on assets. This is a specific way of investigation cost (Landeghem and Persoons, 2001). Efficiency in utilizing assets can enhance productivity at a competitive price and quality. Therefore, it can attract more sales. Since it is operating at optimum cost of production resulting from economies of scale, the profit earned would be increased for a considerable level of sales.

3.1.7 Relationship. Relationships must be established because it has a direct effect on performance. Indirect measurement is used, which is based on the effect produced by their corresponding relationships.

Criteria	Definition of criteria	Sub-criteria	Definition of sub-criteria
Reliability	The ability to deliver the item to the correct destination on or before the target schedule and the item is retained to its original form and shape	On-time delivery Accuracy Security	Percentage of items delivered on or before the target schedule Percentage of items delivered to the right destination without lost Percentage of items delivered in original form and shape
Lead time	Time interval between the customer placing the item and the corresponding delivery to the destination	Customer response time Processing time Queuing time Transportation time	The amount of time between the placing of item at drop box or service counter and its corresponding processing The amount of time required for the processing of the item after its receipt but before its corresponding delivery The total amount of time of the item waiting at one place for the next processing step to another The time interval required for delivering the item to the target destination from the processing centre The average number of post offices available per each district
Convenience	Ease of reach of service by customer	Post office Drop box Operating hours Item collection Stamp selling Payment method Delivery coverage Labor	The average number of post offices available per each district The average number of drop boxes available (both situated inside and outside post office) per each district The average number of operating hours per working day The average frequency of item collection per working day from customer at service counter and drop box The number of location (including shops and machines) available for selling stamp per each district The number of payment method available The number of destination available for posting The number of various tasks a labor can perform
Flexibility	Ability of an organization to effectively adapt or respond to change		

(continued)

Table I.
Definition of criteria and sub-criteria for performance evaluation (first phase of AHP)

Table I.

Criteria	Definition of criteria	Sub-criteria	Definition of sub-criteria
Cost	All the expenditures on the whole operations of organization	Machine	The various types of operation that a machine can perform without requiring excessive operation changeover costs and/or times
		Process	The number of services that can be simultaneously be processed
		Volume	Percentage change in the production volume, which the system can operate profitably in response to customer demand effectively
		Access	Percentage change in the sales after modification of the service coverage (including distribution coverage of mail item and access service coverage offered to customers)
		Sorting	The number of sorting plans that system can accommodate without incurring excessive cost and/or time
		Delivery routing	Percentage of delivery time that can be reduced
		Mix	The number of services available to meet customer specifications
		Launch	The number of new types of service that can be introduced every year
		Manufacturing cost	Re-work cost, operating cost, and maintenance of machinery and equipment as well as salary of employee
		Item carrying cost	Expense on the movement item from one place to another during processing
Storage cost	Cost for the storage and allocation of item within the warehouse during processing		
Distribution cost	Cost associated with delivery activities, including transportation, handling and safety measures		

(continued)

Criteria	Definition of criteria	Sub-criteria	Definition of sub-criteria
Return on assets	Ability of organization to utilize its existing assets to generate production and make profit	Product of operation margin	Percentage of net profit to sales
Relationship	Creditability and degree of friendly with customers, employees and partners	Total asset utilization or turnover Customer Employee Partner	Percentage of sales to the total assets of the company owned Percentage change in the number of customer complaints registered A measure of job satisfaction of employee Percentage of late, wrong, damaged or lost delivery to the next tier Percentage of sales of new services to the total sales
Innovative-ness	Any practices, methods or elements that can be added to the existing operations with the purpose of improving the current performance level	New launch of services New launch of technology	Percentage of reduction in time required for producing the same type of service or percentage of reduction in cost required for producing the same type of service

Table I.

3.1.8 Innovativeness. The requirement of customer is continuously changing. Keen competition and pressure on profit margin continuously require innovativeness.

According to Table II, various types of rating are established to describe the level of sub-criteria. Data collection is relatively easy and accessible owing to the nature of quantitiveness. Managers can judge the performance of the criteria in a direct way. Since qualitative attributes may be difficult and inconsistent, evaluation standards on these qualitative measures are shown on the last column of Table II to show how performance can be evaluated more consistently.

3.2 Framework of the second phase – selection of improvement alternatives

In the second phase, seven criteria will be examined: improvement, cost, time, capability, integration, willingness, and constraint. Similar to first phase, each criterion is further decomposed into sub-criteria. To close performance gap, good practices should be learnt from the leading company. These practices become the alternatives to be evaluated. The best practice will be selected by evaluating with the criteria in levels 2 and 3 as shown in Figure 1. Ratings are established for criteria and sub-criteria. Similar to the first phase, the measurement of quantitative criteria is relatively easy and accessible. The definitions and measurement of each criterion is explained below to improve understanding of readers and potential users. This can enable them to obtain relevant information during selection process. Thus, a more effective group interaction leads to an optimal solution (i.e. best practice).

3.2.1 Improvement. Absolutely, improvement of the alternative is a big concern because it is the objective of benchmarking. Degree of improvement reveals how much the alternative can help and its suitability to improve the situation. A suitable alternative should make a significant improvement within a short period to give a high effectiveness.

3.2.2 Cost. Cost must be considered for both long and short-terms operation. In short-term, cost of the alternative is important in terms of improving the existing situation only. Long-term operation of the alternative may affect the future strategy and development.

3.2.3 Time. Absolutely, time must be considered since more cost is involved if more time is spent. Time is also important to reveal the degree of improvement since dynamic environment may reduce its effectiveness.

3.2.4 Capability. It is defined as the capability of postal company to manage and monitor the alternative so as to achieve the improvement. It is essential since even the alternative itself is very effective, if the company does not have any knowledge and technique to operate the alternative, it cannot maximize its contribution towards the improvement.

3.2.5 Integration with the existing system. Clearly, integration must have a direct influence on the performance of alternative because service level is determined by the overall performance of the system (existing activities and alternative) and each activity in the system is mutually affected.

3.2.6 Willingness. It refers to the degree of willingness to accept the alternative with the belief of improving the corresponding sub-criteria. If people are in favor of the alternative, its preparation and implementation will be more efficient and effective. The importance of their willingness depends on the nature of weakness and alternative. For example, a new post office will be opened, customer's willingness is relatively important because it can provide better convenience.

Criteria	Sub-criteria	Rating	Evaluation standard
Reliability	On-time delivery	> 99 percent	Total number of items delivered on or before target schedule/total number of items handled × 100 percent
		97-99 percent	
	Accuracy	95-97 percent 93-95 percent < 93 percent	Total number of items delivered to the right destination/total number of items handled × 100 percent
Lead time	Customer response time	Too long	Total number of items delivered in the original form and shape/total number of items handled × 100 percent (Actual time – standard time)/standard time × 100 percent
		Long	
		Acceptable long Reasonably short Short	
Convenience	Processing time Queuing time Transportation time Post office	Very high degree	> 10 offices/district 8-10 offices/district 5-7 offices/district 3-4 offices/district 1-2 offices/district > 9 boxes/district 7-9 boxes/district 5-6 boxes/district 2-4 boxes/district 1 box/district
		High degree	
		Average Low degree Very low degree High degree Average Low degree Very low degree	
Drop box	Drop box	Very high degree	> 25 percent + 10 to +25 percent + 0 to +10 percent – 10 to 0 percent < –10 percent
		High degree	
		Average Low degree Very low degree	

(continued)

Table II.
Rating and evaluation
standard of criteria and
sub-criteria for
performance evaluation
(first phase of AHP)

Table II.

Criteria	Sub-criteria	Rating	Evaluation standard
	Operating hours	Very high degree	16-24 hours
		High degree	9-16 hours
	Item collection	Average	7-9 hours
		Low degree	6-7 hours
		Very low degree	< 6 hours
		Very high degree	< Every 3 hours
		High degree	Every 3-5 hours
		Average	Every 6-9 hours
	Stamp selling	Low degree	Every 10-24 hours
		Very low degree	> Once a day
Very high degree		> 19 locations/district	
High degree		15-19 locations/district	
Payment method	Average	10-14 locations/district	
	Low degree	5-9 locations/district	
	Very low degree	1-4 locations/district	
	Very high degree	> 4 methods	
	High degree	4 methods	
	Average	3 methods	
	Low degree	2 methods	
	Very low degree	1 method	
Delivery coverage	Very high degree	> 250 destinations reached	
	High degree	201-250 destinations reached	
	Average	151-200 destinations reached	
	Low degree	101-150 destinations reached	
	Very low degree	< 100 destinations reached	
Flexibility	Labor	Very high degree	Number of tasks a labor can perform
		High degree	> 4 tasks
		Average	4 tasks
		Low degree	3 tasks
		Very low degree	2 tasks
			1 task

(continued)

Criteria	Sub-criteria	Rating	Evaluation standard
	Machine	Very high degree	Number of operations a machine can perform
		High degree	
	Average	> 4 operations	
	Low degree	4 operations	
	Very low degree	3 operations	
Process	Very high degree	Very low degree	2 operations
		Very high degree	1 operation
		> 5 services	
Volume	High degree	Number of services that can be simultaneously be processed	
	Average		
	Low degree	5 services	
	Very low degree	4 services	
	Very high degree	3 services	
Access	High degree	(Change in the production volume/total volume) × 100 percent	
			Average
	Low degree	> 100 percent	
	Very low degree	80-100 percent	
	Very high degree	50-80 percent	
Sorting	High degree	(Change in sales after modification of service coverage/total sales) × 100 percent	
			Average
	Low degree	60-80 percent	
	Very low degree	40-60 percent	
	Very high degree	20-40 percent	
	High degree	Number of sorting plans a system can accommodate	
			Average
	Low degree	< 20 percent	
	Very low degree	> 5 sorting plans	
	Very high degree	5 sorting plans	
	4 sorting plans		
	3 sorting plans		
	2 sorting plans		

(continued)

Table II.

Table II.

Criteria	Sub-criteria	Rating	Evaluation standard		
Cost	Delivery routing	Very high degree	(Decrease in delivery time/delivery time) × 100 percent	> 70 percent	
		High degree		40-70 percent	
		Average		20-40 percent	
	Mix	Low degree			0-20 percent
		Very low degree			< 0 percent
		Very high degree	Number of services available		> 8 services
		High degree			7-8 services
	Launch	Average			5-6 services
		Low degree			3-4 services
		Very low degree			2 services
Return on assets	Manufacturing cost	Very low degree	Number of new services that can be introduced	> 3 new services	
		Very high degree		3 new services	
		High degree		2 new services	
	Item carrying cost	Average			1 new service
		Low degree			0 new service
	Storage cost	Very high			> 50 percent
		Average	(Corresponding cost/total cost) × 100 percent		35-50 percent
	Distribution cost	Low			20-35 percent
		Very low			10-20 percent
		> 80 percent	(Net profit/total sales) × 100 percent		< 10 percent
Product of operation margin	60-80 percent				
	40-60 percent				
Total asset utilization or turnover	20-40 percent				
	< 20 percent	(Total sales/total assets owned) × 100 percent			

(continued)

Criteria	Sub-criteria	Rating	Evaluation standard
Relationship	Customer	Excellent	Percentage of change in complaints annually
		Good	
		Average	
		Fair	
	Employee	Poor	The average score (ranging from 0 to 10) of job satisfaction for selected employee
		Excellent	
	Partner	Good	Percentage of late, wrong, damaged or lost delivery to the next tier
		Average	
		Fair	
		Poor	
Innovativeness	New launch of services	Excellent	(Sales of new service/total sales) × 100 percent
		Good	
	New launch of technology	Average	(Reduction in time/total time) × 100 percent or (reduction in cost/total cost) × 100 percent
		Fair	
		Poor	
		Excellent	

Table II.

3.2.7 Constraints. It is defined as the number and variety of limitation and restriction existed in selecting the alternative. Constraint is treated as undesirable factor to reduce the choice of selecting alternative. Sometimes, the constraint is inherent to their characteristics of the company or it is the environmental factor that is controlled by third party.

The overview of the definitions of each sub-criterion is given in Table III in the second phase of the proposed framework. Similar to the first phase, the relative weights of criteria and sub-criteria in the second phase are derived by using pairwise

Criteria	Sub-criteria	Definition
Improvement	Effectiveness	Forecasted degree of change in the corresponding sub-criteria within a specified period
	Payback period	Forecasted period of time between initial implementation of alternative and the corresponding improvement begin
Cost	Set-up and installation cost	It is the expense during the set-up and installation of the alternative
	Running cost	All estimated costs associated with the operation of the alternative including both labor and machinery running cost
	Maintenance cost	Regular inspection and repair for the machinery and equipment of the alternative
Time	Research time	The amount of time spent in the research for investigating the effectiveness and suitability of the corresponding alternative
	Set-up and installation time	The time period required to set-up and install the alternative
Capability	Technical	Forecasted percentage of delay or error caused by technical problem of the alternative
	Engineering	Forecasted percentage of delay or error caused by engineering staff
	Management	Forecasted percentage of delay or error caused by management team
Integration with the existing system	Ease	Time required to integrate the alternative with the existing system completely, without causing any disturbance of performance
	Compatibility	Forecasted percentage of change in productivity or forecasted percentage of delay or error made by the entire system after integrating the alternative with the existing one
Willingness	Customer	The degree of willingness to accept the alternative with the aim of improving the corresponding criteria
		Top management
		Employee
	Constraint	Partner
Internal		
	External	The number and variety of limitation and restriction existed in selecting the alternative

Table III.
Definition of sub-criteria for the selection of improvement alternatives (second phase of AHP)

comparison with respect to the goal of selection of improvement alternative. With the relative weights of both criteria and sub-criteria, selection can be performed to find out the best improvement alternative. Rating and evaluation standard of qualitative attributes are given in the last column of Table IV to enable consistency during the entire selection process.

A case study is employed to demonstrate the usefulness of the proposed benchmarking process. Details of the case study can be found in the next section.

4. Application of the proposed methodology in postal industry

In this section, a demonstration will be provided to illustrate how the double AHP approach can be employed to benchmark the postal industry.

4.1 First phase of the benchmarking process

In this performance evaluation, it is assumed that the company to be benchmarked will be Company A and its direct competitors will be Competitors X, Y, and Z. A rating scale has been derived to score the performance level as illustrate in Table II. What the users need to do is to enter the ratings of performance levels of Company A and its three competitors on each of the attribute. Together with the priorities derived before, the overall scores of performance level for the postal companies will be determined. Table V shows the results of pairwise comparison of criteria in level 2 for the first phase of AHP. All CRs are found to be acceptable, that is, less than 0.1.

Table VI illustrates the result of the performance evaluation of the postal companies with regard to each criteria and sub-criteria defined previously. In the last row of Table VI, “percent Max” is used to indicate the overall performance and the performance gap with other companies. Therefore, company with 100 percent max is the industrial leader, i.e. Competitor X. The benchmarked company, Company A, ranked the third among four companies.

The total score in Table VI is meaningless to the absolute performance of the benchmarked company, or the competitors, because the score is in relative sense among the four companies. In order to find out the strength and weakness of Company A, it is required to compare its rating of each sub-criterion against the three competitors. From Table VI, rating of on-time delivery of Company A (95-97 percent) is lower than that of Competitor X (>99 percent), so on-time delivery is the weakness of Company A relative to Competitor X. Similarly, the ratings of accuracy are the same for both Company A and Competitor X, thus accuracy is the strength of Company A. Following the same procedure of comparison, on-time delivery, security and response time, etc. are examples of weaknesses of Company A. To close the performance gap, good practices must be learnt from the best-in-class company, i.e. Competitor X.

In traditional benchmarking process, the analysis is stopped here. Whether the good practices learnt is suitable for Company A is unknown, as many factors may influence the efficiency and effectiveness towards continuous improvement and limit their choice of alternative. In this connection, the second phase of AHP can provide management with easy methodology to decide which alternative is the most appropriate to suit their current operational condition.

Table IV.
Rating and evaluation
standard of criteria and
sub-criteria for the
selection of improvement
alternatives (second
phase of AHP)

Criteria	Sub-criteria	Rating	Evaluation standard	
Improvement	Effectiveness	Very significant	Forecasted degree of change in the corresponding sub-criteria	
		Significant	> 90 percent	
		Little	60-90 percent	
Cost	Payback period	Very little	30-60 percent	
		No	0-30 percent	
		Very significant	< 0 percent	
	Set-up and installation cost			< 2 days
		Significant		2-7 days
		Little		1-2 weeks
		Very little		2-3 weeks
		No		> 3 weeks
	Running cost	Very high		> 10 percent
		High		8-10 percent
Average			5-8 percent	
Low			3-5 percent	
Very low			< 3 percent	
Maintenance cost	Very high		> 50 percent	
	High		40-50 percent	
	Average		30-40 percent	
	Low		10-20 percent	
	Very low		< 10 percent	
			> 50 percent	
			40-50 percent	
			30-40 percent	
			10-20 percent	
			< 10 percent	

(continued)

Criteria	Sub-criteria	Rating	Evaluation standard
Time	Research time	Too long	>8 weeks
		Long	5-8 weeks
		Acceptable long	3-5 weeks
		Reasonably short	1-3 weeks
		Short	<1 week
	Set-up and installation time	Too long	>3 weeks
		Long	2-3 weeks
		Acceptable long	1-2 weeks
		Reasonably short	3-7 days
		Short	<3 days
Capability	Technical Engineering Management	Very high	Forecasted percentage of delay or error caused
		High	0-3 percent
		Average	3-5 percent
		Low	5-15 percent
		Very low	15-30 percent
	Ease of integration with the existing system	Very easy	>30 percent
		Easy	<1 day
		Medium	Time required for integration of alternative with the existing system
		Difficult	1-3 days
		Very difficult	3-7 days

>2 weeks
(continued)

Table IV.

Table IV.

Criteria	Sub-criteria	Rating	Evaluation standard	
Willingness	Compatibility	Very high	Forecasted percentage of change in productivity	
		High		
		Average		
		Low		
			Very low	> 80 percent
	Customer	Very high	0-3 percent	
		High	3-5 percent	
		Average	5-15 percent	
		Low	15-30 percent	
		Very low	> 30 percent	
Very high degree		8-10		
Constraint	Top management	High degree	Forecasted percentage of delay or error made by the entire system after integration	
		Average		
	Employee	Low degree	The average score (ranging from 0 to 10) of degree of willingness to accept the alternative for each parties	
		Very low degree		
	Partner	Very large	> 4 constraints	
		Large	4 constraints	
	Internal	Medium	3 constraints	
		Small	2 constraints	
	External	Very small	0-1 constraint	

	Reliability	Lead time	Convenience	Flexibility	Cost	Return on assets	Relationship	Innovativeness
Reliability	1	1	3	5	6	5	6	9
Lead time		1	2	5	4	6	5	9
Convenience			1	2	3	4	2	7
Flexibility				1	2	3	2	5
Cost					1	1	1/2	4
Return on assets						1	1/2	4
Relationship							1	5
Innovativeness								1

Table V.
Relative priorities of
criteria in level 2 (first
phase AHP)

4.2 Second phase of the benchmarking process

Referring to the result of first phase of AHP, the goal in this second phase is selection of improvement alternative for Company A to improve, say, on-time delivery. To improve on-time delivery, Company A had identified that the good practices that can be learnt from the industrial leader (i.e. Competitor X) were changing collection schedule, increasing capability of transportation vehicles, and rearranging delivery routing. These changing opportunities become the alternatives in the second phase of AHP. Refer to Table IV, a rating scale has been derived to rate the sub-criteria and the evaluation standard of ratings of sub-criteria. However, it indicates the evaluation standard of ratings for the improvement alternatives (changing collection schedule, increasing capability of transportation vehicles and rearranging delivery routing) in this demonstration only. Since different natures of alternative have different evaluation standards, so users are required to define their evaluations standard before selection of improvement alternatives. By entering the ratings of sub-criteria for each changing opportunity into the expert choice, the best practice can come out.

Table VII shows the result of the selection of improvement alternative with regard to each criteria and sub-criteria defined previously. Rearranging delivery routing with 100 percent max is the best practice that Company A should implement to improve its on-time delivery. Through the second phase of the benchmarking process, Company A cannot only identify its performance relative to its competitors, but the company can also evaluate the improvement alternatives from the market leader so the best practice can be implemented. In fact, this is a continuous improvement process because the company can improve its weaknesses one by one.

5. Conclusions

The proposed double AHP method can provide a complete framework for benchmarking logistics performance of postal industry. In this paper, benchmarking is mainly divided into two stages, i.e. performance measurement and continuous improvement. The first phase of the AHP can enable managers to understand their existing level and the performance gap with the best-in-class company. Competitive advantage and disadvantage can be also identified to indicate the direction of improvement. The second phase of the AHP provides a quantitative model for managers to select the best practice that can be learnt from the industry leader.

Table VI.
Performance evaluation
(first phase of AHP)

Criteria	Sub-criteria	Company A	Company X	Company Y	Company Z
Reliability	On-time delivery (percent)	95-97	> 99	97-99	93-95
	Accuracy	97-99	97-99	97-99	95-97
	Security	93-95	97-99	97-99	95-97
Lead time	Customer response time	Reasonably short	Short	Short	Acceptable long
	Processing time	Short	Short	Short	Reasonably short
	Queueing time	Acceptable long	Reasonably short	Reasonably short	Reasonably short
Convenience	Transportation time	Reasonably short	Reasonably short	Short	Acceptable long
	Post office	High	High	Average	Average
	Drop box	High	High	High	Average
	Operating hours	High	Very high	High	Average
	Item collection	Average	High	High	Average
	Stamp selling	High	Average	Average	High
	Payment method	Average	High	Average	Low
	Delivery coverage	High	Very high	High	Average
	Labor	High	Very high	High	Average
	Machine	High	High	High	Average
Flexibility	Process	High	Average	Average	Average
	Volume	High	High	Average	Average
	Access	High	Average	High	Average
	Sorting	High	High	High	High
	Delivery routing	Average	High	Low	High
	Mix	Average	High	Very low	Low
	Launch	Low	Low	Very low	Low
	Manufacturing	Average	Low	Average	Average
	Item carrying	Low	Low	Low	Average
	Storage	Average	Low	Low	Average
Return on assets	Distribution	High	Average	Average	Average
	Operation margin (percent)	40-60	20-40	20-40	20-40
	Turnover (percent)	20-40	60-80	60-80	40-60
Relationship	Customer	Average	Good	Average	Good
	Employee	Average	Good	Average	Good
	Partner	Good	Good	Average	Average
Innovative-ness	New service (percent)	20-40	20-40	20-40	40-60
	New technology (percent)	40-60	20-40	< 20	20-40
Maximum percentage		70.505	100	84.438	47.610

Criteria	Sub-criteria	Changing collection schedule	Increasing capacity of vehicles	Rearranging delivery routing
Improvement	Effectiveness	Very significant	Little	Very significant
Cost	Payback	Significant	Little	Very significant
	Set-up and installation	Average	Average	Low
Time	Running	Average	Average	Low
	Maintenance	Low	Low	Very low
Capability	Research	Acceptable long	Reasonably short	Long
	Set-up and installation	Acceptable long	Short	Long
Integration	Technical	High	High	High
	Engineering	High	High	High
	Management	High	High	Average
	Ease	Easy	Easy	Medium
Willingness	Compatibility	Medium	Easy	Medium
	Customer	Very high	Average	High
Constraints	Top management	High	High	Very high
	Employee	High	High	High
Max (percent)	Partner	Average	Low	High
	Internal	Large	Small	Small
	External	Large	Medium	Small
		97.136	91.237	100

Table VII.
Selection of alternative
for the improvement of
on-time delivery (second
phase of AHP)

The decision will be the most suitable option selected to improve the existing problem and for continuous improvement. The criteria and sub-criteria include in the two phases of AHP are specific to logistics operation of postal service. A specified measurement system is derived to make the judgment of both qualitative and quantitative attributes a standard one.

One may argue the rating and evaluation standard of the measuring system is subjective. However, the proposed framework does not restrict the setting of the rating and evaluation standard. Users can always modify the rating and evaluation standard to suit for particular concerns. The relative weights of the criteria and sub-criteria are derived by survey. In this connection, they are subjected to changes in the preference of people, so it should be constantly reviewed. Since achieving customer satisfaction is the company's goal, so the derivation of the first phase AHP should be done by customer, hence the benchmarking process can be customer-oriented. However, for the continuous improvement, i.e. selection of improvement action, the relative weights should be done by top management as they are decision makers.

As benchmarking is a continuous process, the double AHP approach can provide company with easy methodology for benchmarking. Moreover, AHP is an effective tool for decision-making among a group of people. Benchmarking involves support from all departments, thus AHP can provide a common framework for different departments so that the same benchmarking methodology is shared to maximize the efficiency and avoid inconsistency. Since every criterion is considered in turn, a consensus choice of decision alternative is achieved. The AHP methodology is very flexible that changing of relative weight is allowed at any time and new alternatives can be added as necessary. Different companies may have their own goals and operational strategies, so the values of relative weights may be different. The use of AHP enables companies to enter their own pairwise comparison to reflect their own management strategies so that the benchmarking outcome can provide a best solution meeting their existing and future business strategies.

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Corresponding author

Felix T. S. Chan can be contacted at: ftschan@hkucc.hku.hk