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# A BSC Framework for Air Cargo Terminal Design: Procedure and Case Study

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## Introduction

“Air cargo” is defined as “cargo delivered by airfreight”. The airfreight business began in the early 1950s, as a by-product of the airlines’ passengers business. Only in 1975 did the business become independent and profit-oriented. The demand for air cargo transportation has increased significantly over the last few years, because product life cycles have shorted and the demand for rapid delivery has increased.

The air cargo industry incorporates an industrial supply chain, which includes airlines, customs, ground services, air cargo forwarders, brokers, domestic transportation, air cargo terminals, distribution centers and integrated international express services. Of these, air cargo terminals are critical in the air cargo supply chain. A typical air cargo terminal has three main users –airlines, air cargo terminal operators and forwarders/cargo-agents who are the principal contributors to the revenue of air cargo terminals. The air cargo terminal operator must identify the requirements of forwarders/cargo-agents in the design of new facilities or services to serve best the interests of its users. Accordingly, the balanced scorecard (BSC) is used to meet the design requirements for customers, employees and stockholders. Additionally, quality function deployment (QFD) is applied to ensure concurrently the quality of products/services during the design process.

Competition in the air cargo industry has intensified recently. Hong Kong International Airport, which sits on 1,200 hectares of Chek-Lap-Kok Island, handles around 32 million passengers and 2.2 million metric tons of freight per annum, with an annual capacity of

three million metric tons (Moorman, 2000). When the airport is fully developed, the cargo capacity will increase to nine million metric tons per year. Hong Kong is evaluating plans for two logistics centers in the airport, which would enable companies to provide sourcing and distribution services to consignees. In the near future, some of the Mainland’s 70 airports, including Beijing, Shanghai and Guangzhou, will be able to compete with Hong Kong, which presently handles 40% of all total foreign trade in China.

The Asia-Pacific is becoming the largest air cargo market, and the air cargo volume of Taiwan CKS (Chiang-Kai-Shek) airport grew steadily over the last 20 years. In 2001, the total capacity of the air cargo terminals at CKS airport is approximately 1.3 million metric tons. After the new terminals have begun operation and the present terminals have been expanded, the total air cargo handling capacity of CKS airport will be 3.7 million metric tons in 2006.

## Purpose

While focusing on air cargo terminals, this article proposes a novel procedure for designing such terminals by Industrial Technologists and others. It also presents a case study. The BSC methodology is used herein to enable a company to develop a framework for establishing its design requirements. Additionally, a house of quality (HOQ) is built for concurrent design, based on the QFD method. This study has two main purposes: to develop a procedure for designing an air cargo terminal and apply systematically the methodologies of BSC and QFD in a case study of air cargo terminals.

## Conceptual Background

The design process is highly complicated because it depends on factors such as the complexity of the process, the range of product/service functions, the industrial environment and the volume of components. Yang, Hsu and Ching (2002) employed the five logical tools of the thinking process to analyze the three product designs to facilitate manufacturing, shorten time-to-market, and produce more customer-oriented products. Meanwhile, the Pre-Requisite Tree and Transition Tree of the five logical tools can be applied to deploy the specifications of air cargo terminal design.

In 1961, 91% of the time taken to ship air cargo was spent on the ground. Lobo and Zairi (1999a) found that an air cargo shipment passed through an average 40 hands and was associated with 12 individual documents as it moved from the shipper to the customer. The air cargo shipment took a total of six days in 1988. Hence, the air cargo industry has been focusing on process design/management beyond organizational boundaries. Performance variables must still be identified to design better the air cargo terminal with improved efficiency and quality of service.

Fielding, Glauthier and Lave (1978) and Dajani and Gilbert (1978) addressed standard variables and performance indicators for monitoring and managing transportation and transit systems. Some of the developed guidelines can thus be applied to identify variables that correlate with the performance of an air cargo terminal. Humphreys and Francis (2000) stated that the measures most commonly associated with airport performance measurement include overall cost, generated revenue, productivity of labor and productivity of capital. Seneviratne and Martel (1991, 1994) claimed that a variable should satisfy certain criteria before it can be considered a useful index of performance. It should reflect specific management goals; be simple to define and quantify; not require extensive and expensive data collection,

and be sensitive to changes to improvements or management actions.

Ahn (2001) employed the BSC framework proposed by Kaplan and Norton (1992, 1993) to integrate a company's mission, values, vision, strategy into the four perspectives of BSC, which subsequently evolve into the company's performance targets and indicators.

With respect to the non-financial related evaluation, van Veen-Dirks and Wijn (2002) claimed that companies should focus more on non-financial performance indicators, given rapid changes in the environment.

With respect to applications of BSC to information management and information technology, Protti (2002) employed BSC to evaluate the applications of an information system of National Health Service (NHS) in UK. The results revealed that analyses of the positive and negative effects of an information system through the applications of BSC could result in the development of important performance indicators of the NHS. In 2003, Stewart and Mohamed (2003) used BSC as a framework to analyze the benefits of exploiting information technology to project management.

With respect to applications in the field of transportation, Poli and Scheraga (2003) designed a BSC framework to elucidate customer satisfaction from five perspectives. The results revealed that transportation operators must find a balance among all quality perspectives and prioritize the needs of key customers. Rouse, Putterill, and Ryan (2002) spent four years monitoring the performance and studying the control systems used by international airlines in maintenance. The monitoring and control system evolved from the mathematical model of BSC eventually became an integrated performance evaluation system. The results of that work supported the development of an accurate and effective performance feedback system. C. H. Chen and Chou (2004) was the first to apply BSC in air cargo terminal research to develop a

framework for improving performance. Chen analyzed the cause-and-effect relationships of strategies and developed a strategy map of a company's mission, values and vision, and then explicated strategic themes and derived performance improvement measures.

Akao introduced QFD in 1972 in Japan, as part of his work at the Mitsubishi Heavy Industries Kobe Shipyard. QFD can be used to store the desires and requirements of customers, supporting customer satisfaction (Evans & Dean, 2003; *Wasserman*, 1993). Nahm and Ishikawa (2004) claimed that QFD is not just a quantitative evaluation tool but also a means of planning used in concurrent engineering (CE). All major functions that contribute to getting a product/service to market involve continuous product/service development. They depend on the realization of the original concept in sales, use and disposal. QFD is implemented not only in physical product design, but also in non-physical product design. J. Chen and J. C. Chen (2001) systematically studied a case study to select textbooks for use in manufacturing-related technology courses based on a QFD-based framework.

Lee and Ko (2000) established a framework for developing and implementing a corporate business strategic plan. The framework has two steps. The first step is to conjoin the SWOT matrix with the BSC to construct a systematic and holistic strategic management system, and the second step uses the QFD method with the BSC and the main strategies of Sun Tzu. SWOT, which stands for strength, weakness, opportunity and threat, is a systematic tool for developing strategies. Lee, Lo, Leung and Ko (2000) presented a framework for formulating a vocational education strategy by linking SWOT, BSC, QFD and MBNQA (Malcolm Baldrige National Quality Award). Their strategy formulation framework has four parts - SWOT analysis, linking SWOT with BSC, deploying all indices of MBNQA, and merging BSC with MBNQA using the QFD method.

## Procedure for BSC-based Air Cargo Terminal Design

### BSC to Meet Design Requirements

The BSC framework is used to develop the customer requirements and design requirements to meet in air cargo terminal design. It ensures that all employees are in line and are striving toward a common mission. This is one of the most important values of a BSC. A mission is the origin of work. The vision of a company helps to develop a flexible and adaptive strategy from the missions and core values. The vision is the picture that includes the targets to be met in the next five, ten or 15 years. A vision should not be abstract—but should be as clear as possible in outlining the organization's themes and providing the organization with a basis for setting strategies and targets.

Based on Kaplan and Norton (1996, 2004), the financial perspective remains an important tool for companies, since it reflects the results of any actions taken to improve customer satisfaction and loyalty, process efficiency, quality and innovation, all to produce financial benefits. Improving customer satisfaction and increasing customer loyalty to achieve the goal of financial perspective are the main strategic objectives of customer perspective. Acquiring customers, retention of customers, and meeting customers' expectations are typically key determinants of customer perspective.

The internal process perspective comprises innovation, operation and post-sales service. Innovative process flow is used to design or develop new products or services, to attract new customers and to satisfy customers' requirements. The operation process flow begins with receiving an order and ends with the delivery of products or services. It must be highly efficient, consistent with service time and include on-time delivery. The post-sale service process increases the value-add of products or services used by customers.

Strategic objectives and performance indicators of employees' learning and growth perspective are used mainly to

ensure outstanding internal processes, which will in turn be the basis of internal process, customer, and financial perspectives. However, the organizational climate is the leading indicator of the employee turnover rate, employee productivity and internal process perspective. Additionally, employee competence is not only a leading indicator but also the basis of the BSC framework.

### QFD for Concurrent Engineering

The core of QFD is the matrix, called the HOQ. It comprises two main parts - the "WHATs", and the "HOWs". When QFD is employed, the most important tasks are to define and understand the "WHATs", which are the needs of the internal and external customers, and to define the "HOWs" to meet the customers' requirements. The four perspectives of BSC constitute the "WHATs" of QFD. The procedure for formulating the key performance indicators (KPIs) can be applied to derive the "HOWs" associated with QFD.

Integrating BSC and QFD facilitates CE toward the common goal of ensuring the satisfaction of shareholders, employees and external customers. The concept of QFD for product development, elucidated in Ermer and Kniper (1998), can be translated into a design framework for an air cargo terminal. The voices of shareholders, employees and external customers are incorporated

in the first matrix ("WHATs"). The second and the third matrices include the "HOWs" and the relationship matrix, as determined by BSC analysis. Finally, the technical importance matrix and the importance of customer requirements matrix are determined by using HOQ and a questionnaire survey.

## Case Study

### Case Study Profile

Taiwan CKS airport is geographically better located than any other main Asia-Pacific cities (Hong Kong, Shanghai, Manila, Seoul, Tokyo, Singapore, Sydney) in terms of average flight time between these cities. The costs of labor and property in Taiwan are lower than those in Hong Kong, Tokyo and Singapore. Additional, Taiwan has better trade and industrial bases than Manila, with greater resources for courier service providers. There, the United Parcel Service, Inc. (UPS) established its Asia-Pacific transit center at CKS airport in 1991. Table 1 reveals that the mean annual growth rate of the cargo volume in CKS airport over the last 20 years is 11.3%. In 2004, the total import and export cargo volume to and from CKS airport was 1.7 million metric tons, representing an annual growth rate of 13.4% over the preceding year. Air cargo terminals and the airlines in Taiwan are still expanding quickly, as they seek to exploit Asia's robust growth in trading and manufacturing.

Table 1. CKS airport cargo volume

	Volume	Growth		Volume	Growth
1984	214,479,600	17.2%	1995	754,489,258	13.9%
1985	234,338,300	9.3%	1996	796,459,768	5.6%
1986	286,961,200	22.5%	1997	913,519,573	14.7%
1987	345,652,600	20.5%	1998	932,052,762	2.0%
1988	343,453,600	-0.6%	1999	1,057,236,939	13.4%
1989	384,372,100	11.9%	2000	1,208,838,480	14.3%
1990	400,597,000	4.2%	2001	1,189,873,251	-1.6%
1991	451,032,712	12.6%	2002	1,380,748,058	16.0%
1992	522,448,895	15.8%	2003	1,500,070,877	8.6%
1993	559,192,235	7.0%	2004	1,701,020,000	13.4%
1994	662,256,874	18.4%	Average Growth		11.3%

Source: Aviation Department, Transportation Ministry, Taiwan



Taiwan's air cargo terminals have been expanding rapidly in recent years. The privatization of Taiwan Air Cargo Terminal Logistics (TACT) was completed in the year 2000 and by converting to the Build-Operation-Transfer (BOT) business model. In this BOT model, the case company built and operated the air cargo terminal of Taiwan under an exclusive permission by the government. When the permit expires in 20 years, the operation as well as the facilities will be transferred back to the government without any financial reciprocity. In 2002, it conducted an expansion project, increasing its annual cargo capacity to 1.5 million metric tons.

Evergreen Air Cargo Service Corp. (EGAC) was established in March 2000, and began operating in 2002. Its annual cargo capacity was half a million metric tons. Far Glory Air Cargo Terminal Co., Ltd (FGAC) and Ever Terminal Co., Ltd (EverTer) in the area surrounds the airport, have an annual cargo capacity of 300,000 metric tons. Far Glory Air Cargo Park, a free trade zone (FTZ) inside the airport, and the Guanyin Logistic Zone in Tao-Yuan County, are expected to begin operations in 2006. The planned annual cargo capacity of FTZ is one million metric tons, with an area of 45 hectares.

**Development**

Before the cause-and-effect relationships are analyzed and the KPIs are determined, the mission, core values and vision of the enterprise must be established. The mission, core values and vision for the case company are elucidated and analyzed through a series of interviews with senior managers and an investigation of the company's documents, including planning proposals, project plans and research reports. However, the questionnaire submitted by the customers at the company in the case study for the last three years, revealed that the most unsatisfactory items are inefficiency of the internal process and poor quality. The strategy theme will involve an expansion project and ongoing improvement activities to increase efficiency and quality through the questionnaire analysis, an investi-

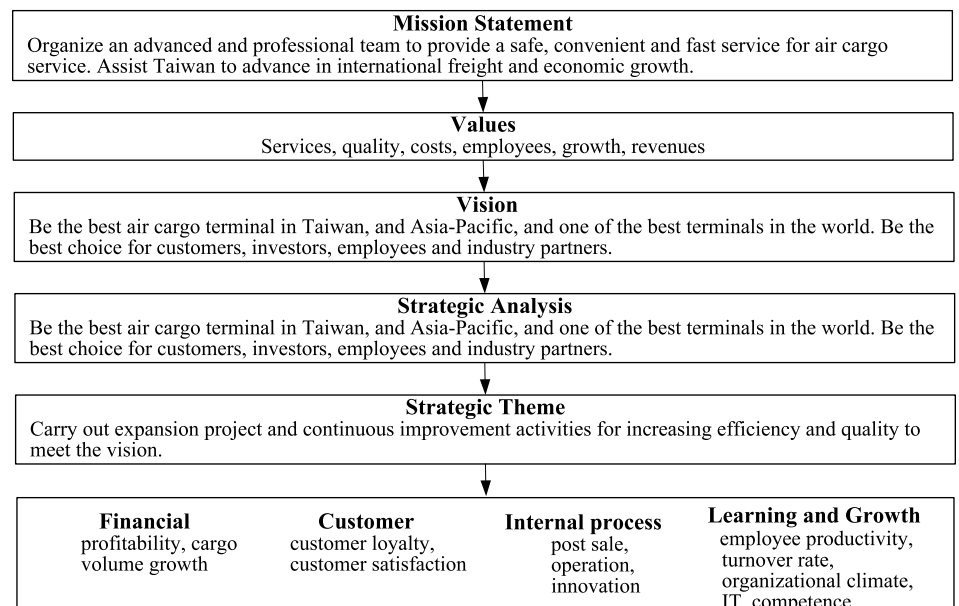
gation of the company's documents, an analysis of forces driving industry competition and a SWOT analysis. Finally, the four perspectives of BSC are used to derive corresponding measures. Figure 1 presents the process for developing the BSC strategy.

The industrial environment and strategy are analyzed, using the analysis of forces driving industry competition (Porter, 1980) and SWOT analysis. Figure 2 and Table 2 provides the results of the analysis. According to the analysis of forces driving industry competition, the room to negotiate prices is small for the case company because it is a BOT business and has cross-holding relationships with downstream companies. With respect to the forces associated with new entrants and substitutes, the entry barrier in Taiwan appears to be high. The threat from the substitutes in the short term is unclear, but the threat over the long term is evident. The SWOT analysis indicates that the technologies transfer and the retention of old customers from the pre-BOT company are strengths. The weaknesses of the case company are the old facilities and poor quality of operating procedures. The opportunities are based on the fact that Taiwan is geographically well located and has better trade and

industrial bases than other Asia-Pacific countries. The opening of the market, regional competition, and political turmoil are potential threats to the further development of the company in the case study.

The aim of the cause-and-effect relationships chart is to help the company's employees understand swiftly the relationships among strategies, as displayed in Figure 3. As well as helping employees understand the priorities and relationships among the four perspectives of BSC, the cause-and-effect relationships chart can also help in deriving strategic objectives associated with the four perspectives. Interviews, documentary analyses, questionnaire surveys from 2002 and 2003 on forwarders where the respective sample sizes are 108 and 109, strategic analysis and a cause-and-effect relationships chart were used to derive a BSC model of the case company, as part of a strategy map, as shown in Figure 4. An overview of the case company's strategy, with its strategic theme as the main focus, is clearly presented. The strategy map of the case company provides three benefits to its employees: it improves communication among departments, understanding of the operating targets associated with the four

*Figure 1. BSC strategy developing flow*



perspectives and their relationships, and the establishing of consensus in striving for a common goal.

A customer orientation is critical to ensuring that QFD satisfies customers' expectations of products and services. The questionnaire surveys of customer satisfaction toward forwarders conducted in 2002 and 2003 yielded KPIs in the perspectives of customer and internal process. Indices of learning and growth are derived, based on the eight evaluation items of Hellriegel and Slocum (1974) and Hoy, Smith, and Sweetland (2003), to measure the impact of the goal of an open and healthy organizational climate. Lantz and Friedrich (2003), Kor (2003) and Clasen, Meyer, Brun, Mase, and Cauley (2003) posited that functional competence, cognitive competence, human relationships competence and work experience govern overall employee competence.

Developing KPIs is one of the most important tasks in BSC. Not only are KPIs useful in evaluating performance, but they also serve as a basis for companies to redesign an air cargo terminal by QFD. The strategic theme, a cause-and-effect relationships analysis, and a discussion and alignment of the strategy map, were considered to derive the strategies, strategic objectives and KPIs for the balanced business scorecard of the company in the case study (as shown in Table 3). All of these in Table 3 are used to establish the customer requirements ("WHATs"), the design requirements ("HOWs") and the relationship matrix.

In 2004, a questionnaire survey on forwarders where the sample size is 100 was conducted to analyze the importance of the three perspectives. Based on the 2004 questionnaire survey, the customers' priorities concerning services were analyzed from three perspectives (customer, internal process, learning and growth), and customer requirements were determined to have absolute importance values of 112, 139 and 94. The importance values 112, 139 and 94 are calculated by using Equation 1 with the values of the input

variables from the responded questionnaires.

$$Absolute\ importance = (very\ important \times 3) + (normal \times 1) - (unimportant \times 1) - (very\ unimportant \times 3) \quad (1)$$

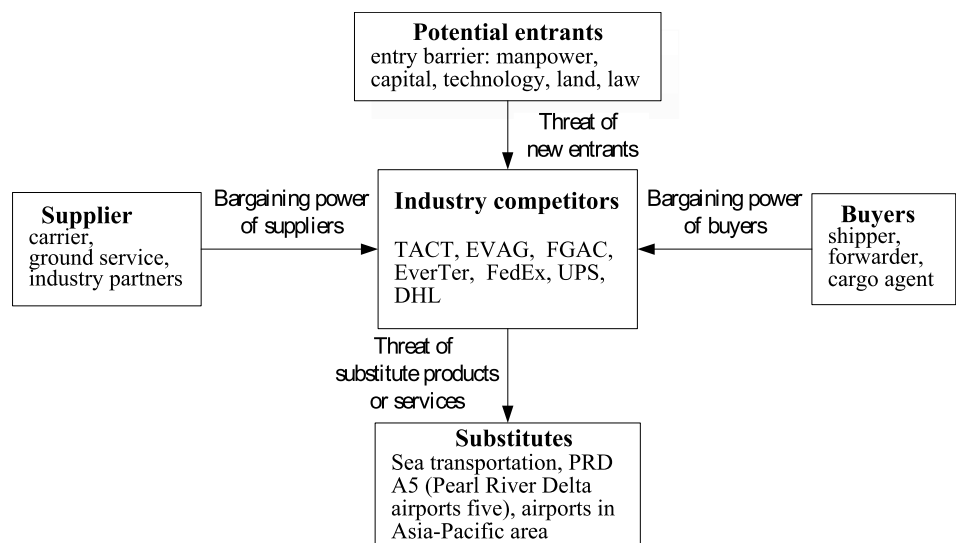
The importance index for the financial perspective could not be obtained from the questionnaire. Alternatively, the average of the values measured from the other three perspectives is adopted

as an estimate, which is one fourth of the total weights. This is based on the recommendation in Kaplan and Norton (2001), where they propose a balanced weighting scheme with the financial measures receiving only 22% of the relative weight. Moreover, the absolute importance measure can be transformed into a relative importance measure, by dividing the importance of individual perspective over the sum of the importance of overall perspectives.

Table 2. SWOT analysis

Strength	Weakness
1. Technology transfer	1. Old facilities
2. The retention of old customers	2. Lack of instant information
3. Operation team	3. Not convenient in custom operation
4. Cargo volume increasing steady	4. Limited by government regulations
5. Business entrance barrier	
Opportunity	Threat
1. Geographically better located in Asia-Pacific's area	1. Market open for foreigners after joining WTO.
2. Business diversification	2. Global economic cycle
3. Asia-Pacific transit center	3. More competitors in the Asia-Pacific Area and PRD A5
4. Cargo volume growth resulting from new air cargo park	4. New competition from domestic companies
5. Aviation city development and high speed train ready soon	5. Terrorism threat
6. Intermodal air-sea transportation	6. Threat of regional wars
7. High-Tech industry development and short transportation time needed	7. Political turmoil
	8. Industries moving to other countries

Figure 2. Forces driving industry competition in air cargo industry in Taiwan



Wasserman (1993) noted a formula for the importance of design requirements, as presented in Equation 2, in which the technical importance of design requirement is the importance of customer requirements multiplied by relationship indices.

$$W_j = \sum (d_i \times R_{ij}) \quad (2)$$

where

$W_j$ : absolute, technical importance of design requirement  $j$ ;  $j = 1, 2, \dots, n$ .

$d_i$ : degree of importance of customer requirement  $i$ ;  $i = 1, 2, \dots, m$ .

$R_{ij}$ : quantified relationship index between customer requirement,  $i$ , and design requirement,  $j$ ;  $i = 1, 2, \dots, m$ ;  $j = 1, 2, \dots, n$ .

The relationship indices between customer requirements and design requirements are represented on a 1-3-5-9 scale. The relative technical importance indices are the same calculation procedure as described in the relative importance measure. Finally, the authors developed five matrices of the HOQ—the customer requirement matrix, the design requirement matrix, the relationship matrix, the importance of customer requirement matrix and the technical importance matrix—as presented in Figure 5.

**Discussion**

The relationship matrix in Figure 5 is developed based on cause-and-effect relationships of BSC (Figure 3) and the frequency of customer complaints obtained from surveys conducted in 2002, 2003, and 2004 for forwarders and airlines. The technical importance matrix is subsequently calculated by the relationship matrix and the matrix representing the relative importance of customer requirements. With the results of technical importance matrix, it can be used not only to deploy the QFD continuously, but also to plan and control the budget of this expansion project by considering the evaluation of current status, the benchmark analysis and the cost factors in the design requirement

matrix. In addition, the design requirements of all inter-correlations are assumed to be positively correlated with each other; the inter-correlation matrix and competitive evaluation are excluded, which fact is one of the limitations on this work.

From the financial perspective, the increase in cargo volume is the leading indicator of profitability; not only is it the traditional financial performance in-

dicator, but also it is the basis of benchmarking for improving performance. Lobo and Zairi (1999a) set the target ROI to 20% as an example of financial benchmarking of the expansion plans of the case company. Customer satisfaction is the leading indicator of customer loyalty. The interviews with customers in this investigation reveals that the availability of parking, service attitudes and professionalism most strongly affect customers' perspectives.

Figure 3. Cause-and-effect relationships chart

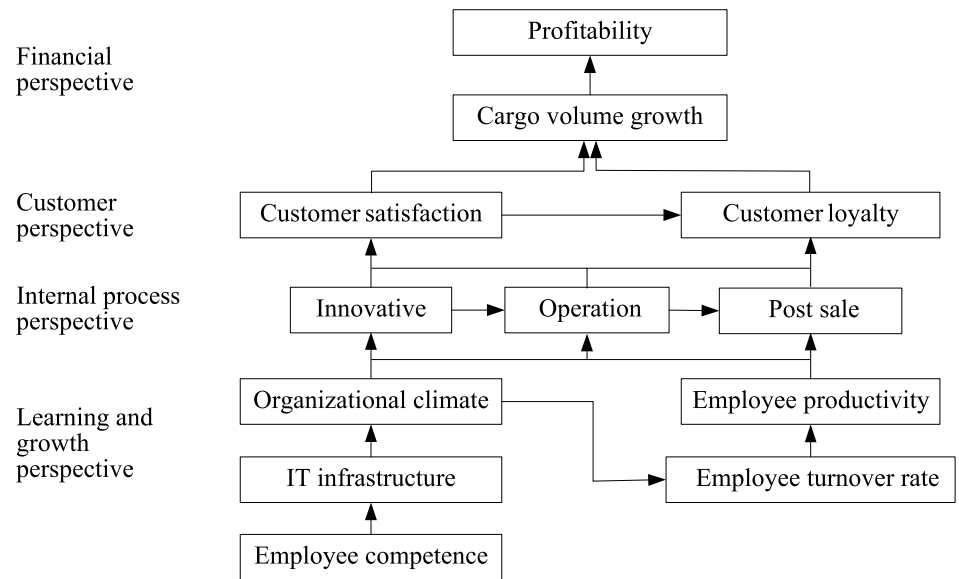


Figure 4. Strategy map

Financial perspective	<b>Cargo volume growth:</b> 1. cargo volume growth 2. space efficiency 3. market share	<b>Profitability:</b> 1. net income 2. ROI
Customer perspective	<b>Customer satisfaction:</b> 1. service attitude 2. availability of parking 3. professionalism	<b>Customer loyalty:</b> 1. top ten customer volume 2. customer retention
Internal process perspective	<b>Innovative process:</b> 1. non-general Cargo service 2. degree of automation	<b>Operation process:</b> 1. MHS 2. density of storage position 3. process efficiency 4. cargo safety
Learning and growth perspective	<b>Employee competence:</b> 1. functional 2. cognitive 3. human relationship 4. working experience	<b>Employee productivity</b> <b>Employee turnover rate</b>
	<b>IT infrastructure:</b> 1. computer/employee rate 2. software capability 3. paper consumed 4. knowledge management	<b>Organizational climate:</b> 1. open and healthy dimensions 2. climate as a dependent variable

Figure 5. HOQ for air cargo terminal design

		Design requirements/HOWs																				Demanded weighted	Relative Demanded weighted						
		Absolute importance	Relative importance	Cargo volume growth	Space efficiency	Market share	Net income	ROI	Service attitude	Availability of parking	Professionalism	Top ten customer volume	Customer retention	Non-general cargo service	Degree of automation	MHS	Density of storage position	Process efficiency	Cargo safety	Accuracy of invoices	Compensate for cargo missing/damaged			Employee productivity	Employee turnover rate	Organizational climate	IT infrastructure	Employee competence	
Customer requirements/WHATs	Financial perspective	—	25	○	△	△	◎	*				△	△															1575	22
	Customer perspective	112	24.35		△				*	○	◎	△	△	△				△	△		△				△	△		1534	22
	Internal Process	139	30.22											*	◎	△	*	○	◎	△	○	△		△				2629	37
	Learning & growth	94	20.43											△	△	△							△	△	*	◎	○	1287	18
Technical importance	Absolute	125.0	49.3	25.0	225.0	75.0	73.0	121.7	219.1	49.3	49.3	135.4	292.4	50.7	90.7	175.4	296.3	30.2	175.4	50.7	20.4	91.5	208.3	126.5					
	Relative	4.54	1.79	0.91	8.16	2.72	2.65	4.42	7.95	1.79	1.79	4.91	10.61	1.84	3.29	6.37	10.75	1.10	6.37	1.84	0.74	3.32	7.56	4.59					

Symbols:◎=9(very strong relationship)○=5(strong relationship) \* =3(fair relationship) △=1(weak relationship)

Table 3. Balanced business scorecard

	Strategies	Strategic objectives	KPIs/"HOWs"
Financial	1. Profitability 2. Cargo volume growth	Steady, continuous operation and profit growth.	1. Cargo volume growth 2. Space effectiveness 3. Market share 4. Net income 5. ROI
Customer	1. Customer loyalty 2. Customer satisfaction	Through the enhancement of customer satisfaction, improve customers' loyalty and cargo volume growth.	1. Service attitude 2. Availability of parking 3. Professionalism 4. Top ten customer volume 5. Customer retention
Internal process	1. Post sale process 2. Operation process 3. Innovative process	Improve customer satisfaction through the enhancement of innovation, operating efficiency, security and after sales service flow.	1. Non-general cargo service 2. Degree of automation 3. MHS 4. Density of storage position 5. Process efficiency 6. Cargo safety 7. Accuracy of invoices 8. Compensation for cargo missing/damaged
Learning and growth	1. Employee productivity 2. Employee turnover rate 3. Organizational climate 4. Information technology IT-infrastructure 5. Employee competence	Through the learning and growth of employee, and company to reduce the employee turnover rate, increase the productivity, then improve the internal process.	1. Employee productivity 2. Employee turnover rate 3. Organizational climate 4. Information technology IT-infrastructure 5. Employee competence



All the indicators of the internal process perspective are the driving factors of the customer perspective. Some of the KPIs of the internal process perspective are the results of questionnaire analyses performed in 2002 and 2003. Of these, facility utilization, facility efficiency, storage turnover rate and waiting time should be considered by the case company in redesigning and improving its operational flows. Lobo and Zairi (1999a, 1999b, 1999c) stated that FedEx could handle cargos of any weight, size or shape in non-general cargo service. Singapore Airlines provides special containers to maintain the temperature of perishable goods for 48 hours. KLM has 80 years of experience in handling live animals.

Finally, the KPIs of learning and growth comprise qualitative and quantitative indicators. The learning and growth of the organization constitute the basis for the success of BSC from the financial, customer and internal process perspectives. The QFD required by the customers is determined from the opinions of internal and external customers. Accordingly, learning and growth are the most important perspectives in relation to both BSC and QFD. The organizational climate is the leading indicator of employee turnover rate, employee productivity and internal process perspective.

### Conclusion

This study proposes a design framework for air cargo terminals, based on BSC methods. The BSC methodology involves three main groups of people—employees, shareholders and customers. This work concerns the design goals of the case company during expansion. The conceptual framework of BSC was applied, and the strategies and strategic objectives of the company were developed according to its mission, values and vision. Accordingly, performance indicators of the air cargo terminal are established. These performance indicators are analogous to the heart of balanced business scorecard and are applied to identify design requirements for air cargo terminals based on the HOQ of QFD. QFD can

be used to predict problems in advance of operation, financial or post sales service during the design stage.

Although the financial indices are the lagging indicators of the other three perspectives, employees and shareholders of the case company assert that financial indices are some of the most important during the design stage. Additional, the desires of both customers and terminal managers were studied in the customer perspective. Three consecutive years of questionnaire study reveals that most of the complaints were about service attitude, availability of parking, and professionalism. Accordingly, the case company improved these issues with strong weightings in the customer perspective as part of its expansion. From the view of terminal managers, KPIs of the internal processes must be measured to redesign the terminal. Restated, the utilization, the availability and efficiency of material-handling equipment, the utilization and turnover rate of the storage positions and space, and the process operating efficiency should be addressed.

The BSC framework is such that learning and growth perspectives represent a basis for reaching financial, customer and internal process design targets. The case study indicates that enhancing the information technology infrastructure and employee competence, and making the organizational climate open and healthy, can improve employee productivity and reduce the employee turnover rate. The case company should focus on information technology infrastructure more strongly than on employee competence in designing their expansion. Learning and growth is the most difficult perspective to quantify. Therefore, the authors wish to evaluate organizational climate and employee competence from learning and growth perspective. The technical evaluation and benchmarking of design requirements will be included in future research.

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