Analysis of Factors Influencing Quality of Service in Passenger Terminal Buildings

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Findings of a personal interview survey of departing passengers conducted to determine the factors influencing the quality of service (QOS) in a passenger terminal building (PTB) are reported. Availability of space is not the most significant factor influencing QOS from the passengers' point of view, and thus, may not be the ideal parameter to use in QOS analysis. The survey results show that the factors influencing QOS differ from one element of the PTB to another. For instance, within the circulation elements 53 percent of the respondents believed that information is the most important factor. Similarly, for the waiting areas the most important factor was the availability of seats and for the processing elements it was the waiting time.

The sudden increase in demand for air travel in the last decade has led to several diverse problems, such as inadequate operational facilities to serve the basic functions. These problems have increased the need to search for satisfactory solutions for the air transportation industry as a whole. Concern here is with a small part of the overall problem: the quality of service (QOS) in a passenger terminal building (PTB). Although the PTB has three principal users—the airline, the airport operator, and the passenger—focus is on the passenger in this paper. Because passengers are the principal source of revenue, it is believed that their needs should be given equal, if not higher, priority than other user needs in the planning and design of PTBs.

Regardless of the configuration, a PTB contains three basic elements: (a) the processing element (involving ticketing, check-in, baggage drop, security, immigration, customs, and baggage claim); (b) the holding element (involving departure concourse, departure lounge, gate lounge, transit lounge, and arrival concourse); and (c) the circulating element (involving drop-off, pick-up, corridors, and airside interface) (*1*). Passengers follow a somewhat typical set of paths through these elements as shown in Figure 1. These paths depend on the different processes and their positions relative to the aircraft and surface modes.

This paper discusses the findings of a personal interview survey of departing passengers conducted to determine the factors influencing QOS in each element in a PTB. QOS is defined as the level of comfort and convenience of the facilities and services that is essential to process passengers in a PTB. The importance of each factor is evaluated according to the manner in which it is perceived by different categories of passengers. It is shown that space is not the most significant factor influencing QOS from the passengers' point of view. Factors such as waiting time and availability of seats are viewed as more important than space.

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CURRENT PRACTICE

The widely used PTB planning, design, and evaluation criteria are based primarily on classical theories of pedestrian movement that evolved from studies related to such urban pedestrian facilities as sidewalks and crosswalks. Fruin's concept of levels of service (LOS) appears to underlie the existing tools and techniques (*2*). For example, Hamzawi describes Transport Canada's Airport Traffic Analysis Model (ATAM), which can develop, test, and evaluate design and planning standards on the basis of passenger volumes (*3*). These standards are given in terms of space per person (module), as suggested by Fruin (*2*). Similarly, Davis and Braaksma (*4*) propose LOS for entry corridors on the basis of space. These levels are somewhat different from the values used by Transport Canada, because they consider the effects of baggage and trolleys on maneuverability.

In theory, this appears appropriate because passengers in a terminal building are essentially pedestrians circulating through the various processing points. However, Seneviratne and Morrall (*5*) have found that contrary to the early beliefs, the relationships between space per person and maneuverability do not have the same characteristics as speed-volume or volume-density relationships on highways. Unlike vehicular traffic, pedestrians are able to move under much denser (congested) conditions. Moreover, according to Seneviratne and Morrall (*6*), pedestrians perceive factors other than space to be more essential for circulation.

The deficiencies in the space-based concept have also been recognized by Mori and Tsukaguchi (*7*), who developed a twofold methodology for evaluating LOS. The first phase of this approach is based on pedestrian behavior such as the speed-density-flow relation and the arrival distribution, and the second is based on pedestrian perception of physical characteristics of the facility. Likewise, Mumayiz and Ashford (*8*) attempted to establish a perception response model based on the relation between imposed demand levels and relevant service measures. This model links the passengers' perception of LOS to the time spent in various processes as opposed to the quantity of space available for each person. Ashford (*1*) has argued that because of the continuum linear approximation of the relation between space and LOS, currently used standards do not correspond closely to the LOS perceived by passengers.

An extensive passenger survey conducted by Condom shed some light on the issue of passenger needs and indicated that QOS of PTBs should be assessed in terms of factors other than space (*9*). These factors should represent the overall quality of the transfer between transportation modes expe-

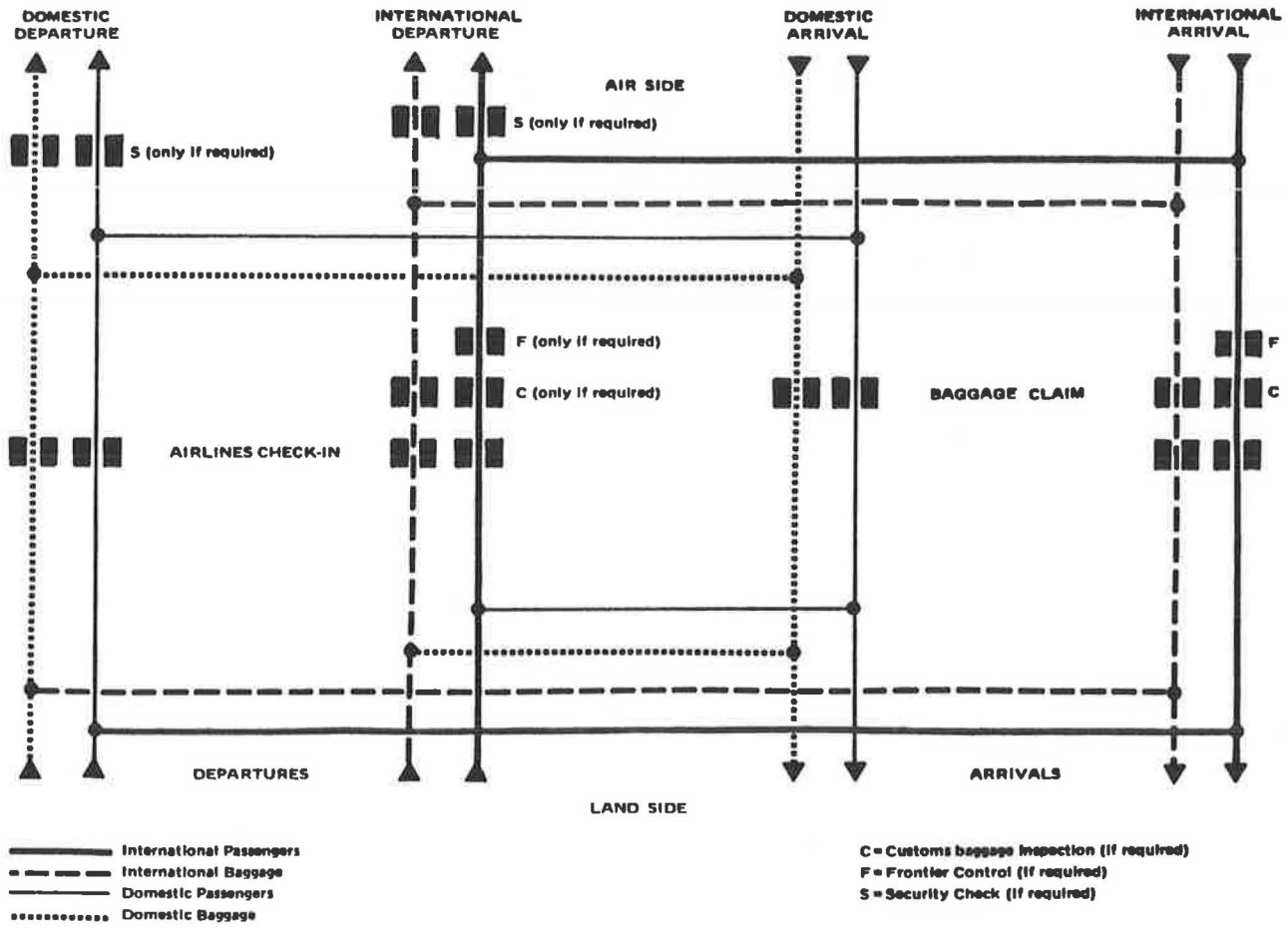

FIGURE 1 Passenger and baggage flow through the PTB.

rienced by passengers. The factors have quantitative components such as walking distance and level changes, waiting time, and availability of space and costs and qualitative components such as courtesy of personnel, information systems, environment, safety, simplicity of procedures, comfort, and convenience. Heathington and Jones have suggested a detailed list of factors (Table 1) that may reflect the user's viewpoint (*10*). Nevertheless, a great deal of subjective judgment or a good understanding of passenger attitudes is needed to identify the most appropriate set of factors from this list to be used subsequently to evaluate QOS in a given PTB.

METHODOLOGY AND DATA COLLECTION

The principal objectives of this study were (a) to perform a disaggregate analysis of QOS at different stages of the flow through the PTB (i.e., in each element); (b) to determine if differences exist among the factors influencing QOS as perceived by passengers when they are classified according to trip purpose, sex, and age; and (c) to determine if factors perceived to influence QOS vary according to the time the passengers spend in the PTB.

The data were collected through personal interviews. To verify the pertinence of the questions, a pilot survey was conducted. From that information, the most relevant set of factors was chosen for detailed study and included in the final questionnaire. Because of time and resource constraints, only the Montreal International Airport at Dorval was studied. Moreover, only departing passengers were considered.

The total number of enplaning and deplaning passengers at Dorval in 1988 was 6,519,000. Of this total, 53 percent flew on domestic flights, 31 percent on transborder flights, 4 percent on charter flights, and 12 percent on regional or local carriers.

The Dorval Airport PTB consists of two pier fingers (one for domestic flights and one for transborder flights) extending linearly from each side of the main area where processing activities take place and where most of the concessions are located.

Pilot Survey

A small sample of 21 passengers was interviewed between 8:00 and 10:30 a.m. on a typical Wednesday. The questions were aimed at obtaining two types of information: (a) mode of arrival at the airport, purpose of trip, frequency of travel by air, and time spent in PTB; and (b) passenger perceptions of the factors influencing QOS for each element of the PTB.

TABLE 1 QUALITY OF SERVICE CHARACTERISTICS (*10*)

Facility	Type of Measure	Originating	Terminating	Connecting	Through	Standby
External walkway	Quantitative	Walking distance Pedestrian assists Pedestrian density Direct flow Lighting Aids for handi-capped	Walking distance Pedestrian assists Pedestrian density Direct flow Lighting Aids for handi-capped	N. A.	N. A.	Walking distance Pedestrian assists Pedestrian density Direct flow Lighting Aids for handi-capped
	Qualitative	Exposure to weather Safety information Systems and signs Pedestrian density Cleanliness Security Environment	Exposure to weather Safety information Systems and signs Pedestrian density Cleanliness Security Environment	N. A.	N. A.	Exposure to weather Safety information Systems and signs Pedestrian density Cleanliness Security Environment
Baggage Check	Quantitative	Processing time Service variability range	N. A.	N. A.	N. A.	N. A.
	Qualitative	Convenience Complexity of procedure Courtesy of per-sonnel Environment	N. A.	N. A.	N. A.	N. A.
Ticketing	Quantitative	Processing time Service variability range	N. A.	N. A.	N. A.	N. A.
		Convenience	N. A.	N. A.	N. A.	N. A.
	Qualitative	Complexity of procedure Courtesy of per-sonnel Environment	N. A.	N. A.	N. A.	N. A.
Internal circulation	Quantitative	Walking distance Pedestrian assists Pedestrian density Direct flow Lighting Aids to handi-capped Cost to passenger	Walking distance Pedestrian assists Pedestrian density Direct flow Lighting Aids to handi-capped Cost to passenger	Walking distance Pedestrian assists Pedestrian density Direct flow Lighting Aids to handi-capped Cost to passenger	Walking distance Pedestrian assists Pedestrian density Direct flow Lighting Aids to handi-capped Cost to passenger	Walking distance Pedestrian assists Pedestrian density Direct flow Lighting Aids to handi-capped Cost to passenger
	Qualitative	Exposure to weather Safety Information systems and signs Pedestrian density Cleanliness Security Environment	Exposure to weather Safety Information systems and signs Pedestrian density Cleanliness Security Environment	Exposure to weather Safety Information systems and signs Pedestrian density Cleanliness Security Environment	Exposure to weather Safety Information systems and signs Pedestrian density Cleanliness Security Environment	Exposure to weather Safety Information systems and signs Pedestrian density Cleanliness Security Environment
Public waiting	Quantitative	Number of seats Size of area Lighting	Number of seats Size of area Lighting	Number of seats Size of area Lighting	N. A.	Number of seats Size of area Lighting
	Qualitative	Seating arrange-ments Comfort	Seating arrange-ments Comfort	Seating arrange-ments Comfort	N. A.	Seating arrange-ments Comfort
	Qualitative	Privacy Amenities	Privacy Amenities	Privacy Amenities	N. A.	Privacy Amenities
Security	Quantitative	Processing time Service variability range Location re con-cessions	N. A.	Processing time Service variability range Location re con-cessions	N. A.	Processing time Service variability range Location re con-cessions
	Qualitative	Convenience Complexity of procedure Courtesy of per-sonnel Environment	N. A.	Convenience Complexity of procedure Courtesy of per-sonnel Environment	N. A.	Convenience Complexity of procedure Courtesy of per-sonnel Environment

(*Continued on next page*)

TABLE 1 (*Continued*)

Facility	Type of Measure	Originating	Terminating	Connecting	Through	Standby
Departure lounge	Quantitative	Processing time Service variability range Number of seats Size of area Lighting Location re concessions	N. A.	Processing time Service variability range Number of seats Size of area Lighting Location re concessions	Processing time Service variability range Number of seats Size of area Lighting Location re concessions	Processing time Service variability range Number of seats Size of area Lighting Location re concession
	Qualitative	Convenience Complexity of procedure Courtesy of personnel Environment	N. A.	Convenience Complexity of procedure Courtesy of personnel Environment	Convenience Complexity of procedure Courtesy of personnel Environment	Convenience Complexity of procedure Courtesy of personnel Environment
Boarding means	Quantitative	Walking distance Level Change Aids to handicapped	Walking distance Level Change Aids to handicapped	Walking distance Level Change Aids to handicapped	Walking distance Level Change Aids to handicapped	Walking distance Level Change Aids to handicapped
	Qualitative	Exposure to weather Safety Convenience	Exposure to weather Safety Convenience	Exposure to weather Safety Convenience	Exposure to weather Safety Convenience	Exposure to weather Safety Convenience
Baggage claim	Quantitative	N. A.	Processing time Service variability range Area size Pedestrian density Claim frontage Care of handling Aids to handicapped Proximity to curb	N. A.	N. A.	Processing time Service variability range Area size Pedestrian density Claim frontage Care of handling Aids to handi capped Proximity to curb
	Qualitative	N. A.	Convenience Complexity of procedure Courtesy of personnel Environment Security Availability of sky cap Location re concessions Seating	N. A.	N. A.	Convenience Complexity of procedure Courtesy of personnel Environment Security Availability of sky cap Location re conconcessions Seating
Information services	Quantitative	Consistency Redundancy Legibility Aids to handicapped	Consistency Redundancy Legibility Aids to handicapped	Consistency Redundancy Legibility Aids to handicapped	Consistency Redundancy Legibility Aids to handicapped	Consistency Redundancy Legibility Aids to handicapped
	Qualitative	Understandability	Understandability	Understandability	Understandability	Understandability
Concessions and miscellaneous services	Quantitative	Number and type Location and size Aids to handicapped Conformance with codes	Number and type Location and size Aids to handicapped Conformance with codes	Number and type Location and size Aids to handicapped Conformance with codes	Number and type Location and size Aids to handicapped Conformance with codes	Number and type Location and size Aids to handicapped Conformance with codes
	Qualitative	Services provided Courtesy of personnel Environment Amenities	Services provided Courtesy of personnel Environment Amenities	Services provided Courtesy of personnel Environment Amenities	Services provided Courtesy of personnel Environment Amenities	Services provided Courtesy of personnel Environment Amenities
International	Quantitative	Processing time Service variability range	Processing time Service variability range	Processing time Service variability range	Processing time Service variability range	Processing time Service variability range

(*Continued on next page*)

TABLE 1 (*Continued*)

Facility	Type of Measure	Originating	Terminating	Connecting	Through	Standby
International	Qualitative	Convenience Complexity of procedure Courtesy of personnel Environment	Convenience Complexity of procedure Courtesy of personnel Environment	Convenience Complexity of procedure Courtesy of personnel Environment	N. A.	N. A.

The passengers were requested to rank the factors for each airport element in order of importance (Table 2).

The statistical package MINITAB was used to analyze the results. The analysis was performed in three steps. First, means and standard deviations of the factor rankings were computed for the two types of passengers (i.e., business and leisure). Because the rankings were on an ascending scale starting from 1, the closer the mean was to 1, the more important the factor. Second, factors were ranked according to means. An analysis of variance was then performed to determine if a difference existed between the mean ranks of each factor for the business, leisure, and combined categories. No differences between the rankings of business and leisure travelers in any of the elements were found and therefore subsequent analyses were confined to combined data. Finally, a test of means was performed on the mean ranks of the factors in each element. On the basis of the *t*-values, the following indicators that were not significantly different at the 0.01 level were chosen for the final questionnaire:

- Circulation elements
  - —Walking distance
  - —Visual information
  - —Availability of space
  - —Level changes
- Waiting elements
  - —Availability of seats
  - —Seating comfort
  - —Ease of access to waiting areas
  - —Layout of seats
- Processing elements
  - —Waiting time
  - —Convenience
  - —Availability of space

Detailed Survey

The final survey was conducted at the same airport. Of the 249 passengers interviewed, the responses of 227 passengers were considered for further analysis; the remaining were discarded because of either incompleteness or inappropriateness of answers. These 227 passengers were from 10 domestic and transborder flights and represented 2.53 percent of the estimated enplaning passenger volume of 8,980 for that day. The survey was not conducted at the most representative time because the end of July is the period of construction holidays in Quebec. However, access to restricted areas was permitted during this time only, and parts of the a.m. and p.m. peak periods of a mid-week day were covered.

The final questionnaire consisted of three sections covering each of the primary elements (circulation, waiting, and processing) (Figure 2). Each passenger was asked to identify the factor that he or she believed was the primary determinant of QOS for each element.

The circulation element was defined to include all corridors and paths that the passengers need to use in order to reach their final destination in the PTB. These are, for example, the corridors from the entrance doors to check-in counters, from check-in counters to security checks, from security checks to gates, and so on. The passengers needed to identify one of the following factors as the primary determinant of QOS: (a) walking distance; (b) information, referring to signs (comprehensibility, location or visibility, and visual flight information and auditory information); (c) availability of space for circulation or degree of congestion; and (d) level changes, referring to vertical movements that require passengers to use stairways, escalators, or elevators.

The waiting element consisted of public waiting areas, departure lounges, and concessions. The suggested factors were (a) availability of seats; (b) variety and location of concessions and essential facilities, referring to the ease of access to these concessions and essential facilities and to the number and types of the different concessions; and (c) internal environment, referring to all aesthetics and climate characteristics such as cleanliness, lighting, color schemes of carpets, furniture, air conditioning, and so on.

The processing element consisted of such activities encountered by departing passengers as ticketing, check-in, and security checks. One of the following factors was to be chosen: (a) waiting time, including processing time; (b) convenience, referring to facilities or devices available to facilitate the processing activity such as ergonomic counters, baggage carousels, baggage carts, and so on; and (3) availability of space.

ANALYSIS OF RESPONSES

The responses to the final questionnaire were analyzed using the statistical package SAS. Because there were no rankings, this analysis was mainly tests of proportions.

Basic characteristics of the respondents are given in Table 3 as an overview of the sample. Of the 227 passengers sampled, 68 percent were male and 32 percent were female. A large portion of the males, as opposed to the females, were traveling for business. Forty-seven percent of the passengers were between ages 30 and 49 (which was to be expected,

TABLE 2 AIRPORT ELEMENTS AND CORRESPONDING FACTORS SUGGESTED IN PRELIMINARY SURVEY

Airport elements	Factors
Parking and curbside	(i) direct access (minimum walking distance) (ii) level changes (going up or down) (iii) space available for circulation (iv) more weather protection (v) better visual information (comprehensible) (vi) lighting (vii) aesthetics (beauty, cleanliness)
Check-in	(i) shorter waiting time (ii) convenience (counter space, ease of baggage handling) (iii) space for circulation (iv) aesthetics
Internal circulation	(i) direct access (minimum walking distance) (ii) level changes (going up or down) (iii) more space available for circulation (iv) better visual information (comprehensible) (v) lighting (vi) aesthetics
Public waiting areas	(i) number of seats (ii) good seating arrangements (iii)space available for circulation (iv) lighting (v) comfort (vi) proximity of concessions and amenities (vii) aesthetics
Concessions and amenities	(i) number and type (ii) location (iii) aesthetics (beauty, cleanliness)
Security check	(i) shorter waiting time (ii) space available for circulation (iii) convenience (iv) simplicity of procedure
Departure lounge	(i) number of seats (ii)space available for circulation (iii) ease of access (iv) lighting (v) proximity of concessions and amenities (vi) aesthetics (beauty, cleanliness)
Boarding	(i) level changes (going up or down) (ii) space available for circulation
Information systems	(i) uniformity (ii) utility (iii) legibility

because most business travelers fall in this age category). In fact, even though the range of 30 to 49 is twice the range of other age categories, the proportion of respondents that were in this category was more than twice the proportions in other categories. Most of the passengers in the last category, 60+ years, traveled for leisure. Fifty-four percent of the sampled passengers were traveling for leisure. (At the time of the survey, many people were on vacation, which explains the higher number of leisure travelers. In other periods, for example during the first survey, the opposite was observed.)

It is clear from Figure 3a–c that the most important perceived factors are (a) information in the circulation element (53 percent of passengers), (b) seat availability in the waiting element (44 percent of passengers), and (c) waiting time in the processing element (60 percent of passengers). However, the relative importance of factors within an element differs from one element to another. For example, in the circulation element, 53 percent of the passengers perceive information to be the most significant and 38 percent believe that walking distance is the most significant. Availability of space is clearly

1) At what time did you arrive at the airport? (1-4)

2) What is the purpose of your trip? (5)

Business 1
Leisure 2

3) Is this your first trip by air? (6)

Yes 1
No 2

4) If no, how frequently do you fly? (7)

Between 1 and 8 times/year.....1
9 times or more/year.....2

5) At what time does your flight depart? _____ (8-11)

6) What is your flight number? _____ (12-15)

7) At which gate do you board? _____ (16-17)

PART "A" : CIRCULATION

This section refers to all places where you circulate, i.e. from entrance doors to check-in counter, from check-in counter to security check, from security check to gate, etc...

8) Which of the following factors do you feel is **most** important? (18)

Walking distance .....1 Go to no.9
Information (signs, visual, auditive) .....2 Go to no.10
Space for circulation .....3 Go to no.13
Level changes .....4 Go to no.15

9) a) Was the distance you walked, between entrance doors and check-in counter (19)

Good? 1
Acceptable? 2
Too long? 3

b) Was the distance you walked, between check-in counter and security check (20)

Good? 1
Acceptable? 2
Too long? 3

PART "B": WAITING AREAS

This section refers to waiting areas, departure lounges and concessions (restaurants, bars, boutiques, etc.).

17) Which of the following factors do you feel is **most** important? (37)

Availability of seats .....1 Go to no.18
Variety and location of concessions (restaurants, bars,cafés,boutiques,etc) and of essential services (washrooms, water fountains, etc.) .....2 Go to no.19
Internal environment (aesthetics, climate, etc) .....3 Go to no.22

PART "C": PROCESSING POINTS

This section refers to processing activities (check-in and security check).

23) Which of the following factors do you feel is **most** important? (46)

Waiting time .....1 Go to no.24
Convenience (handling baggage, etc) ..2 Go to no.26
Availability of space .....3 Go to no.27

PART "D": GENERAL INFORMATION

29) In which category of age do you belong? (56)

Less than 20 1
20 to 29 2
30 to 49.....3
50 to 59.....4
60 or more.....5

30) Sex? (57)

Female 1
Male 2

FIGURE 2 Final questionnaire.

TABLE 3 CHARACTERISTICS OF PASSENGER SAMPLE

TOTAL SAMPLE : 227 Passengers.	
SEX :	FEMALE: 32% MALE : 68%
AGE :	LESS THAN 20: 5% 20 to 29 : 17% 30 to 49 : 47% 50 to 59 : 15% 60 AND OVER : 16%
PURPOSE OF TRIP :	BUSINESS : 46% LEISURE : 54%

not as significant as expected because only 6 percent perceive it as the most important, and level changes came last with only 3 percent of passengers perceiving it as most important. On the other hand, passengers in the waiting element appear to have different priorities, and the proportions for each of the three factors do not differ as much as they do in circulation. For instance, 44 percent perceived seat availability as the most important, 34 percent of the passengers chose the variety and location of concessions, and 22 percent chose internal environment.

Information is probably regarded by many as the most significant factor because it directly affects other factors. For example, passengers can minimize walking distance and level changes if the appropriate information is available at the appropriate place to aid them in reaching their destinations. Also, when information systems are well managed and well utilized, obscurity and time lost in searching are minimized. A certain confidence then develops in a passengers' mind and helps them better appreciate the airport facilities and procedures. Availability of seats appears to be a logical factor that influences QOS, when passengers are in the waiting element, whether the department lounge or public waiting area, because people need to occupy themselves until boarding time. This need to be occupied and pass time is perhaps why accessibility to concessions is perceived as important by an equally large percentage (31 percent) of respondents.

The factors perceived as determinants of QOS in the processing element appear completely different from those in other sections. The 60 percent who feel that waiting time is the most important is twice the proportion of those who chose convenience (31 percent) and almost seven times the proportion of those who chose availability of space (9 percent). Once again, space is of little significance.

STATISTICAL COMPARISON OF FACTORS

To determine if there is a significant difference in the passengers' perception of the most important factors (QOS variables), X^2 test was performed on the proportions. This enabled 95 percent confidence that, for example, the share of passengers who believed that information was the most important factor for circulation (see Figure 3a) is significantly different from the share of passengers who identified walking distance as the most important factor. Similar differences existed between the number of votes received by the most important factor in the waiting element and the number of votes received by the most important factor in the processing element, as seen in Figures 3 b and c.

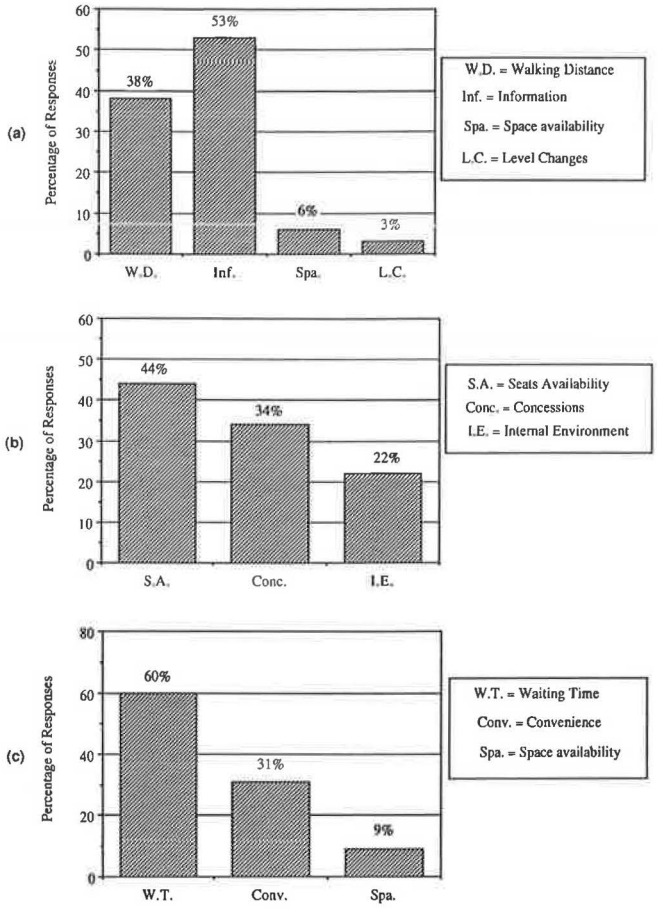

FIGURE 3 Passenger perception of variables in elements. (a) Circulation, (b) waiting areas, and (c) processing.

There was also a significant difference at the 5 percent level between the business and leisure travelers' perception of the most important factor within each element of the PTB. For example, it is evident from Figure 4 that waiting time is the most important factor at processing for both groups of passengers. However, there is a significant difference in the proportions of the two groups who rated this factor in the same way. In other words, the difference between the proportion of business travelers (70 percent) and leisure travelers (50 percent) who identified waiting time as the most important factor was significantly different. One can also see from Figure 4 that, for circulation, the percentage of business travelers who identified walking distance as the most important factor is greater than the percentage of leisure travelers; it is the reverse in the case of information.

These differences appear to reflect differences in the value of time for the two groups as well as differences in familiarity with the airport (i.e., business travelers, who are more frequent travelers, are less likely to need information than leisure

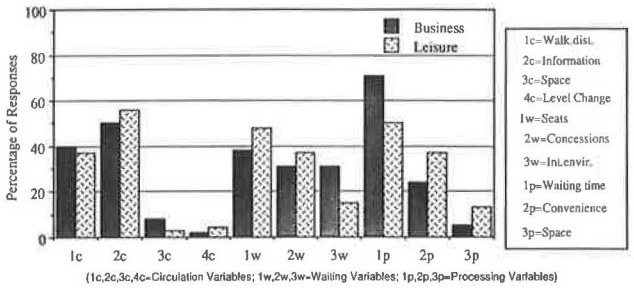

FIGURE 4 Comparison of variables by trip purpose.

travelers, who fly less frequently). However, the differences are not statistically significant in all cases.

Significant differences also exist between the perceptions of males and females. Although both males and females consider walking distance and information significantly more important than space and level changes, a significant difference exists between the proportions of the sexes identifying walking distance and information as most important (see Figure 5). There is also a difference in the proportions of the sexes who identify the same factor as most important. For instance, the percentage of males who are concerned with waiting time at processing is significantly larger than the percentage of females. On the contrary, the percentage of females identifying convenience as the most important factor is much greater than that of males.

When the different age categories shown in Figure 6 were considered, it was found that there are significant differences in the proportions that identified walking distance as being most important for circulation. The differences are also significant in the case of information. These differences demonstrate the relative importance of walking distance for the different age categories. Nearly 55 percent of the 60+ years group believed walking distance to be the most important factor. In the waiting element, one can find the same degree of age differences in the proportions that identified availability of seats as the most important factor. The majority (over 65 percent) of the older passengers thought that seats were most important, but they were hardly concerned about the internal environment as compared with concern about the internal environment expressed by other age categories. As for the processing element, age categories 20–29 and 30–49 were mainly concerned about waiting time. The proportions of these two categories that found convenience and space to be most important are significantly less than for waiting time, whereas the 60+ years category is indifferent among their choices.

The amount of time spent in the PTB by business and leisure travelers is presented in Figure 7. Over 60 percent of the business travelers spent between 30 and 90 min in the PTB before the flight. On the average the leisure travelers spent approximately 30 min more than the business travelers. Note, however, that regardless of the time spent, there is no difference in the perception of the different factors between business and leisure travelers (Figure 8).

CONCLUSION

There are many factors to be considered other than space or time when it comes to evaluating QOS from the passengers' point of view. This limited study has also demonstrated that QOS is a complex concept that is inappropriate to evaluate with one indicator. The factors influencing QOS differ

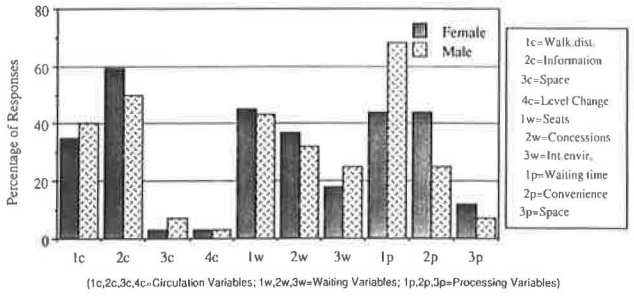

FIGURE 5 Comparison of variables by sex.

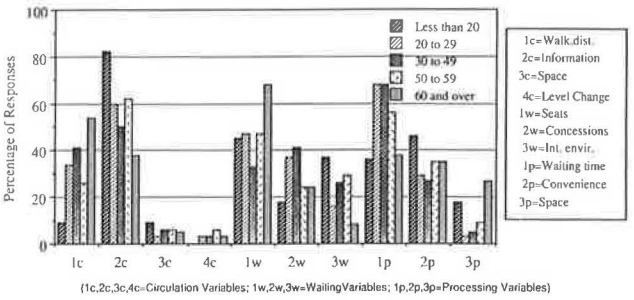

FIGURE 6 Comparison of variables by age groups.

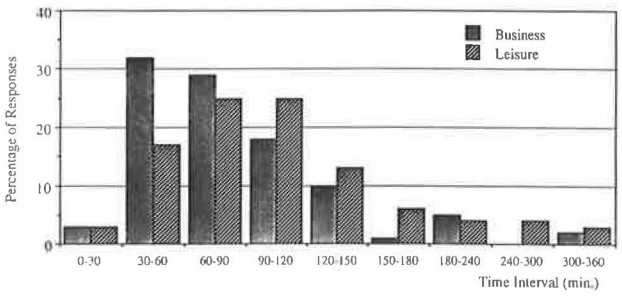

FIGURE 7 Time spent in PTB.

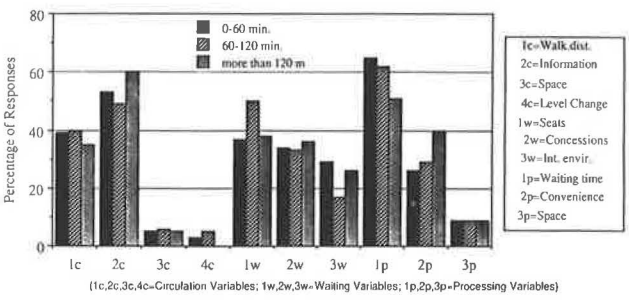

FIGURE 8 Comparison of variables by time spent in PTB.

depending on the element of the PTB that one is considering. Thus, changing passenger needs should be considered in planning and designing PTBs.

The optimal set of evaluation factors for a particular facility can only be determined by interviewing passengers. For instance, the factors identified in this study may not be the optimal set to evaluate another site. This study can be considered a pilot study to determine the bases for evaluating QOS in PTBs. However, the problem of finding a compromise design that could account for the concerns of different age categories, business or leisure travelers, and males and females still remains unsolved. Moreover, incorporating such qualitative aspects as information and internal environmental quality into the designs and developing a yardstick for measuring them could be an extremely difficult process. Even if this dilemma could be resolved, the process of developing design standards that could satisfy the needs of other PTB users will be an uphill task.

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