How Airport Users luggage affects their Perception of Seat Design at Airports

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1. Introduction

Airports have developed to keep pace with the development of airplanes. Depending on their size and target passengers, airports can be divided into two types: international airports and regional airports. Users of international airports have varied backgrounds, so international airports place an emphasis on image building, since they function as a brand for the country. Regional airports, however, provide low-cost and short-distance flights, which generate economic growth in one region. Facilities at airports and their design must meet travellers' needs. Travellers do not merely pass through customs and board their flights, and a modern airport does not only provide comfortable facilities – it also provides duty-free shopping stores and perhaps a shopping mall. Because the behaviour of travellers at airports is diverse, the facilities are not designed just for a specific user group. Instead, they meet all kinds of travellers' needs.

Seats are common facilities in public spaces. During the 1940s, seats in airports were comfortable, movable and had armrests. At that time, this type of design was international. Now, airports continue to use this design with their new arrangements for seats. Seat users prefer seats at the edges of a rank, at a corner and with armrests. For the aged, resting occupies half of their journey time. When resting, they put down their luggage, which causes safety concerns (Chang, 2007). In public spaces where there are many people, a social centrifugal design is often used to maintain volume and order (Hanyou, 2009). Gender is also one factor contributing to the choosing of seats. People of the same sex will tend to sit face-to-face, while those of a different sex tend to sit next to each other (Leventhal et al., 1978). Furthermore, most people think that public seats should have backs (48%) and that they should be in groups of two or three (95%; Ni, 2002). The integration of these design principles into the design of seats is an important task and the subject of this study. This study aims to understand the arrangement of seats so that travellers who do not know each other do not feel embarrassed when sitting together. The type of arrangement that best allows travellers to place large items of luggage beside them, the optimum number of seats in each unit and whether tables or armrests should be provided is determined through observation and continuous recording. In a survey about facilities and services at Taipei International Airport (2010), respondents noted that there was no place to put their belongings and 22% of the subjects were not satisfied with the service facilities. This demonstrates that seats in airports have more than one priority. Unlike ordinary public seats, seats in airports have to meet more diverse needs, such as for standing space and luggage space, and a provision for the consumption of food, sleeping and chatting. Previous studies have focused on how luggage is transferred safely (Dale et al., 2007) or how people form their own area when choosing seats. For example, a single traveller will choose seats in a corner and put his or her luggage on the neighbouring seat, which allows single travellers to form their own area more easily than when travelling with a companion (Batchelor & Goethals, 1972; Collett & Marsh, 1980; Rivano-Fischer,
Fewer mentioned the relationship between the travellers' needs and the facilities provided.

This study, using Taipei Songshan Airport as an example, aims to examine how the arrangement of seats can be better suited to the behaviour of travellers (see Fig.1. for layout). Taipei Songshan Airport was built in 1936, when Taiwan was under the rule of Japan. At that time, it was called "Matsuyama Airdrome." After World War II, it was renamed "Taipei Airport." In 2009, the opening of the Taipei MRT Neihu Line made Songshan Airport into the second airport that can be reached by the public metro system in Taiwan. The importance of the transportation position to the airport can easily be seen. There are two terminals at Songshan Airport. Terminal 1 was renovated for international flights, while maintaining the original construction of the building. Thus, this terminal was chosen to be the observation site for the study. Terminal 2 is for domestic flights.

In the past, people have responded negatively to the facilities at Songshan Airport. This study aimed to find out people's preferences for the use of seats and the placing of luggage by means of observation and through the distribution of questionnaires. Taking advantage of the opportunity provided by the remodelling of Songshan Airport, the arrangement of seats could be changed based on the results of observation and the questionnaire surveys. Then, 495 travellers were observed in a twelve-hour period. The new seating arrangement was verified, which provided an input into the future improvement plan.

3. Results of Investigation

3.1 Duration Recording

Most of the people observed were middle-aged. They were family or friends. The number of companions ranged from one to three people, but most travellers were in pairs. The general pattern observed was that three travellers were usually a family and two travellers...
were friends. Travellers usually chatted with each other, daydreamed, used mobile devices or slept on their seats. They usually lay back in their seats. Most of the travellers did not carry large luggage when they were in the waiting lounge. During the observation, people usually took only one piece of luggage with them to the waiting lounge. Travellers with no luggage sat straight and travellers with one piece of luggage sat with their body facing to the side. More male travellers slept when they were on the seats, while more female travelers chatted. Travellers usually lay back in their seats, males more often than females. Travellers sat straight when they slept, chatted, daydreamed, or used mobile devices. Travellers who did not place their backs against the backrest were relatively smaller in size. The seat utilization rate for each observation period in each area is shown in Fig.3.

The utilization rate represents occupied seats / total seats. The utilization rates in Zone A and Zone C were similar. The utilization rate was higher in Zone A than in Zone B. Zones A and B are both on the first floor, but differently arranged (Fig.4.).

**Zone A**

From the observation of Zone A, it is evident that seats in the first row and beside the aisles were frequently occupied (Seats 04, 12, 08, 16, 17, 18, 19, 20, 21, 22, 23, 24). This demonstrates that travellers chose seats that allowed them to move most easily, so the seats by the aisles are more often occupied. The luggage was mostly placed in the aisles, especially in front of the first row. When family and friends sat together, they did not keep their luggage beside them if they sat on inner seats. People with companions often chose seats in the first rows, which allowed space for items of luggage.

**Zone B**

Seats in Zone B are arranged densely. The observation demonstrates that most travellers chose seats in the first row and on both sides. Because there is no aisle in Zone B, luggage was placed along the sides. Luggage was often placed around Seats 17, 23 and 34. Seat 19 was the most frequently occupied seat.

**Zone C**

In the waiting lounge on the second floor, there was less luggage because travellers who had checked in their large luggage items at the check-in counter. Most travellers placed their luggage near their seats. Travellers with more than one piece of luggage arranged their luggage neatly. The utilization rate in this zone was average (Fig.4.).
the reasons for the choice of seats. Travellers who sit on seats near the centre can see the check-in lobby on the first floor and these seats are bigger than others. There is a better outlook from these seats. It is hoped that seats in Zone C can be more effectively used in the future (Fig.5).

The number of times each seat is used and how many times luggage is placed beside each seat is also of interest. This identifies the seats in each zone that are more suitable for resting or placing luggage. Two formulas are given below:

1) Number of users for each seat = total number of users / total seats
2) Number of pieces of luggage for each seat = total number of luggage items / total seats.

Fig.5. shows that the number of users of each seat in Zone A was more than that for Zone B. However, the number of items of luggage for each seat was greater for Zone B than Zone A. There is an aisle between the seats in Zone A, so it is more convenient for users to pass. The aisle in Zone A also allows travellers to place their luggage beside them. Travellers in Zone B have to place their luggage in front of their seats, which results in inconvenience for people who want to pass through the Zone. On the first floor of the airport, many travellers wait in line to check-in with their luggage. Although the space for luggage is almost the same in Zone A and Zone B, the utilization rate is higher in Zone A. This shows that the seat arrangement in Zone A is more suitable.

Zone C is located on the second floor, near the departure gates. Most large luggage has already been checked in, so the amount of luggage at each seat is lowest in this zone. However, the comfortable sofa in Zone C is more frequently used than the seats in Zones A and B.

During the continuous recording, 20 travellers were observed in Zones A and B and another 20 in Zone C. The movements of the travellers are described in more detail as follows.

**Zones A and B**

The first example is a couple. The woman sat down first. The man placed his baggage in the aisle (for 75 seconds). After the baggage was put down, they talked to each other, played with their cellphones and chatted on their phones. Ten minutes later, the man went to buy some food and came back to the seat after two minutes. They continued to talk and play with their cellphones. Twenty-five minutes later, the woman left for the gift shop and came back with a gift after three minutes. They started to repack their baggage. Their movement pattern shows that they did not leave the seats together: one person stayed at the seat while the other went away. When they needed to repack their baggage, the man used other empty seats to place their belongings.

Another case was a mother with her child. They sat on a seat and the mother helped the child put a straw in his drink. They stayed for only thirty seconds. The next case was a man who carried one large bag and one small one. He put his luggage beside his seat, occupying a small area. He took out his notebook and used it for three minutes. He then put on his jacket and left the seat. A man with a suit had a large bag. He did not sit on the seat. Instead, he put his briefcase on the seat and repacked his bag. He took off his jacket, put it in the bag and then left. This took about two and half minutes.

Another man carried a large bag and a small one. He organized his clothes and took his Walkman out. Three minutes later, he left his seat. This observation indicates that people who used the seats to repack their baggage stayed at the seats for a short period of time. In two similar cases, there was a middle-aged woman who spent 97 seconds repacking, and two male travellers, one of whom sat on the seat while the other repacked the baggage. They stayed for only a minute and left. A man with a large and a small bag also sat on a seat, waiting for his companion. He looked around for about fourteen and a half minutes. When his companion arrived, they went to the check-in counter and came back to the same seat without their baggage. Because they did not feel comfortable on their seats, they were continuously moving their bodies. They occupied three seats and placed a small bag on the middle seat. They left after talking to each other for eleven minutes.

In another case, one elderly female and three middle-aged women companions mostly arranged their belongings and talked. They had brought two large bags and three small ones. The elderly female sat for seven and a half minutes. The other three women sat for five minutes, half a minute and two and a half minutes, respectively. They often stood up to stretch and then sat down. There was also an elderly female with five companions (one middle-aged male, two middle-aged females and two children); the elderly female used the seat for seventy-two minutes. At first, only the elderly female sat down with a large and a small bag. She repacked the baggage and organized her own clothes. Thirty minutes later, her companions came with two luggage carts loaded with baggage, including a large piece of baggage and a baby carriage. They occupied an area with these belongings and talked and rested, taking turns to carry the baby. When they ate lunch, they did not lie back. The elderly female used her seat for a longer time. The middle-aged male spent an hour on his seat and only five minutes having some food, and the two middle-aged women spent one hour chatting on their seats.

**Zone C**

Most of the travellers in Zone C had checked in and did not carry large items of baggage. Three women
chose Seat 44 and formed a circle to eat their packed lunch and chat.
A couple chose Seat 52 to take pictures of themselves. They could see the flight schedule from Seat 52. One father took a child with him. The child crawled across Seats 23, 24 and 25. A man chose Seat 56 to read with his legs crossed. Two males and one female used two large items of baggage and a small item to occupy an area, laying their backs on the seat to rest and talk. Later, one male and one female came to join them with their packed lunch. These five travellers constantly changed their posture, crossing hands or crossing their legs. They stayed for forty-eight minutes.

A middle-aged couple chose Seat 11, where they could see the flight schedule board in the distance. Because the schedule board was too far away, the woman left the seat to check the schedule. They stayed for about thirty-two minutes. During this time, they talked, took pictures and switched to other seats. Four males and one female chose Seats 36, 37, 47, 48 and 49. They moved Seats 36 and 37 to use them as a table for their food. After eating their food, they took out some documents and talked. They also used their baggage to occupy an area. Because they were talking actively, they all leaned forward and did not lie back. They stayed for about forty-five minutes and then left.

Continuous reporting shows the different ways in which single travellers and groups of travellers use the seats. The results are as follows.

When there is only one traveller, seats in Zones A and B have higher backs and users have to straighten their upper body to lie back, so users are unable to sit for a long time and rest. In the observation, many single users put their hands behind their head, to reduce the load on the spine. Seats in Zone C are sofa-like: they are lower and made of softer material. Many single users of these seats read books and played with cellphones. Single travellers care about privacy and their own space, so they chose seats that were further away from other users and they often utilized baggage to occupy a space. During continuous reporting, single travellers made phone calls, played with cellphones, took a nap, listened to music and repacked their luggage. Travellers with baggage chose seats beside the aisles in order to open the suitcase to repack their baggage. It was found that travellers often put their gifts in their baggage and travellers in suits often took off their jackets and put them in their suitcases, so sufficient space for baggage is important in Zones A and B. When the utilization rate was low, single travellers occupied more space by putting small baggage items on nearby seats.

One or more travellers together first chose a section of seats. After they sat down, they placed their baggage to occupy an area and in order to communicate with each other. If any companion needed to leave the seat to do something else, such as buying food or going to the toilet, at least one companion stayed behind to look after the baggage and keep their seats. They took turns in order to keep their seats. Their posture on the seats was different, depending on their behaviour. Travellers who were resting laid their backs on the seats; others who were eating a packed lunch or talking actively leant forward.

Generally speaking, seats in Zones A and B are suitable for a short period of time, so travellers often repack their baggage and clothes near these seats. Because of the high backs, travellers who want to stay...
for a longer time have to change their posture to reduce the load on their body. The sofa seats in Zone C are more suitable for longer periods: since they are arranged in an arc-shape, travellers can easily establish an area; the means of utilizing the seats are more flexible; travellers can chat, eat, drink and rest; and, the more convenient location of the flight schedule boards allows travellers to use seats in Zone C more comfortably.

3.2 Questionnaire Survey

Two hundred questionnaires were distributed in May 2012. The questions enquired about travellers' experience of using and choosing the seats and their evaluation of the facilities at the airport (see Appendix for the questionnaire). Of the subjects, 52% were female and 48% were male; 67% were young adults who flew at least once a year and only 12.5% flew alone. Most of the subjects had one or two companions.

Results of the questionnaire survey:

Over half of the subjects had one or two companions when they were in the airport. Most people found a seat to rest and wait (21.5%), chat with partners (15.4%) or went shopping in the store (19.7%; see Fig.6.). Generally, when the design of chairs is considered it is confined to the chair itself. This study, however, examined the design of chairs in relation to the user and the environment. It attempted to understand the reasons why travellers choose their seats. When asked what functions a seat should provide, most of the subjects answered: space to put luggage (26%), proximity to the boarding gates (23%) and good views (16%; see Fig.7.). The subjects thought that seats should be more private (15%), flight schedules should be more easily seen from the seats (24%) and that they should be able to talk to their companions in other seats (17%). The reasons for choosing the facilities are reclining seats (28%), space to put luggage (25%) and good views (15%; see Fig.8.). The subjects expected seats on which they could lie back (18%), which had space to put luggage (15%), were made from comfortable material (15%) and were suitable for long periods of use (12%; Fig.9.).

3.3 Evaluation After Rearrangement of the Seats

The renovation plan for Taipei Songshan airport was used as a basis for the rearrangement of the seats. The goal was to increase the utilization rate and make the placing of luggage more convenient. Taipei Songshan airport rearranged the seats on the first floor and second floor; that is, in Zones A, B and C. Based on the previous observation, the arrangement of Zone A is more suitable for taking luggage in and out of than Zone B.

This study suggested combining Zones A and B, using the arrangement of Zone A (see Fig.10.). For Zone C, there was a large difference in the utilization rate of each seat. This may be attributable to the asymmetrical arrangement. Several seats were moved to create a more symmetrical arrangement and to smooth the traffic flow.

New Zone A after rearrangement

Before the rearrangement, luggage was mostly placed beside the seats on the left. The number of seats was increased and the placement of luggage seemed more even. Every seat was taken by someone. However, the luggage often obstructed passengers who were walking, especially when the luggage was placed in the aisle.

New Zone C after rearrangement

After the seats in Zone C were adjusted, they were more uniformly used by travellers. When Seats 34 and 35 were separated, the utilization rate for Seats 24 to 28 and Seats 37 to 42 became higher. However, Seats 35 and 36 were not occupied at all. This may be attributable to their position, which obstructs the traffic flow and causes trouble to the users.
01 to 34 were occupied more often than other seats. The two formulae employed in the previous section relating to the number of users of each seat and the number of items of luggage at each seat were employed to see if the new arrangement of the seats was indeed better. Table 2. and Fig.11. show that the utilization rate in Zone A decreased but the number of items of luggage increased. The number of users of each seat in Zone C remained the same, but the number of items of luggage increased.

Table 2. Comparison between the Utilization Rate Before and After Rearrangement

|                  | Before | After | Before | After |
|------------------|--------|-------|--------|-------|
| Number of users of each seat | 5      | 3.39  | 5.12   | 5.08  |
| Number of luggage at each seat | 2.79   | 2.86  | 1.53   | 2.53  |

Fig.11. Number of Users and Luggage of Each Seat in Before and After Rearrangement

4. Discussion

The questionnaire survey demonstrates that travellers at the airport are not often alone. Most are with family and friends, so they talk and communicate. The observation showed that most travellers sit with their backs on the seats, and most bring one piece of luggage. Because luggage is not easily moved, most placed it around the aisles or in front of the first row. Luggage blocked the aisle if it was placed incorrectly. When travellers sit down and place their luggage, they occupy a small area so that they can chat to their companions and look after their luggage. This finding echoes the findings of Ni's research in 2002. Users prefer to choose seats at the sides, at the corner, or with armrests.

Both Zones A and B are on the first floor, but the utilization rate in Zone A is higher than that in Zone B. There is still an aisle in Zone A, which enables travellers to move about a little. However, the seats in Zone B are arranged more densely. When the seats in the first row were fully occupied, the other two rows remained empty. A comparison of the three zones shows that the seats which are more private are more frequently occupied. When travellers rest on their seats, they also like a small area so that they can chat to their companions and look after their luggage. This finding echoes the findings of Ni's research in 2002. Users prefer to choose seats near to the boarding gates and to have good views.

In terms of the relationship between seats and luggage, the ideal situation is that one seat accommodates one piece of luggage, which would mean that the number of users of each seat approximates to the number of pieces of luggage for each seat. The rearrangement was designed to make travellers with luggage feel that they have more room to place their luggage and to rest. The increase in the number of luggage pieces shows that this goal is achieved. However, when there are more users with luggage, each user expands his/her territory, so other users retreat. After rearrangement, the aisles between the seats do allow users' access. If the spaces in the aisles are not wide enough for luggage, there is no increase in the utilization rate. These are priorities for the improvement plan for Songshan Airport.

5. Conclusions

Airports, as the starting points for international travel, must fulfil the needs of travellers from different countries. Previous annual reports on Taipei SongShan Airport have criticized the quality of the facilities. This study chose airport seats, which are the most extensively used facilities in airports, as the research topic. By using observation and a questionnaire survey, an attempt was made to understand the problems of the current situation and to propose suggestions for a future design. This study shows that the future design of seats should take the following requirements into consideration:

1. Seats should suit travellers' different postures while resting or waiting. Travellers are asked to check in two hours before departure, so they must stay at the airport for some time. Shopping centres at airports also make use of travellers' free time by stimulating consumption and marketing the country's culture. For travellers who merely want to take a rest before their flight, the design of seats should account for the different body shapes of people from different countries, with comfort as the priority. When there are flight delays, the seats should allow travellers to rest for a longer time. Armrests make it easier for people to get up and sit and making the armrests removable could increase the usefulness of the seats in special situations.

2. Widening the aisles: The arrangement of seats in Zone A is obviously more suitable than that of Zone B. The aisles are retained, making it more flexible for users to move. When Zone A was expanded, however, the utilization rate showed no notable increase because the present width of the aisles is about one metre. If the travellers take their luggage into the aisles, traffic flow is obstructed because the gaps between the rows are also not wide enough to place luggage. Most of the luggage is placed in the area surrounding the seats, so the width of aisles and gaps must be enlarged and more seats added, to make travellers with luggage more comfortable.

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3. Adjusting the distances between seats to allow space for luggage:

Travellers bring luggage when they go to the airport, and before checking in, they have large items of luggage. When they have to wait in line at peak times, luggage is not only a burden, but also an obstruction, which hinders other travellers. The results of the observation show that travellers with luggage choose seats in the first row, so that they can place their luggage in front of them, which means that the gap between different rows is important. Different arrangements might address this problem. Seats that all face the same way restrict the placement of luggage and the position of the aisles. A face-to-face seating arrangement allows people to have more space. This is often seen in many international airports. It is necessary to account for "personal space" and "territoriality" when designing public seats (Lin, 2010).

4. Arranging the seats so that travellers can enjoy the view and see the information on the flight schedule:

The seats in the newly built observatory at Songshan Airport allow passengers to view take-offs and landings. However, seats with this type of view are not commonly found at airports. Most of the seats with views are located in front of the boarding gates. The survey shows that the presence of a good view influences their selection. This type of seat allows a different view and lets travellers enjoy their waiting time. Many international airports use TV commercials or billboards to attract travellers attention and promote their countries. However, in addition to these visual attractions, information about the flight schedule and the present time are vital, so the location of seats must allow access to visual information.

5. Arranging the seats symmetrically for a smooth traffic flow and higher utilization rate:

Zone C on the second floor originally had an asymmetrical arrangement of seats. These asymmetrically placed seats blocked the traffic flow. After the rearrangement, several small areas were formed in Zone C. This helped to increase the utilization rate and also the number of luggage items. Although Seat 27 appears not to be arranged symmetrically with the other seats, its utilization rate is not very low because it is in the centre of the small area. Most users tended to prefer their own private space, so arranging the seats symmetrically and creating small open areas with a centre increases the utilization rate.

6. Arranging the seats to allow travellers to communicate and have their own privacy:

The survey showed that most travellers come with friends or family, so the arrangement of the seats to allow communication is important. People who travel alone also need some privacy; travellers with no luggage also choose a more private space. If they sit on the seats in the back rows, they feel more secure and comfortable, as they can see all of the seats. The design and arrangement of seats must consider both the needs for communication and privacy, therefore fulfilling different users' expectations.

In summary, the satisfactory design of seats in airports should give passengers enough space to place their luggage and to have food and drinks. Four or five seats per unit is the best combination, and tables are useful in certain places. The seats should also be near the flight schedule board. The arrangement of indoor chairs can allow more efficient communication, even between teachers and students (Kaya, 2007). At airports, the need for communication between companions and the need for personal privacy coexist. The research results show that congestion will bring negative effects, reducing users' time in seats (Baker et al., 1994; Underhill, 1999). The arrangement of seats will determine how long passengers stay (Suda, 1998). Thus, when seats are in a row, space should be reserved as aisles. Four or five seats are suggested for a unit. This can prevent passengers from being blocked by luggage. Moreover, small tables can be appropriately placed to fulfill the need for a place for putting things down temporarily. This research did not examine seats arranged on a temporary basis, which could be a flexible way to adjust the arrangement of seats to meet the needs of people at different times. However, if a normal setting of seats can be defined, this would still be a more convenient method to set the seats for both users and the airport. Besides, the present study did not bring travellers who have already passed customs and still carry baggage into discussion. The observation only focused on the international terminal. Whether travellers have different needs after entering customs could be a possible further topic. In the future, the researcher plans to investigate the whole process of checking in, going through customs and waiting for boarding in order to define what kinds of facilities are the best. When a public space is going to be reconstructed, the present situation of users should, it is suggested, be recorded. After the reconstruction is completed, the users' experience of the original design and the new design can be compared; thus users' needs can be better understood.

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