

AISLE CHAIR DESIGN PROPOSAL INFORMED BY OUTREACH TO MANUFACTURERS: EXECUTIVE SUMMARY

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The team decided to modify features of the commercial Aisle Buddy design, features that addressed the major concerns that came out of the combined class research. Most of these concerns could be addressed by changing a few aspects of the design and without having to change the entire precedent design itself. Most of the major concerns were addressed, however a few concerns were not addressed by our modifications and further modifications of the chair have been suggested as a second iteration design chair of the chair. These second iteration changes have less benefit and more cost than the changes proposed in this iteration. The team feels that these small iterative changes to the chair will allow for a smoother transition of the chair into market and lessen the purchasing costs for the airlines while raising acceptability and preference of the chair. The second iteration of this chair will be a completely new designed chair to the Aisle Buddy line.



REVISED HEADREST DESIGN



REVISED ARMREST DESIGN



REVISED FOOTREST DESIGN

The headrest was chosen as one area of the Aisle Buddy which deserved redesign. This was initially because of the concern raised about head lolling by those persons with weak necks. The headrest is present on the Aisle Buddy, which is great for when people are being tipped backward and need their head to press upon something. However, the headrest is slick and is not design to be leaned back on for support or comfort. Further consideration of the headrest presented another opportunity for the team to address because the headrest on the Aisle Buddy serves another function: as a tool for relaxation since the Aisle Buddy is now also having a secondary use and the users are sitting for longer periods in them between flights.

The redesign of the headrest allows for a stable and comfortable support of the head by cradling the head with a cushioned foam support. The current headrest design on the Aisle Buddy is adjustable, and this feature was kept because it is valuable in accommodating the various sizes of aisle chair users.

The original headrest is 280 mm in width. The redesigned headrest maintained this width of the structural frame of the headrest since there was no reason to change it. However a foam covering was designed to fit on that structure of 280 mm, with a resulting width of 300 mm.

The average head width of people is 150 mm though that number can get to as great as 171 in the 99th percentile. Even so, every individual's head will be able to rest comfortably on this headrest, as not only does it accommodate 100 percent of the population, but the headrest still has the capability of vertical adjustment up to 406 mm.

The armrest was chosen as another aspect of the Aisle Buddy to redesign because the team felt it had great potential for addressing some of the concerns voiced by the users and operators. The concerns that were addressed with our redesign were to keep the arms "inside" the chair and toward the body, as opposed to falling out of and becoming injured, and also to offer better lateral support for the users. A third concern addressed is the issue of comfort, as the Aisle Buddy has become more of a transfer-aisle chair hybrid and users will be sitting in them for longer. Thus, comfort is a key issue that was addressed for this particular re-design.

The armrest redesign includes a wider platform to rest the arm on (2 inches, 0.5 inches wider than the original foam wrapped tubing). The armrest uses the same tube structure as the last armrest, however the foam portion of the armrest has been modified. A concavity was added to the new, flatter foam shape, offering better stability for keeping the arm on the armrest as opposed to rolling off of it with the old, round armrest shape. The added foam padding will also provide needed comfort for users resting their arms.

These changes are able to be made because the armrest of the aisle seats in airplanes are 2 inches wide, and the armrests on the Aisle Buddy are higher than those armrests, allowing for extra room for the users arms and armrests. The designers also ensured that the new foam covering on the armrests would not conflict with the mechanics of the current design, so that the armrests are still able to flip up and down without running into the seatback of the chair while being flipped up. The Aisle Buddy already provided a basis for being able to adjust the armrests outward or inward, and the team felt no need to modify this feature, as it was deemed beneficial.

The armrests which were originally on the chair already helped to provide lateral support for individuals, both with the use of their arms and without. However, the redesign of the armrest allows those people who have use of their arms a more comfortable place to rest them, to brace themselves when needed (ie. over the jetway bump) and to provide further, personal lateral support aside from the strap system, which is sufficient. The team feels that aside from the other two uses, allowing the user to have this measure of control over supporting themselves will help to provide psychological satisfaction with the product.

With an average forearm length of 252 mm, and the amount of usable armrest (armrest covered with foam and not behind the chair back) of 254, the average forearm length should be 100 percent supported. However, at three standard deviations, the range of arm lengths that will likely be using this aisle chair are from 196 mm to 308. In this range, arm lengths will be 130 percent supported to 80 percent supported. There has been no problem associated with having armrests too long, as the user does not have to rest his or her arm on the entire length of the armrest. Though, some benefit may be derived from being able to rest the hands on the armrest. The portion of the population with longer arms still have at least an 80 percent support of the forearm with this armrest and should be able to rest comfortably with that much support.

The footrest was the third and final component redesigned for this iteration of the Aisle Buddy. The footrest was designed to address the concern for feet sliding off of the footrest. In addition, keeping the feet stable during a transfer also helps provide a sense of security.

The footrest was designed to accommodate all foot sizes and allow slip resistance to any foot via a front lip and two side pieces. The side rails keep the feet from sliding off laterally while the front lip keeps the feet from sliding off frontally. The front lip is only 6.35 mm tall, allowing any shoe to sit atop of it without any discomfort, yet allowing for either enough resistance to keep the feet on the rest or to hook onto part of the shoe to prevent sliding. The footrest has maintained the precedent design’s vertically adjustable nature.

The footrest is 330 mm wide and 152 mm deep. While the average foot breadth is 99 mm, the 99th percentile of people using this aisle chair may have a foot breadth of 126 mm. With both feet together, the foot width at the 99th percentile is 252 wide and shoes may add up to an additional 25 mm per shoe via protrusion of the sole. With a combined total of 302 mm, any sized foot in virtually any shoe should be able to fit in the confined width of the footrest. Length of the users’ feet is not an issue, as has been mentioned above.

The Aisle Buddy chair was chosen as the precedent design chair not only because it meets the requirements imposed by the ADA, but also because it offers better support and physiological stability than the other aisle chairs. This case was proven when the Shepherd Center took an interest in their aisle chair design because the back support of the chair was so beneficial and comfortable. Not only did the back support meet the approval of the Shepherd Center, but the seat cushion has meet the approval of many of the users. The seat of the Aisle Buddy has more padding than most, if not all other aisle chairs on the market. The aisle chair, coming equipped with both headrests and armrests provides even further comfort, leading people to stay in the aisle chairs longer, or as mentioned before, not transfer out of them into a secondary transfer chair between flights.

DIMENSIONS	ELEVATING SEAT	NON ELEVATING SEAT
Seat Width:	13"	13"
Seat Depth:	17.5"	16"
Seat to Floor:	21" (min), 28.5"(max)	Front 22"/Rear 21"
Chair Height: (w/o Headrest)	36" (min), 43.5: (max)	37: (min)
Chair Width:	14.5"	14.5"
Front Wheels: (swivel)	8"x2" (poly filled)	8"x2"(poly filled)
Rear Wheels:	12"x2.25" (poly filled)	12"x2.25"(poly filled)
Turning Radius:	35"	33"
Adjustable Head rest:	up to 16"	up to 16"
Passenger Weight Capacity:	350 lbs.	400 lbs.
Chair Weight:	111 lbs.	65 lbs.

Dimensions listed by Aisle Buddy for their two main chairs

The team’s revised Aisle Buddy aimed to meet the needs of users who are going to transfer planes during their trip, and remain in the Aisle Buddy during the transfer. The primary benefit of doing so is the elimination of two transfers, from the aisle chair to a transport chair and back again. While the Aisle Buddy has many features that support this new use case, there are some additional criteria that must be taken into account.

Users who choose to remain in the chair will be staying seated in the Aisle Buddy for much longer than the average time in the chair while boarding the plane. Under typical circumstances, users will be moved into the aisle chair, wheeled onto the plane, and transferred into their seats – limiting their time in the chair to only what is necessary to accomplish the primary task. Under the new transport use case, users could expect to be seated for a number of hours, depending on the length of time between flights. The users will spend more time in the chair while moving, and could potentially spend significantly more time while stationary.

Transferring between flights now indicates that the Aisle Buddy will travel further distance at higher speed. Transfers can happen at adjacent gates, or across the airport, which opens up the Aisle Buddy to situations that extend beyond the predictable trip down the jetway that it was designed for. These longer distances may also necessitate higher speeds compared to maneuvering on a jetway or down the aisle of an aircraft.

Given the longer time in the chair, and the increased speed the user will experience, the chair must provide increased stability and support. For the user this will involve supporting their head and upper body, and keeping their legs supported and contained within the device. The longer seated times will fatigue the user without giving them more stable options to prop themselves up using their arms, and giving them a variety of supporting resting positions for their head. Any redesign of the Aisle Buddy should address these requirements.

There were a few features that the team noted as being good designs to implement into the Aisle Buddy, however we did not feel that they were necessary on this iteration to address. One of these things was the seat angle. The Aisle Buddy currently has a backward tilt of 3.5 degrees, which is barely a tilt at all. Tilts are often used to help keep people in their seats by preventing them from sliding forward. The team could have addressed this by tilting the entire chair back to an angle of about 15 degrees. However, since in the stakeholder reports, people's main problems were not the entire body sliding from the seat, but rather body members, the team felt this was unnecessary. This change to the Aisle Buddy chair would also have many tooling costs associated with it and change many arrangements or sizes of various parts on the current chair. Here, it seems that the costs outweigh the benefits. Nevertheless, the team would like to suggest this as a future iteration for another Aisle Buddy chair if the Aisle Buddy will be used to transport people between gates.

A second area of concern that was not addressed with a design solution was adding an adjustable wheelbase for stability. This is a very pertinent feature to design for the Aisle Buddy with how the chair is frequently being used. Having a wheelbase that can shrink for transport on a plane, but widen when being pushed through an airport between flights would be a great benefit to stability during the times the Aisle Buddy is being used as a transfer chair and is going at higher speeds. Yet, this design also would change much of the tooling and many of the parts being used on the current Aisle Buddy and the tooling costs would be substantial. The concerns voiced did not mention the chair being particularly unstable when pushed in a controlled manner, unless the user was elevated (raised above the armrests). Thus, this design change is also suggested by the team to be included in a second iteration of the Aisle Buddy redesign.

Transfer boards were not favorably received in the research, thus this subject was not approached by the team. However, if further research were to be done on the use of transfer boards and whether or not they were an effective transfer aid while attached to an aisle chair, it is feasible that this could be a part of a future iteration or redesign of the Aisle Buddy.

Other than these two costly design changes, the three design changes which have been implemented have solved the majority of the concerns which were voiced by stakeholders. The two design changes suggested here are still worth noting and can hopefully be addressed in future iterations of the design.

The Aisle Buddy itself is a chair that has many good attributes to it which have been influenced by the input of the Air Serve crew, who helped to inform the manufacturer of the good and bad aspects of the chair's design. However, the product is not perfect and still had room for improvement, which the research team took advantage of in order to help address some of the remaining concerns voiced by other stakeholder groups. The team believes that the changes that have been implemented here address the widest amount of remaining concerns with the most efficiency and least cost, though a second iteration of this design could improve upon the current iteration even further.