

Table 13. Problems Identified by Critical Observation Analysis

#	Problem Description	Frequency	Des1	Des2	Des3	Average Criticality
1	Steering is difficult to control when driving in reverse. The trailing fork drive wheel design causes the inner column to pull up to a position 180 degrees from straight when driving in reverse.	5	6.4	7	1	4.8
2	Battery sling clasps are designed to be attached by 2 dexterous hands. Many users tie up one hand for support and balance leaving one hand to attach clasps (very difficult). Clasps require precise alignment and force applied from both sides.	4	3.8	7	2	4.3
3	The battery sling is not located in a very accessible position. User must lean into wheelchair seatback (obstructing view of sling) or lean far forward. Some users must reposition themselves during attachment (to get closer after the battery is moved).	4	3.3	6.5	3	4.3
4	Precise positioning is required to attach/detach the column unit into/out of the blocks. The unit must be held at a correct angle and dropped into position evenly on both sides. Force must be applied at both sides evenly in the correct direction to lift out.	4	3.8	7	1	3.9
5	The extended position of the column in transfer mode can collide with the user during transfer. Shins can become pinned between the column and transfer bench or the foot of the user can knock into the column when lifting over it for transfer.	4	3.3	2	2	2.4
6	Free rotation of the column unit in transfer mode can result in the column moving into the way of transfer. When lifting a leg over the unit, it can catch and lift the column up. Also, while seated the legs can push into upper crossbar rotating the column up.	4	2.8	2	1	1.9

Note: "Des" denotes Designer.

Table 13. Problems Identified by Critical Observation Analysis (continued)

#	Problem Description	Frequency	Des1	Des2	Des3	Average Criticality
7	Small jerky adjustments are used to turn instead of smooth continuous adjustment. No differential in the paired drive wheels causes a resistance to turning which can result in jerky motions as the resistance is overcome and the column turns abruptly.	3	4.3	3	2	3.1
8	The column unit plug is located on the opposite side of the column as the crossbar release mechanism. A user oriented on the release mechanism side of the column to attach or detach must reach far across or reposition in order to plug/unplug the unit.	3	2	5	2	3
9	Column switching from power to transfer modes is not smooth. The difference in friction when the crossbar moves from the securing blocks into free rotation causes a jerky motion. The upper crossbar sometimes gently hits the back of the user's leg.	3	2.3	3	1	2.1
10	Motor wires which extend to the plug, limit the rotation of the column unit when it is turned in the same direction continuously. The wires can be wrapped around the motor stopping rotation and, when forced, the plug can be pulled out of the socket.	2	6	5	3	4.7
11	Difficult to pull the upper crossbar into the securing blocks from the free rotation position (transfer to manual or power mode switching). Some subjects had difficulty with the resistance of the securing blocks against the ends of the crossbar.	2	5	6	3	4.7
12	Upper crossbar release mechanism is not located in a very accessible position. Requires user to reach forward (threatens balance for some) and search for release under their leg. Can't see the release while sitting in wheelchair.	2	5	6	2	4.3

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Table 13. Problems Identified by Critical Observation Analysis (continued)

#	Problem Description	Frequency	Des1	Des2	Des3	Average Criticality
13	The response of the trigger control does not compensate for drive wheel reactions. Wheels can slip on takeoff and vibrate the handle (assoc. with a slight pull to the side). One user squeezed & released trigger instead of applying continuous control.	2	5	5	1	3.7
14	Braking action of drive wheels eliminates manual driving when in power mode. The wheels catch when the wheelchair is pushed and drags. Must switch to manual mode before pushing the wheelchair. Users tried to push by hand in power mode.	2	3.5	1	1	1.8
15	Column unit is designed to be attached and detached by two hands (one to release and one to lift or place). A user may tie up one hand for balance and support or may only have one capable hand and any task requiring two hands is difficult.	1	7	7	2	5.3
16	When moving in reverse rapidly, the handle jumped out of the user's hand and rotated 180 degrees. This problem is associated with problem number one in that the trailing fork design of the drive wheel unit is responsible for the forces pulling it.	1	7	7	1	5
17	Crossbar release mechanism requires strength and dexterity to squeeze and hold for release (resistance provided by the springs, shape and smooth texture of the finger grips, and the requirement that both be pushed together simultaneously).	1	7	6	1	4.7
18	Subject had extra difficulty switching between column modes because the upper crossbar had been slightly rotated out of alignment. This can happen because the bar is held in position by a friction contact (not interlocking).	1	6	5	2	4.3

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Table 13. Problems Identified by Critical Observation Analysis (continued)

#	Problem Description	Frequency	Des1	Des2	Des3	Average Criticality
19	The wire protector and wires extending from the motor are sufficiently long enough to drop into a position between the drive wheels and the wheel gear box housing unit. This causes a popping noise (usually while turning). No obvious damage results.	1	6	1	5	4
20	Subject repositioned the column to 180 degrees from the intended position to drive in reverse. This location offered better control due to the trailing fork drive wheel design, but the handle is extended far from the subject (the subject had long arms).	1	5	5	1	3.7
21	The inner tube of the column unit must be rotated correctly for column attachment. The motor must be rotated inferiorly so that it does not fall during attachment making it difficult to handle (ten pound object with inertia). This positioning is not obvious.	1	4	4.5	2	3.5
22	When reaching forward, the handle of the PAU will push into the body of a large operator. This is due to the orientation of the handle arm back toward the operator and the difficulty in rotating the handle while stopped in power mode.	1	3	2	1	2
23	Difficult to determine if the column unit is securely locked into position. One subject was not sure when it locked into place because the securing blocks are out of sight when the operator is seated in the wheelchair.	1	3	3	2	2.7
24	The location of the handle makes it a convenient place to pull back on when moving the column into manual and power positions. One subject tried to grab the handle despite directions not to grab the handle. It can be damaged if used this way.	1	3	1	1	1.7

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Table 13. Problems Identified by Critical Observation Analysis (continued)

#	Problem Description	Frequency	Des1	Des2	Des3	Average Criticality
25	Lubricant inside the crossbar leaked onto fingers through the holes in the crossbar where the release mechanism is located. This occurred when the subject's fingers actuated the release mechanism.	1	4	2	1	1.7
26	Forgot to plug in the battery box plug. Possibly a result of the battery box and sling located out of the line of sight (associated with problem number 5). There is no immediate feedback to tell the operator that the plug is not in place.	1	2	1	1	1.3
27	When driving in reverse, one subject had trouble remembering which way to turn the handle to steer. The tiller steering arrangement may be different from intuitive steering motion.	1	2	1	1	1.3
28	One subject used both hands on the handle while driving. This may be to provide balance and support or the subject may require the extra strength and control contributed by the second hand.	1	1	1	1	1
29	Forgot to plug in the column unit plug. May be due to the location of the plug up under the wheelchair. Not as serious as the battery plug because the user will be able to plug in the column unit while seated (must transfer out to reach the battery).	1	1	1	1	1

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