

STUDY ON STRATEGIC MARKETING AND SPECIFICATION SETTING FOR AN ERGONOMIC WHEELCHAIR FOR PEOPLE WITH LOCOMOTOR DISABILITIES

CIOBOATĂ Ioana-Olivia¹, BABOI Isabela-Andreea¹, SAVU Alin-Alexandru¹, NEACȘU Marian-Constantin¹, VLAD George-Cosmin¹ and Andrei DUMITRESCU²

¹Faculty of Industrial Engineering and Robotics, Specialization: Industrial Design and Innovative Products, Year of study: I, e-mail: olivia.ioanac@gmail.com

² Faculty of Industrial Engineering and Robotics, Manufacturing Engineering Department, University POLITEHNICA of Bucharest

ABSTRACT: This scientific paper addresses the possibilities of developing an ergonomic wheelchair for people with locomotor disabilities - SPD. The needs of potential customers and market opportunities were studied, and some technical specifications were established based on them.

KEYWORDS: people with disabilities, ergonomic wheels, mobility, autonomy.

1. Introduction

1.1 Brief history of the development of the wheelchair for people with locomotor disabilities

Wheelchairs have evolved very little over the last 1000 years. Most of the design changes have come about in the last few decades. The first wheelchair is known to have been designed to provide mobility and was called an 'invalid chair' (Fig. 1.1.a).

It was invented in 1595 specifically for King Philip II of Spain. The chair had small wheels attached to the end of the legs of a normal chair and included a platform for the legs and an adjustable backrest. However, it could not be self-propelled, requiring the assistance of another person to move it. In 1655, Stephen Farfler, a paraplegic watchmaker, built a self-propelled chair on a three-wheeled chassis [1].

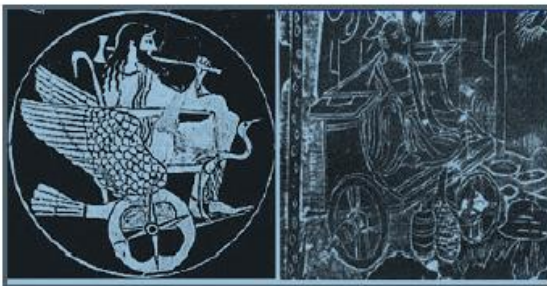


Fig. 1.1.a. The first recorded wheelchairs [1]



Fig. 1.1.b. Chair for King Philip II [1]

1.2. Presenting customer needs

For users in this category, mobility is an impediment to their daily activities. Their main need is to move from one place to another easily and independently. SPD enables mobility for people who can no longer walk on their feet permanently or temporarily due to physical limitations, thus a product will be created to meet the most demanding needs and tastes. The SPD folds up easily and can be placed in the boot of a car for transport.

At the same time, constant wheelchair use puts a lot of stress on muscles that are not really designed to be used in this way, leading to everything from repetitive stress injuries and pain to joint degeneration and carpal tunnel syndrome [2].

Therefore, user need can be addressed by transferring loads and demands typically placed on weaker shoulder and arm muscles to more capable muscles in the upper back to reduce the chance of injury and provide the user with an overall increase in strength and autonomy [2].

2. State of the art

2.1. Existing products on the market and possibilities for development

On the market there are a multitude of construction variants which often do not address the possibility of quick folding/unfolding for movement by placing the seat inside a boot. It can also be noted that competing products do not offer the user autonomy by design and that the effort required to move the seat places a heavy strain on the muscles of the upper limbs. Figure 2.1 shows three models on the international market. [3], [4].

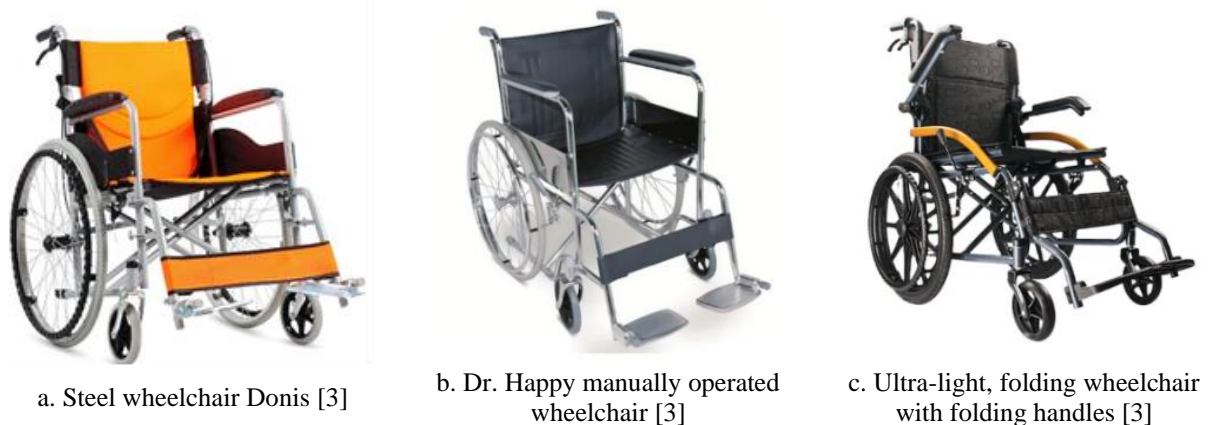


Fig.2. 1. Construction variants of seats on the international market

As can be seen, the seat in fig.2.1.a. is manually operated, its frame is foldable, the maximum weight supported is 100 kg. It is made of a steel frame and the wheels are made of rubber. Obstacles are overcome by lifting the front wheels and driving them over obstacles [3].

Another existing model of chair is Dr. Happy - fig.2.1.b, it is designed with manual drive, it is made on chromed steel frame, foldable; solid rear wheels with plastic spokes, diameter 58 cm provided with brake, and the front wheels are PU filled and the seat and backrest are made of washable synthetic material [3].

The chair has been conceived with a modern design, this chair is manually operated, made on double painted (hardened) steel frame, features rear pocket for carrying papers, folding PU armrest. The seat and backrest are made of soft black washable synthetic material. Footrest is removable, with antero-posterior rotation movement, adjustable in length, with foot pedal and strap for fixing the heels [3].

For the SPD product, the inclusion of the following components will be considered for market access:

- Rowheel system, which allows the pulling motion to be converted into the forward motion of a wheelchair;
- the use of smart materials (the backrest is covered with mesh);
- a molded foam cushion for correct sitting position and reduction of the shock of movement;
- shock-absorbing suspensions for overcoming obstacles and bumps.
- have long wheel bases to reduce the likelihood of tipping forward.

In addition to incorporating all these components, the aim is to design the product to be easy to dismantle/fold, of relatively low weight (max. 15kg).

2.2. Main patents underlying product design

2.2.1. Comfortable wheelchair toilet

A wheelchair commode is provided that includes a portion of the seat, a base with at least one wheel and a lifting mechanism adapted for at least one of the lifting and lowering portions of the seat relative to the base. [5]

The seat portion includes a toilet seat and a backrest, and in which the lifting mechanism is arranged to provide a space under the toilet seat to allow the toilet seat to be positioned over a toilet with the backrest of the seat adjacent to the toilet. The lifting mechanism includes two arrangements of rails, each located on opposite sides of the wheelchair commode. Each of the two arrangement of rails includes two rail elements adapted to expand and retract in a scissor-type movement. [5]

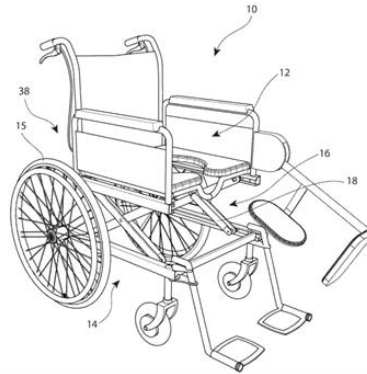


Fig.2.2.1 Comfortable wheelchair toilet [5]

2.2.2. High height wheelchair

The power-operated wheelchair (510) includes a frame (14), a lifting mechanism supported by the frame (18), a seat (22) supported by the lifting mechanism (18) configured to move the seat from a lowered position to an elevated position, a pair of drive wheels (32), at least one drive unit coupled to the frame and configured to apply torque to at least one wheel of the driving wheel pair, an arm assembly (38) including a pivotable arm element (542) coupled to the frame, a front wheel rotating coupled to the arm element and an arm limiting assembly (560) coupled to the frame (14) and configured to move from a first configuration whereby the arm element (542) is capable of pivoting relative to the frame by a first rotational range that is uninhibited by the boom limiter assembly (560), in a second configuration whereby the arm element (542) is capable of pivoting relative to the frame by a second rotational interval which is inhibited by the arm limiting assembly when the arm element (542) is the arm limiter (38), in which the arm limiter (38) is configured to compress in response to the upward movement of the arm element (542), so that the second rotation interval is less than the first rotation interval [5].

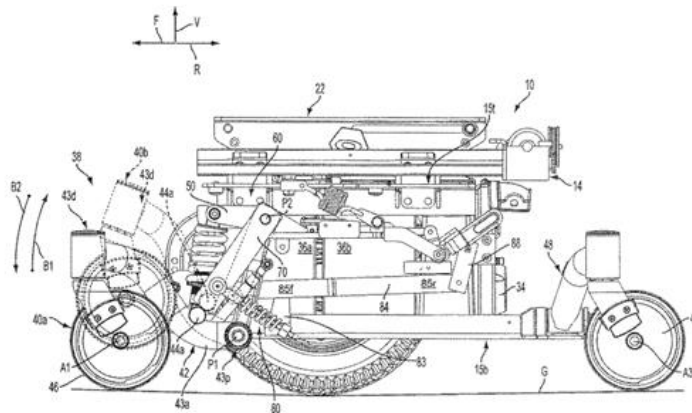


Fig.2.2.2 High height wheelchair [5]

2.2.3. Folding wheelchair

A wheelchair comprises: an armrest holder (6), a seat holder, a support of backrest (3) and a turning mechanism (64), in which the spin mechanism (64) is configured to make the armrest bracket (6) and the seat. the backrest rotates synchronously in relation to the backrest holder (3) [5].



Fig.2.2. 3 Folding wheelchair [5]

3. Strategic product marketing

3.1. Stages of development of the ergonomic wheeled chair for people with locomotor disabilities

3.1.1. Identifying market opportunities

Following the market analysis, it was found that there is a possibility of introducing SPD, following conclusions [4]:

- the non-existence on the Romanian market, according to the current knowledge of the team, of a wheelchair that has ergonomic wheels in its composition;
- the non-existence on the Romanian market, according to the current knowledge of the team, of a wheelchair to transfer the stresses placed on the weaker muscles of the shoulders and arms on the muscles of the upper back;
- the non-existence on the world market, to the current knowledge of the team, of a wheelchair that presents a modeled foam cushion in order to adopt the correct seating position and to reduce the shocks felt after the movement.

3.1.2. Mission formulation

The product description can be achieved using the following assumptions [4]:

- The wheelchair is removable/foldable weighing between 5-10 kg;
- Easy to use and efficiency in storage, taking up very little space;
- Manually operated, allows a movement of pulling back the frame of the seat e for forward movement;
- Reliable and robust.

3.1.3. Selection of potential customers

The selection of potential customers was done using the selection matrix as follows in Table 1 [1],[2],[6],[7].

Table 1. The matrix of selecting potential customers

	Top users	Users	Retailers	Service Center
Clinics for people with disabilities (occasional use)	1	6	2	2
Organizations for people with disabilities (frequent use)	3	9	1	
People with disabilities (heavy use)	1	2	2	

The product is addressed to a market consisting of:

- the user (the person concerned, the relatives of the persons);
- retailers;
- store networks;
- sales centers;
- production department;
- organizations to help people with disabilities.

To identify the requirements of potential customers, the interview was used. The interview guide used in the collection of raw data is presented in Table 2, where the answers given most frequently were selected and completed [1, 4].

Table 2. Model interview used

Product attributes	Responses	Requirement interpreted
Features of use:		
1.The medium of use of the product.	Yes	SPD is used in any atmospheric conditions
2.Provides mobility to all people with disabilities.	Yes	SPD is useful for people with disabilities.
3.It is a comfortable product.	Yes	SPD is comfortable for both the seat and the back.
4. It has additional accessories.	Yes	SPD offers various additional accessories.
Pleasant aspects of the product:		
5. Easy use	Yes	SPD allows mounting and disassembly of seat elements easily and quickly.
6. Provides safety in operation	Yes	SPD ensures the safety of the person using it.
7. Stability	Yes	SPD is light and stable on the go.
8. Documents of use	Yes	SPD is accompanied by the user manual
Unpleasant aspects of the product:		
9. High gauge	Right away	SPD can be quite compact compared to other seats in terms of gauge.
10. Low strength	Right away	SPD withstands accidental shocks
Proposals for improvement:		
11.Product maintenance is easy.	Yes	The SDP has easy maintenance according to the instructions.
12. Pleasant design	Yes	SPD has a pleasant design.

Based on the requirements identified among the users will develop the SPD product that needs to be to live up to the expectations of future customers.

4. Establishment of specifications

4.1.1. Sizes and characteristics of competing products existing on the Romanian market

An important stage in the process of developing a product is the establishment of objective specifications of the product, those values of the characteristic sizes of the requirements, for which the market success of the product is possible [5]. These values are set according to the specifications of competing products [1, 2, 6, 7].

Five competing products were used for one comparison. The characterization of competing products will be based on the following elements: overviews, developed functions and main technical characteristics [1, 2, 6, 7]. Table 3 shows important sizes and characteristics of the four competing products presented in the current study:

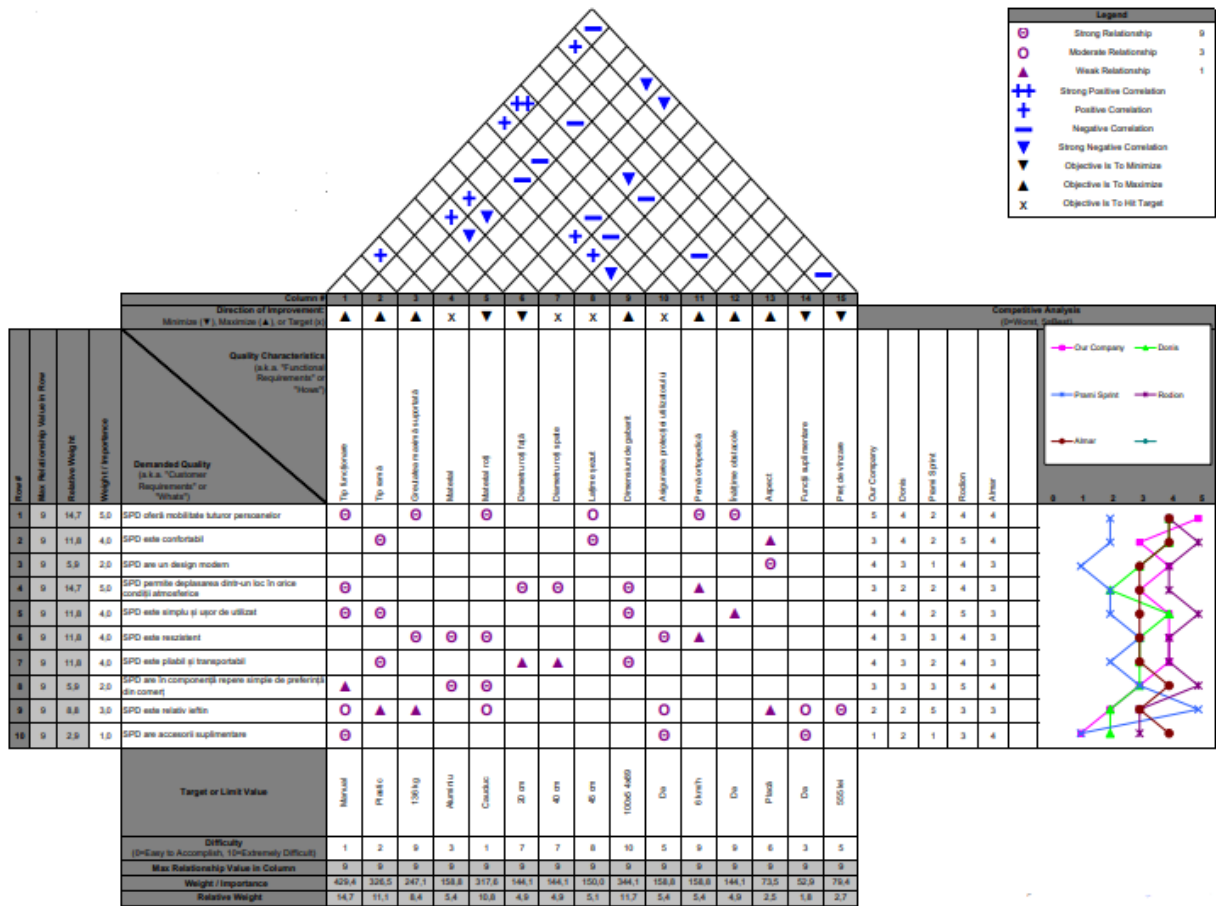
Table 3. Important sizes and characteristics

No.	Size / character.	Unity	Competitive products				
			DONIS wheelchair	PRAMI SPRINT wheelchair	RODION wheelchair	Wheelchair ALMAR	SPD
1	Operation type:	Any kind	Manual	Manual	Manual	Manual	Manual
2	Frame type	Any kind	Pliable	Pliable	Pliable	Pliable	Pliable
3	Maximum mass supported	medical history	110	110	136	115	120
4	Material	Any kind	Steel	Steel& Aluminum	Aluminum	Steel& Aluminum	Aluminum
5	Wheel material	Any kind	Rubber	PU	Metal	Rubber	Rubber
6	Front wheel diameter	cm	17	20	19	19	20
7	Back wheel diameter	cm	58	30.5	40.6	19	28
8	Sitting width	cm	46	46	43	42.5	47.5
9	Overall dimensions	cm	102x67x90	102x63x93	100.5x67x96	100x51x89	108x62.3x91.5
10	Maintenance and installation manual	Yes/No	No	Yes	Yes	Yes	Yes
11	Orthopedic pillow	Yes/No	No	No	No	No	Yes
12	Provides user protection	Yes/No	No	Yes	Yes	Yes	Yes
13	Obstacle height and curbs	cm	-	5	4	35	40
14	Appearance	Subjective	pleasant	unpleasant	pleasant	pleasant	pleasant
15	Additional functions	Yes/No	No	No	No	No	No
16	Selling price	euro	555	600	700	590	850

4.1.2. The house of quality

The first step in completing the quality house is to identify customer requirements and give importance to each requirement. The importance is usually complemented by grades from 1 to 9. The technical characteristics are defined below by translating customer formulations into physical phenomena. The roof of the quality house shows what kind of connection there is between the technical characteristics. Table 4 shows the quality house as follows. [1, 2, 6, 7, 8].

Table 4. House of quality



The Competitiveness Assessment matrix describes how other companies meet customer requirements and have been graded: 1; 3; 5; 7; 9; and for the "Sales coefficient in the future" different marks were given: 1; 1.1; 1.2; 1.4 presented in table 9 [1, 2, 6, 7, 8].

Table 9. Significance of grades

NOTE 1 not important
NOTE 3 unimportant
NOTE 5 important
NOTE 7 very important
NOTE 9 particularly important
Coef. 1 stationary sales
Coef. 1.1 slight increase
Coef. 1.2 significant increase
Coef. 1.4 major increase

An analysis is needed in order to be able to compare the new product requested by customers with existing similar products and to identify those additional features that will ensure competitiveness on the Romanian market.

In order to complete the matrix of the technical characteristics, the connection is made between the requirements of the clients and each technical characteristic granting the grades 1; 3; 5; 7; 9 grades given by multiplying by score standardized [1, 2, 6, 7, 8].

Following these, the evolution of the characteristics will be completed with symbols and finally the roof of the quality house, which is made up of the correlation of the technical characteristics. The evolution of the characteristics is as follows: Increases ↑; Expires ↓; Const ≡; Indif ×.

The signs adopted in correlating the characteristics with the customer requirements are shown in Table 10.

Table 10. Characteristics correlation indicators

Strongly positive	circle with +
Positive	the sign +
Negative	the sign -
Strongly negative	circle with -

At the bottom of the quality house are listed the target values for the technical characteristics. Current priorities, competition and future goals have been set.

5. Conclusions

Given the existing products on our market with their shortcomings / disadvantages, the research undertaken clearly indicates that the new product is needed. On the marketing side, the market opportunities in Romania were identified with the potential clients.

The QFD method was applied to determine the importance of specifications and features.

Based on the presentation of this paper, the following stages of product development will be followed, such as: project management, conceptual design, detailed design, prototype manufacturing and testing, and economic analysis.

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