

SOCIAL INCLUSION: A MULTIDISCIPLINARY DESIGN APPROACH

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Abstract: *This article shows the design of an assistive product and a proposal of a business plan for persons with motor disability in lower-limbs, in accordance with the guidelines for social inclusion of the World Health Organization (2001). The design project with interdisciplinary characteristics was based on the application of an extended model of Axiomatic Design with an active participation of the user. The design of this assistive product sought to overcome physical barriers which the user encounters daily so that his mobility, safety and comfort are improved. The business model, in which the user participates throughout the whole production and sales process of the assistive product, belongs to the stage of the rehabilitation process in which the disabled person has access to the types of activities that give meaning and purpose to his life. The ability of mobility, with the assistive product, and of productivity, with the business model, allows the user to reach the last level of the rehabilitation process corresponding to the equality of opportunities. Both results, the assistive product and the business plan, involve the participation of the university, the private enterprise and the state. It is concluded that the interdisciplinary work with the participation of the user can provide effective solutions to a problem as complex as social inclusion. The results obtained from a social approach allow the development of different products and interdependent processes.*

Key-words: *Social Inclusion, Interdisciplinary Design, Product Design*

1. Introduction

The concept of disability changed the vision of the person as "the problem" toward a new approach that recognizes these people as subjects with rights, capabilities and skills to participate fully in society with equal opportunities (UN, 2006), which is now known as social inclusion. This achievement of equality is understood as the process by which the various systems

of society: the physical environment, services, activities, information and documentation, are made available to everyone, especially to people with disabilities (National Council for Economic and Social Policy, 2004). A key area for inclusion constitutes the workplace. The participation of people with disabilities in the economic and productive processes although it has many obstacles is therefore a very important scenario for the action in the pursuit of equal opportunities (Rosenqvist, 1990). Currently, the disability in Colombia, although it is a theme that is being worked on and there are some advances in terms of job accessibility, does not have yet a firm structure that facilitates the insertion of these people in the workplace (Otoya et al., 2001). The research project, ANDAR, focused on the problem of social inclusion for people with disabilities, was developed in Santiago de Cali, Colombia, as an interinstitutional agreement between Pontificia Universidad Javeriana, Universidad del Valle, a private company from Colombia and the Politecnica Universidad de Valencia in Spain (ANDAR 2010).

In the project, there were two approaches to social inclusion: first, a product of support for mobility (UNE-EN ISO9999: 2007) (Spanish Association for Standardization and Certification AENOR, 2007) was designed in an interdisciplinary way for accessibility to the physical environment and on the other hand, a business model for social and labor inclusion was conceived.

A design of a wheelchair with special characteristics was proposed in order to optimize the functionality of the person. This special features to overcome physical barriers are the propulsion by means of levers to promote functionality in the displacement, a

transmission system to facilitate the climbing in steep terrains and the ability to stand up to have access to higher levels of reach. In this way, the assistive product facilitates the autonomous displacement of the people to optimize their physical inclusion, since it compensates the loss of mobility. The product design was carried out under the framework proposed by the Extended Model of Axiomatic Design (MADA) Aguilar-Zambrano (2009), which is a complement to the methodology proposed by Nam P. Suh (1990). In turn, the business model is an external factor or environmental factor in which an effective participation of people with disabilities is expected. They can be involved in the employment process, in mass production processes, marketing and distribution of this product support . During construction of the possible business models that would cover the needs of social inclusion of individuals, the needs of the market and of the assistive product for mobility area, a set of four possible models were proposed, where finally one of them was chosen as the most appropriate for achieving social inclusion from the labor point of view of people with disabilities.

2. Design of an Assistive Product for mobility

In order to decide what product to design, the Analytic Hierarchy Process, AHP, which has multi criteria and multi expert characteristics, was used. Different professionals of different fields: electronic, mechanical, and industrial engineering, industrial design, psychology, occupational therapy and a user participated in the selection process. The first alternative chosen for the product design was the Class 12 of the UNE-EN ISO9999: 2007 Standard, assistive products for personal mobility, that is why it was decided to design a wheelchair (Unal Journal Bogota). The design process, following the model (Figure 1) was developed in three parts: In the first part, the workteam was formed; in the second, a systematic analysis of the problem was done. In this analysis, a hierarchical structure of the design was determined; and in the third part, the design process for the lower or detail levels was structured. In this part, the functional independence and the quality of the design were permanently verified.

In the first part of MADA, for the design process of the wheelchair, a multidisciplinary and multi-organizational team was set up in this way: from different disciplines, electrical, electronic, mechanical, and industrial engineering; industrial design, occupational therapy and psychology, and from the organization: the user with disabilities, the State through government agencies, the universities and a technology-based company.

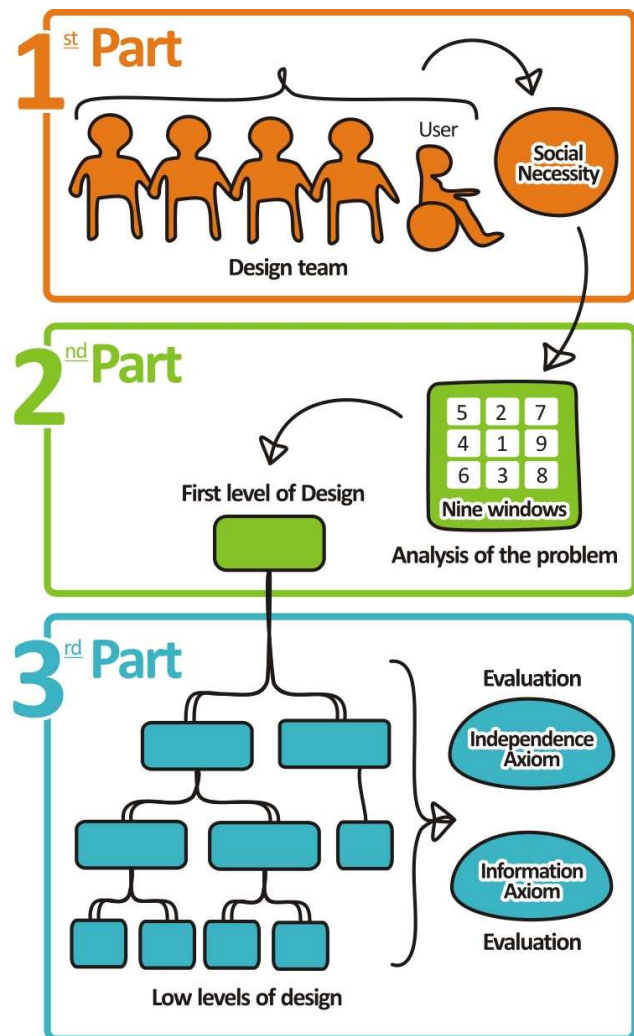


Figura 1 Diagram of Extended Model of Axiomatic Design. Source: Aguilar-Zambrano (2009)

In the second part of MADA, which includes two stages, the problem analysis and the formulation of the first level of design, various activities were carried out: for the analysis stage, information was collected and processed from a social, technical, legal, and market perspective; for the formulation stage, an analysis of the Nine Windows, from which the contradictions were obtained and with them the needs or customer

attributes. With this information, the team identified four first-level requirements and design constraints were established. Subsequently, solutions were proposed for each requirement and thus nine alternatives of the product were configured, of which one was selected (Figure 2) to continue in the third part of the Extended Model.

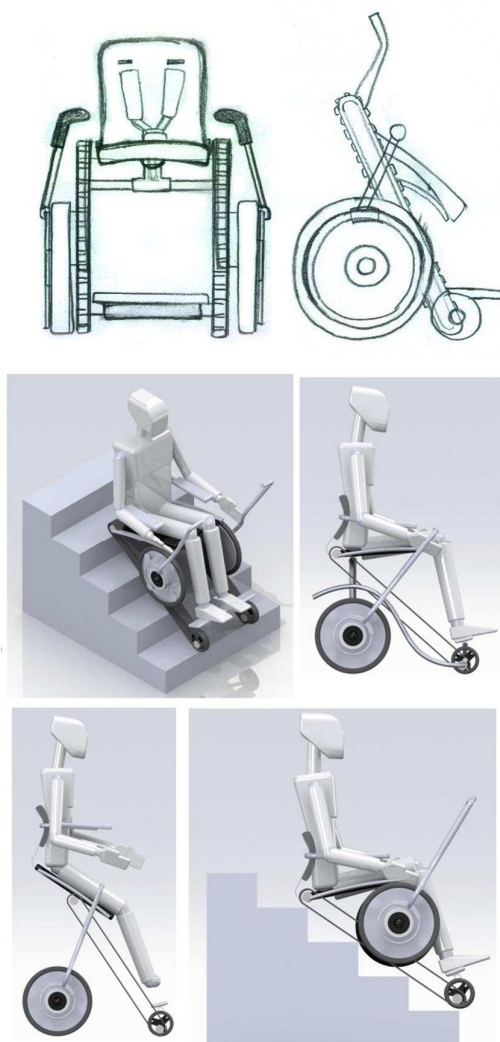


Figure 2 Graphical representation of the selected alternative using AHP. Top, bidimensional sketches; down: 3D models.

In the third part, low-level requirements were identified with their respective design parameters to complete the design process of the assistive product for mobility. The last level, describes in detail the parts of the product. Throughout the whole process, the compliance of the functional independence with the Design Matrix

was monitored. Likewise, the quality of the process was monitored with the Content Information. The result of applying MADA is shown in Figure 3. It is a three-wheeled, manual and semi-stand up wheelchair which is driven by means of levers. In it, all the energy required comes from the user, making it lighter and more versatile than a motorized wheelchair; and thanks to its mechanisms, the user may feel less fatigue than with a hand rim propulsion wheelchair. The levers, wheels and the overall structure allow the user to move through different terrains and with different levels of effort.



Figure 3 Result of MADA application. Silla de ruedas manual bipedestadora. Arriba, vista perspectiva; abajo, vista lateral.

3. Business Model Proposal

The International Classification of Functioning, Disability and Health (ICF) of the World Health Organization (2001) proposes the domains for the component *Activities and Participation* in a single list that covers the whole range of vital areas, from the basic learning or mere observation, to other more complex areas such as interpersonal interactions or employment. Thus, the skills and abilities of a disabled person are determined in order to identify opportunities for participating in the workforce, both in terms of their ability to move, and from the point of view of the possibility of performance that is provided by the context. In this way, a business model, which aims to manufacture, market and distribute the resulting product of the project, was proposed. The model involves the participation of people with disability so that with their participation they generate value for their family, the Colombian industry and particularly for the Valle del Cauca, Colombia. To present the business model, a proposal related to innovation in the organizational structure was used. This strategy allows the participation of people with disability in each of the phases of the model using their faculties, abilities and aptitudes to do various activities. Thus, the business model proposed by Mutis and Ricart (2008) was taken as reference. This model was made up as the set of choices of the company and their consequences. In the proposed model, the participation of people with disability and cost-benefit relations with other actors in the model are choices of the company in order to ensure labor participation and social inclusion of people with disabilities. To set up the business model the following elements were identified: Strategic partners, key activities, key resources, value proposition, customer relationships, channel sales and marketing. Based on the above information, four possible business models that make it possible to link the supply, demand and need of the user within the current characteristics of the market for the assistive products were proposed. Figure 4 shows a diagram of the structure of the proposed business model, which involves the participation of people with disabilities, private businesses, foundations related to people with

disability, international fund management and the product distributors. In the business model, the technology-based company manages logistics for the foundations and the distributors can agree on “maquila” type organization. Thus, the foundation with people with disabilities participate both in the manufacture or assembly of the product as in the marketing and distribution activities. To this end, the fund manager through the relationship with NGOs will give funds to the foundations so that they organize themselves as service or manufacturing companies.

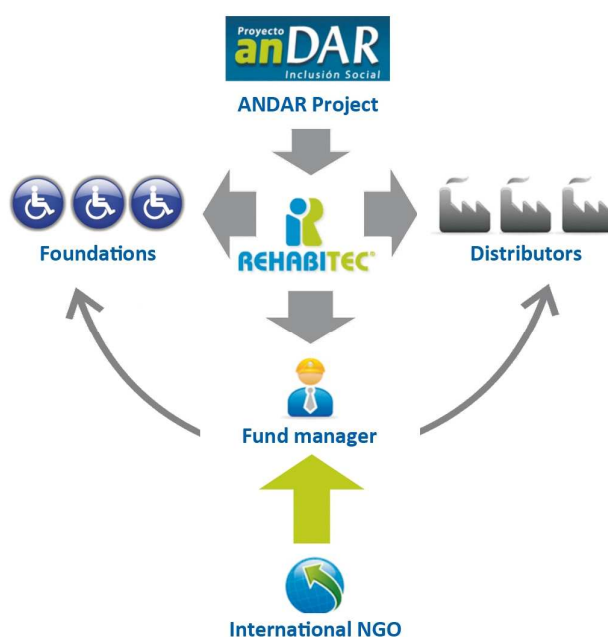


Figure 4 Business Model Proposal

Strategic partners of the firm are the foundations, distributors and fund manager. In the business model each of the partners has assigned clearly defined activities for the success of the model.

As for the company, the key resources are the capacity in resource management and logistics management. Also, the company must strengthen the capacity to do market research and measurement of demand and needs of the users of the product to increase sales and maintain market recognition. As for the foundations, the key resources are the organizational capacity and management of technology resources to maintain a manufacturing or assembly line according to the requirements of the company. Also,

they must maintain an ideal operation in the activities of marketing and product distribution.

3.1 Value proposal

From a market perspective, the product presents qualities that differentiate it from others. The main features of the wheelchair are: three-wheeled configuration, manual, semi-standing position and propulsion using levers. All the energy required comes from the user, making it lighter and more versatile than a motorized wheelchair, and thanks to the mechanisms it has, the user may feel less fatigue than with a hand rim propulsion wheelchair. The levers, wheels and the overall structure allow the user to move around different terrains and with different levels of effort. The wheels are smaller than those of conventional wheelchairs – since it is unnecessary the hand rim propulsion – and it makes the chair to be lighter and easier to maneuver. The front-wheel drive helps the user ascend curbs more easily and quickly and the rear wheel is used for stability when maneuvering and, especially during the semi-standing position. The levers- besides increasing the efficiency in the transmission of force – prevent the user from suffering injuries in the joints of the upper limbs due to poor posture when applying force on the rim, and at the same time, promote physical activity. These movements – which can be alternated or rowing – are made in ergonomically correct ranges. The semi-standing position is controlled from the levers and the armrests, to raise and lower, respectively. The descent is made in stages, at the speed that the user can move the levers, and the semi-standing position or ascend is done by means of a pneumatic mechanism – faster– so that the user can reach the semi-standing position in a short time.

3.2 Relationship with the customer

The customers will be people with disabilities who are interested in using the assistive product. The client-company relationship will be through the sales channels and business strategy defined.

3.3 Sales Channels and Business Strategy

The model proposes different sales channels such as direct sales, use of distributors, contracts with the state and

foundations. It also proposes the use of electronic channels for marketing.

4. Discussion

The current conception about disability arises from the recognition of the right to participate fully in society; in this way, the disability is seen as a deficit in the relationship of these people with their environment (Bronfenbrenner, 2002). This view shows that the problem is vast, complex and requires a systemic approach to tackle it, according to the guidelines proposed by the World Health Organization in the ICF. The complexity is such that in the present study, social inclusion is addressed in its initial stage, of physical inclusion, for people with locomotor disability in lower limbs, with the construction and application of a consulting instrument and interdisciplinary participation: engineering, occupational therapy, psychology and industrial design. Also, with this interdisciplinary and interinstitutional participation, phase three of the inclusion, was addressed with the sole objective of labor inclusion. Despite the interdisciplinary approach of the problem there are still many aspects to cover. Although disability in Colombia is an issue that has been addressed, currently it does not have a structure that facilitates the employment of these people in the workplace. According to interviews with people with disability during the research (Aguilar, et al., 2009), most reported not having access to jobs and those who are employed do not feel comfortable, since the jobs they hold are generally informal and others state that they have “informal self employments” that barely meet their daily needs. Different authors present the economic factor as a barrier to social inclusion (Otoya et al., 2001). Similarly, this study found that 72% belonged to socioeconomic strata 1 and 2, 75% of working individuals claimed to be self-employed, and 50% met monthly income up to one legal minimum salary. To worsen this situation, the population had people under its economic protection (60%), and difficulties in accessing waged employment (73%), professional technical training (83%) and higher education (74%). At the same time, it was shown that 41% of the sample purchased its assistive product for mobility with his own resources. However, 82% cannot afford an assistive product with better technical specifications because of his limited purchasing power. These figures define the socioeconomic profile of the population.

But poverty not refers to the level of income, but it is related to social inclusion (Yeo, 2001), hence, the mere

fact of getting an assistive product for mobility is not a guarantor of inclusion. It is necessary to have in mind that the disabled person is in a macro system which whose environment encompasses much beyond his immediate situation, and this broader context refers to forms of social organization, belief systems and lifestyles that prevail in each culture or subculture (Bronfenbrenner, 2002). Thus, getting involved in vital situations depends not only in moving around, but also of the environment in which the person is. This problem requires an inter-institutional and intersectorial effort, to help improve the lives of this population. Besides the economic factor, another factor that creates barriers for the inclusion, is the lack of accessibility in the city. According to the results, in the city of Cali there are difficulties in the access to physical surroundings and to information and communication resources (67%). Leaving the house itself is only viable through vehicular routes, due to accessibility barriers present in the sidewalks (91%), which is a safety risk in this population. Buildings (54%) and public transportation (62%) are also considered as barriers for the inclusion. Working with multidisciplinary teams broadens the view of the problem. The objective of the project addresses the design problem considering its context of utility and the hierarchical model covers various elements of analysis of a problem that overcomes the technical and formal aspect. During the configuration of the possible business models that would cover the needs of social inclusion of individuals and the needs of the market and of the sector of assistive products for mobility, there were 4 possible models, where one ultimately was defined as the most appropriate for achieving social inclusion from the labor point of view of people with disabilities (see Figure No. 4). This model offers certain advantages over other possibilities, since people with disabilities can participate actively in the generation of value during the manufacturing, marketing and product distribution. The being employed in any stage of the business will improve the quality of life and that of their families and at the same time can access a variety of events arising from work activity, such as job training and personal growth seminars, increase in the purchasing power, access to credit, family compensation fund, social benefits, among others. Some aspects that may give rise to difficulties in implementing the business model are the social and political ones, regarding the collection of international resources for development of such projects because if all the requirements to apply to such aid are not met, the project could be extended in terms of time and

resources which increases the investment. However, within the model, there is an option of hiring a person or expert entity on the subject to successfully achieve the activities related to the collection of these resources.

On the other hand, institutions of and for disabled people were not created for industrial or service activity, therefore, in the first stages it is necessary to structure an organizational model that allows them to link their everyday activities with those of the industry and market participation. Also they must do the necessary legal procedures to create a new company.

5. Conclusions

The assistive products for personal mobility represent a good opportunity for the design of products from a multidisciplinary view, focusing in the social inclusion problem. Selecting this option as a goal of the design poses significant challenges for the social, technical and commercial development. In this way, this project made a contribution to the physical and social inclusion from an inter-disciplinary and interinstitutional point of view.

The problems addressed by the context present elements of interest for each of the actors, with different motivations, the University with the research, users with the needs, and the Company with the production and sale of innovative products. Therefore, in the design process, the use of multi-analysis techniques to achieve the reconciliation of different motives is required.

From the point of view of Design, two issues related to social inclusion were addressed: first, the design of the wheelchair, which in part, makes it possible to overcome barriers that the locomotory disability in lower limbs generates. It is a product that helps the person overcome obstacles of the physical environment, and which provides him with safety and comfort to move around. Second, the business model which belongs to the rehabilitation stage in which the person with disability must acquire access to the type of activities that give meaning and purpose to their lives. This situation is in direct relation with the productive employment, contributions to the family and community and the active participation within society. Access to employment brings about access to recreation, culture, sports and inclusion in different family and social activities.

In the proposal of physical and labor inclusion, the people with disabilities who were once considered vulnerable are now considered agents and beneficiaries of the social and economical development of the family. Two proposals were made, from the interdisciplinary design with actions related to the promotion of accessibility to the physical environment, the workplace, and therefore the accessibility to society in general with the aim of guaranteeing the equality of opportunities for all, through their participation in society.

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