ISSN 2821-9074 (Online)
ISSN 2730-2601 (Print)
RICE Journal of Creative Entrepreneurship and Management, Vol. 4, No.1, pp. 27-47, January-April 2023

doi: 10.14456/rjcm.2023.3
Received 24.10.22/ Revised 1.04.23/ Accepted 8.04.23

Design Development of Environment and Facilities for Disabled Workers in Department Stores and Large Wholesale-Retail Businesses: A Case Study of Mahatai Foundation

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Abstract

The purposes of this research were: (1) to identify needs of disabled persons and their obstacles at work, (2) to develop workplace facilities to increase the work efficiency of disabled persons, and (3) to evaluate the effectiveness of the designed workplace facilities for disabled persons. The design development of the workplace facilities was targeted at two types of disabilities--physical disability and vision impairment. The researcher used a triangulation method combining questionnaire, semi-structured interview and observation to validate the obtained data. Three research instruments yielded data for product development process using the principle of Universal Design. The designed facilities were trialed with disabled workers at Mahatai Foundation in Chonburi Province. The results revealed that disabled workers were able to working cooperatively with others but they needed suitable facilities in appropriate working environment. The results on the newly developed workplace facilities supported work efficiency of disabled workers. They were able to use the facilities quickly with a good motivation at work. The newly designed facilities proved reducing risks at accident during working time.

Keywords: *Disabled persons, workplace facilities, work environment, universal design, work efficiency, Mahatai Foundation*

1. Introduction

The development of the country is essentially an equal opportunity provided for people of all ages to have a decent living. Disadvantaged people, the disabled, the elderly, and other low socio-economic groups may be deprived of basic necessities and facilities in life to a certain extent.

Currently, Thailand has to cope with the elderly in becoming an aging society. However, one urgent issue seems to rest upon how to support disabled people to work with normal colleagues; the authorities concerned need to take into consideration appropriate design for the work environment, equipment, and facilities so that people with disabilities can work and live comfortably alongside with those without physical limitations.

As known, people with disabilities have human dignity, rights and liberty to be protected as Thai citizens. They should be independent in their way of living at a full potential of each individual. They should not be discriminated against regarding education opportunities and occupations. Disable persons are entitled to basic education to higher education like other ordinary citizens. It means that the government needs to provide suitable transportation and access to designated places for those with physical limitations. As seen in Bangkok, there are ten primary schools for people with certain types of disabilities. Secondary education for disabled persons is co-educational with public schools and accepts disabled students with good academic results and active learning ability. As for higher education, Suan Dusit Rajabhat College and Rajasuda College Mahidol University are open to the disabled to study including those with hearing impairment but still not covering all types of disabilities As of now, occupational development for the disabled is lacking (Pruettikomon, 2019) and social enterprise as a new alternative on how to change the attitudes of the general public toward the disabled. Career guidance enables people with disabilities to be able to rely on themselves with pride—feeling empowered to live independently and become part of the society on an equal footing with normal people (Pruettikomon, 2019). Career promoting guidelines generally deal with zero discrimination and ample employment opportunities. In particular, the government has restrictions on vocational training for disabled people. The researcher wanted to find a model and a guideline to promote occupational groups for the disabled, and planned to put forward the social business development model in support of the disabled.

To improve the quality of life for disabled people, it is imperative to secure cooperation from many parties concerned in society—in the government and private sectors. The study by Pruettikomon (2019) reported that there are four basic disability rehabilitation systems that support facilities for the disabled--vocational, medical, educational and social rehabilitation--and create environmental facilities along with attitudes of

normal people toward disabilities (National Committee for the Promotion and Development of the Quality of Life of Persons with Disabilities, 2010). There is a need to integrate disabled people into the main social stream by providing them access and positive environment via currently available technology as well as knowledge so that they can work with other normal social members.

It can be said that the environment and facilities are the key factors to support disabled people to work routinely with efficiency. The design should be based on their identified needs and other relevant information obtained from a standard assessments of their physically limited performance by normal supervisors and colleagues for further improvement. In this regard, the researcher combined quantitative and qualitative research methods to collect data from a survey, a questionnaire, an observation scheme and brainstorming sessions from various parties concerned. The researcher expected to use the obtained information for design development of work environment as well as facilities in the office context. The researcher also planned to evaluate those newly created work environment and facilities in terms of their practical functionality.

2. Research Objectives

The research carried three objectives:

2.1 To identify needs of disabled persons and their obstacles at work, regarding behavior, environment, and encountered problems in the offices of large wholesale-retail department stores as data for the design of the work environment and facilities.

2.2 To develop workplace facilities to increase the work efficiency of disabled persons in the offices of large wholesale-retail department stores.

2.3 To evaluate the effectiveness of the designed work environment and workplace facilities for disabled persons in the offices of large wholesale-retail department stores.

3. Research Methodology

3.1 Population and Sample

3.1.1 The population used in this research consisted of 1255 disable persons from department stores or large wholesale businesses in Bangkok.

3.1.2 The sample group used in this research was disabled persons selected by the stratified random sampling method of Krejcie and Morgan (1970) on three retail-wholesale businesses: (1) C.P. ALL Public Company Limited: 156 persons at Makro, (2) Big C Supercenter Public Company Limited: 103 persons (Big C), and (3) Ekkachai Distribution System Co., Ltd.: 35 persons at Lotus's.

Three sample groups were as follows.

Group 1 provided data on work environment, problems and design requirements for the mass in operations conducive to the design of facilities in the work of disabled people in the large wholesale businesses and department stores in Bangkok. The total number was 260 divided into: (1) C.P. ALL Public Company Limited: 138 persons at Makro, (2) Big C Supercenter Public Company Limited: 91 persons at Big C, and (3) Ekkachai Distribution System Co., Ltd.: 31 persons at Lotus's.

Group 2 provided data on work environment, problems and design requirements for the mass in operations conducive to the design of in the work of disable people in the large wholesale businesses. The total number was 14 divided into: (1) C.P. ALL Public Company Limited: 7 persons at Makro, (2) Big C Supercenter Public Company Limited: 5 persons at Big C, and (3) Ekkachai Distribution System Co., Ltd.: 2 persons at Lotus's.

Group 3 provided data on satisfaction with Facility Design Model on disabled people in department stores or large wholesale businesses. The total number was 20 divided into (1) C.P. ALL Public Company Limited: 11 persons at Makro, (2) Big C Supercenter Public Company Limited: 7 persons at Big C, and (3) Ekkachai Distribution System Co., Ltd.: 2 persons at Lotus's.

3.2 Research Instruments

The researchers used a triangulation method combining questionnaire, semi-structured interview and observation to validate the obtained data. Each instrument was constructed with specifications and rechecked by three experts in design and development for disabled workers in the workplace.

4. Data Collection

The researcher used five steps in collecting data.

4.1 Gathered information on the behavior of the visually impaired, completely blind, partially blind, physically handicapped and the official impaired hearing to understand their problems and obstacles at work.

4.2 Collected information on devices that help to enhance the perception of touch, ways of living with the general public of the visually impaired, the interactions among the visually impaired/ hearing impaired/ physically handicapped and close friends/ colleagues working/ having work experience at Mahatai Foundation.

4.3 Studied the process of design onto product development to meet the specific needs of disabled employees to suit their work.

4.4 Designed and developed environments and facilities for disabled persons working in the offices of large wholesale-retail department stores/ shopping malls to support those visually impaired workers.

4.5 Approached three assessment experts on environment and facilities of disabled persons to select a suitable model by evaluating and using the obtained data to analyze decision alternatives to reach an appropriate selection.

5. Research Data

The researcher reported the obtained data in nine categories.

5.1 The Samples under Study

The population of this study was those physically disabled and visually impaired persons working in large retail-wholesale businesses.

There were two types of people with disabilities from birth and those from and accidents. Other two types of visually impaired people were either naturally blind or blind from a cause later in life. They worked as telephone operators at Mahatai Foundation--a center for quality services by disabled workers. They worked on a long-term performing on tasks ranging from center surveying, research, co-working, to packaging and shipping in a team of quality and responsibility as assigned.

This research focused on disabled persons in two categories--the physically handicapped and the visually impaired as the target groups. The

researcher used Mahatai Foundation as the training facility context in preparing people with disabilities prior to their work in actual retail-wholesale businesses or department stores. The details of three groups of samples were as given in Subsection 3.1.2.

5.2 Representatives in Testing the Product Performance

Thirty disabled employees--15 physically disabled and 15 visually impaired at Mahatai Foundation--provided data on the tested product performance, as shown in Tables 1 and 2.

Table 1: Data Collection at Mahatai Foundation Chonburi from 15 Physically Disabled Representatives in Testing the Product Performance

Name [consent given]	**Age**	**Gender**	**Cause of disability**
1.Kitiphat	22	Male	Congenital
2.Phasada	38	Male	Accident
3. Weerawat	33	Male	Accident
4. Anganet	20	Male	Congenital
5. Sirikan	27	Female	Accident
8.Yuwathon	29	Male	Accident
7. Sorat	40	Male	Accident
8. Chatchai	38	Male	Congenital
9. Juthamas	28	Female	Congenital
10.Kuekoon	21	Male	Accident
11. Sister Pang	26	Female	Congenital
12. Yuwan	29	Female	Accident
13. Songkran	43	Female	Accident
14. Nongnook	41	Female	Accident
15.Manee	41	Male	Accident

Note: Table 1 shows 10 persons from accidental disabilities and 5 persons with disabilities from birth.

Table 2: Data Collection at Mahatai Foundation Chonburi from 15 Visually Impaired Representatives in Testing the Product Performance

Name [Consent given]	**Age**	**Gender**	**Cause of disability**
1.Nathee	20	Male	Blur blind
2.Kanya	32	Female	Blind
3.Nammon	35	Female	Blur blind
4. Patthama	26	Female	Blur blind
5. Chankla	28	Male	Blind
6. Maythee	24	Male	Blur blind
7. Rungarroon	42	Male	Blind
8. Maneenart	35	Female	Blind
9. Sing	25	Male	Blur blind
10. Sister Yao	39	Female	Blind
11. Sister Kwan	36	Female	Blind
12. Chowvanit	28	Male	Blur blind
13. Komsan	45	Male	Blind
14. Nongyao	42	Female	Blind
15.Audom	47	Male	Blur blind

Note: Table 2 reports 9 completely blind persons and 6 blur blind persons.

5.3 The questionnaire asked for feelings and opinions about the satisfaction and effectiveness of educational and product design programs to assist the mobility and visually impaired people in their careers. The questionnaire items were validated in content validity by three experts in design development for people with disabilities. All respondents were asked to react to the designed product model.

5.4 Interviews carried both closed-ended and open-ended questions to secure information on what to develop and design products to ease mobility in physically disabled and visually impaired people at work.

5.5 Observation focused on behavioral details of the samples and information on the production of office furniture and facility items for the disabled in their work environment to conclude guidelines for product

development based on the data obtained from a digital camera and portable computers that save needed data and images.

5.6 The Use of Research Instruments

The researcher obtained data for analysis--ranging from sampling, a questionnaire, an interview scheme, an observation technique, along with electronic media, cameras, and recording devices. The respondents were to report their satisfaction with the newly created environment and facilities for disabled workers. The developed design was meant to assist people with mobility disabilities at work. The obtained data were analyzed for product development after the process used by Victor (2002).

5.7 Principles of Design Procedures

The researcher studied information on design principles and procedures from journals, books, the Internet and related research. The data were also secured by field surveys, observations, notes and interviews in designing and operating in planned steps. The target design needs to suit disabled workers' use in terms of position, location, aesthetic features, and design inspiration to be accepted by consumers in the target market among competitors. The design principles account for consumers' acceptance in terms of aesthetic features as well as good quality of the finished products.

5.7.1 Analysis of 5W1H Design Guidelines

The researcher used the obtained data to analyze product properties and create design guidelines in the steps as follows:

Have mobility features for those workers with visual disabilities.

Need tables for the disabled and the visually impaired.

Need location for furniture and office equipment to be installed in office space or suitable area.

Be functional during work time or doing activities on the desk.

Be responsive to why and when for mobility of visually impaired workers' tasks on the designed desk.

Be responsive to how to tackle arising problems to meet the needs of users for maximum utility.

5.7.2 Data Analysis for Design by SWOT Analysis

Strengths

Mobility for visually impaired people in using designed furniture to meet the needs of target workers.

Weaknesses

The use may cause inconvenience to some normal users who do not wish to co-work with disabled workers.

Opportunities

With mobility for visually impaired workers, the created office furniture could be applied in functionality to normal workers to create a sense of equality in occupation.

Threats

The issue of safety in the design for disabled workers could pose a threat to an organization to spend more on special office furniture to suit disabled workers. There were four types of disabilities to cope with: physically handicapped from birth, physically handicapped by accident, partially visually impaired, and completely blind. In this regard, the design principles primarily require safety and convenience in use (Lin & Wu, 2015).

5.8 Analyzed Data

Observation and interview data on mobility disabilities were from the disabled workers' opinions as responses to both the open and closed questions. These data made it possible for the researcher to draw conclusion on the design development for disabled workers. The researcher classified data as follows:

Part 1 Data obtained from the sample group via interviews.

Part 2 Data on disable problems identified by three experts for the design development of office furniture and equipment suitable for the disabled and the visually impaired at work.

Part 3 Data on disabled users' satisfaction with the designed environment and facilities for disabled workers in large retail-wholesale department stores.

Part 4 Statistical data on designed furniture and office equipment for the disabled and the visually impaired at work.

As for the *satisfaction* meanings on the scale of 1-5, the researcher specified:

4.50 – 5.00 highest satisfaction
3.50 – 4.49 high satisfaction
2.50 – 3.49 moderate satisfaction
1.50 – 2.49 low satisfaction
1.00 – 1.49 lowest satisfaction

As for the *performance* meanings on the scale of 1-3, the researcher specified:

2.50 – 3.00 the highest level performance

1.50 – 2.49 the moderate level performance

1.00 – 1.49 the lowest level performance

The researcher used data as percentage, arithmetic mean, design drawings and procedures.

5.9 Product Development Process

Figures 1-4 show the process of design development of environment and facilities for disabled workers in large retail-wholesale businesses or department stores.

Figure 1: Brainstorming for Product Development and Identifying Disable Problems at Mahatai Foundation (1)

Figure 2: Brainstorming for Product Development and Identifying Disable Problems at Mahatai Foundation (2)

Figure 3: The Design Concept for the Mass as a Guideline for Design Development

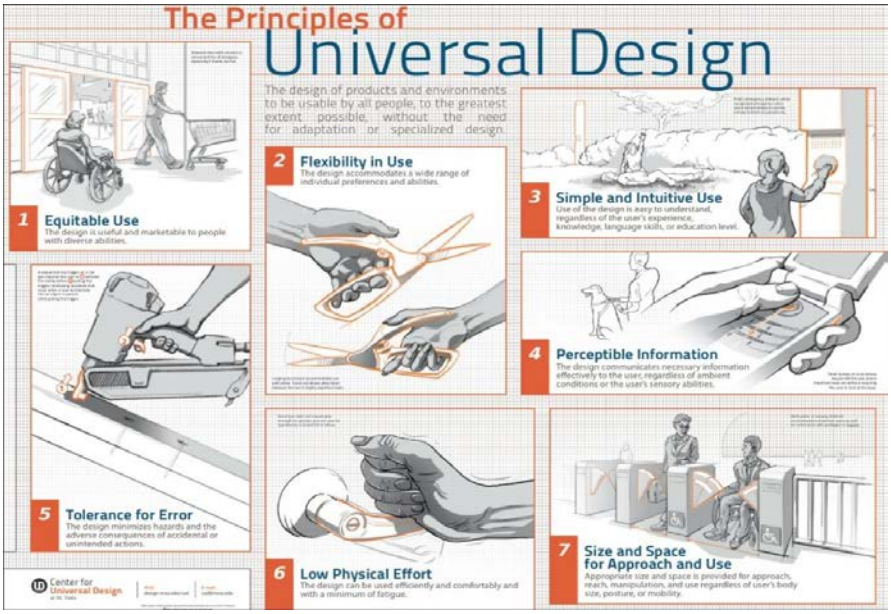


Figure 4: Drawing Development of an Office Furniture Adjusted to the Size of a Wheelchair for the Physically Handicapped

As shown in Figures 1-4, the researcher collected data needed for a guideline to the design development of adjustable tables for wheelchair seats. There were two types of wheelchair seats for the disabled or leg-injured. Those with an injured leg can still walk but need to sit with arm or hand support. There are various needs, such as a handicapped person needs

a hand or a mechanical arm to ease their mobility. Finger disabilities may require gloves or a hand-grip device; finger disabilities need a keyboard for finger disabilities and a computer mouse for feet (Saito, 2006).

The researcher wanted to design facilities for people with mobility impairments, especially those on wheelchairs. Different sizes of wheelchairs were a common problem for the disabled to move to a normal office chair--making it not convenient for disabled workers when going to the bathroom. Access to a low power plug could be a problem when bending down to reach it. The storage position of personal equipment also posed a problem to those on wheelchairs to store lunch boxes, drinking water, tea, coffee, and other personal belongings. The researcher therefore listed design guidelines in two main aspects: (1) using the standard size wheelchair, and (2) designing an office table to fit the wheelchair size. These design guidelines were to meet the needs of disabled workers economically and cost-effectively.

The design guidelines encompassed four parts as follows:

(1) The high-shaped office desk (Top) is a concave shape (Curve) to accommodate a wheelchair and can be adjusted up and down to fit in the wheelchair. The height can be adjusted between 70-90 centimeters, which can be adjusted up to the maximum of 20 centimeters to fit a manual/ motored wheelchair.

(2) The location of the power plug and the height of the edge of the table and the design of the back cover to prevent dropping were to help disabled workers to reach or store things conveniently.

(3) The storage area was designed to have a side table to store personal items, particularly utensils to be cleaned or washed easily.

(4) The floor materials require viscosity. Most disabled workers live close to their workplace and can travel to and from on their own. The floor with increased viscosity will allow them to use and clean the floor by themselves. In addition, their cloth bag hung on their wheelchair can easily store their personal belongings. The path in the main area of the office space should be clear from obstruction of all kinds to avoid stumbling or tripling that may occur.

The guidelines deal with identified or foreseen problems with the disabled's environment or facilities, and particularly allow them to be seated in wheelchairs when working in the assigned office space conveniently, as shown in Figures 5-10 from the first to the second draft of design development.

Figure 5: Conceptual Design Image Improved from the First Developed Draft: The Second to the Third Draft

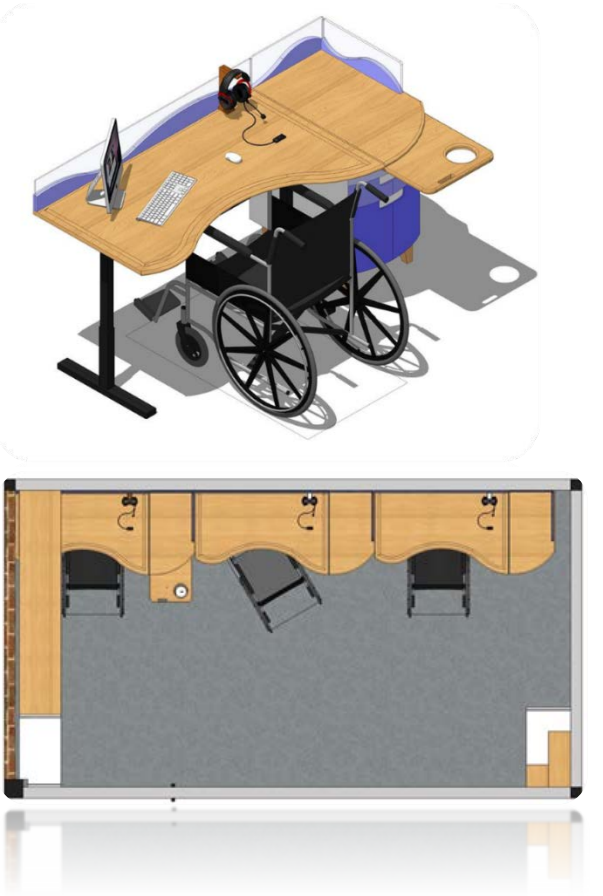


Figure 6: Note-Taking Device for the Visually Impaired Based on Braille.

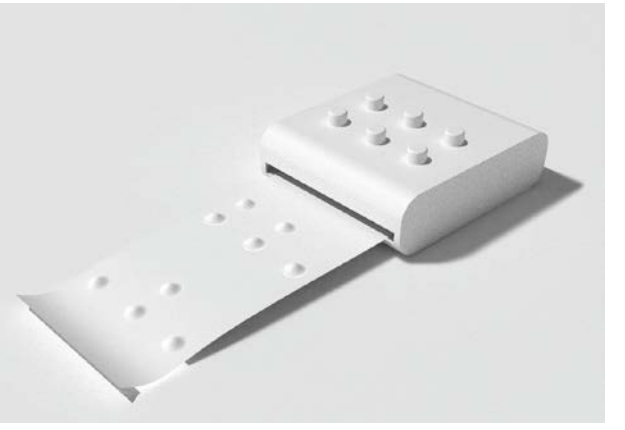


Figure 7: Electrical Shock Protection Device for the Visually Impaired

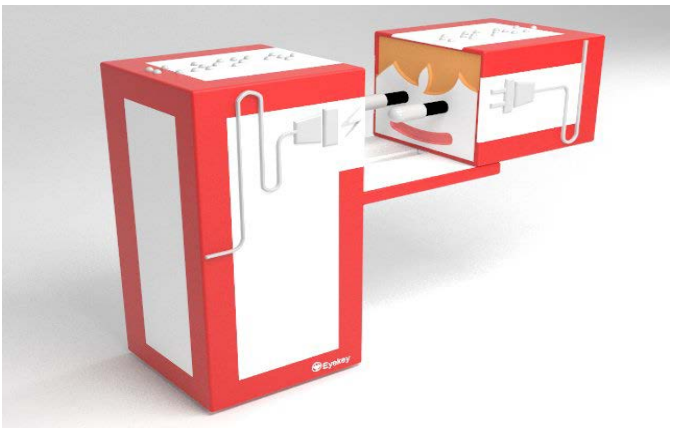


Figure 8: Paper Punching Device for the Visually Impaired or Workers with Weak Arm Muscles

Figure 9: The Pen for Writing Notes for the Physically Handicapped or Workers with Weak Arm and Hand Muscles

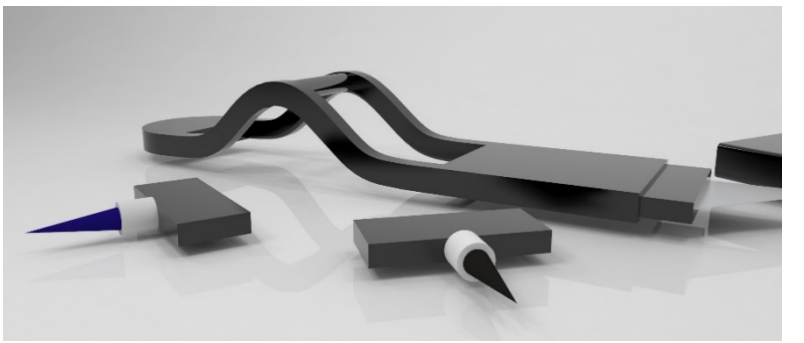
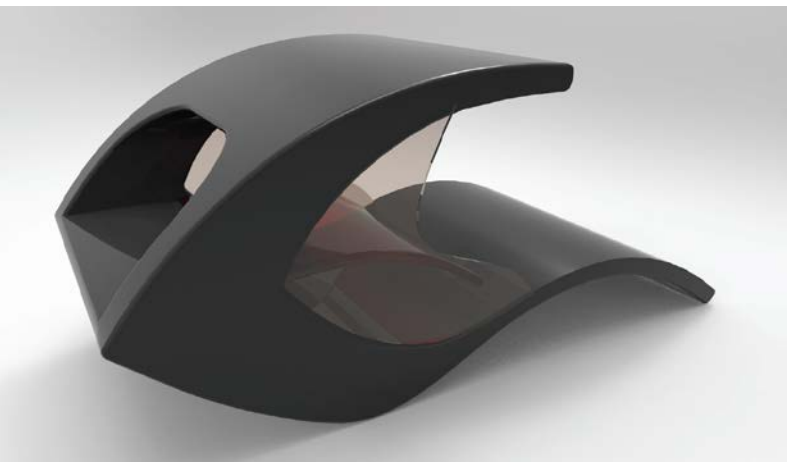


Figure 10: A Mouse for Computer Work for Disabled People Using a Foot



6. Results and Discussion

The researcher analyzed the obtained data on designed desks for workers with mobility and visual impairment, and then secured interview data from disabled workers as well as three furniture and electronics specialists.

6.1 The Disabled

The executive of Mahatai Foundation said that standard size office furniture and equipment are not suitable for people with mobility disabilities at work. There should be more space for wheelchair access and safety.

6.2 Furniture

One specialist in mobility disabilities emphasized planning for the installing procedures, selection of materials and methods of use, styles and properties of each material type, creativity for the designed furniture for ease, durability, and safety.

6.3 Electronics

One specialist asserted that electronic systems be used in testing the structure regarding the ease of use and safety to prevent electric shock.

The results from the study showed what and how the designed product can come directly from people with mobility disabilities and stakeholders concerned. The universal design principles can be applied to specific work environment for those workers who are physically handicapped or visually impaired. As shown, the work table needs to be adjustable with an electric system to suit those who have muscle weakness. It is important for a designer to modify the target facility for safety, convenience, and functionality as the primary concerns (Lin & Wu, 2015).

From the preliminary data collection, the respondents considered the importance of furniture for safety as well as the use of colors, sizes, proportions, as well as material types used in production. The survey yielded satisfaction data; the use of mobile camera in support of the data obtained from the questionnaire helped set a guideline for designing and producing a prototype.

The analyzed data revealed that people working in large wholesale and retail department stores were dominantly females (F=58.33%, M=47.67%), and the average age ranging from 20-60 years (80%), having completed primary education (50%), and with a bachelor's degree (25%), working periods were 0-1 years (52.49%), and those worked 1-5 years (33.33%). Those disabled respondents were in the clothing department (14.16%); the hearing impaired respondents were telephone operators (14.16%) and visually handicapped and wheelchair-bound (12.50%). It should be noted that the purchasing department doesn't want people with disabilities to work for fear of affecting the image of good health.

The majority of the disabled respondents earn more than 10,000 baht per month, with food allowance of 500 baht per month (50%), the salary from 10,000-15,000 baht per month (25%) based on assigned duties. Some supervisors noted that people with disabilities may not be able to work toward organizational goals. From their observation, people with disabilities

do not want to change position (80%) and tend to opt for rather easy tasks that do not require much thought and risk. However, the use of teamwork could help as an incentive for survival and cooperation in working toward the organizational goal (Sukiam, 2020).

The researcher observed that people with disabilities tend to view the environment and facilities as not supportive to their employment. In fact, the mindset of the disabled toward work challenges, organizational goals, and innovative contribution are of prime importance. Employment is not simply the way to earn one's living, but the path to fulfill one's goal toward the selected career as well as contributing to the growth of the organization. In this regard, the organization could consider work competency development for all employees to create good products and deliver quality of services with their collective efforts and cohesive collaboration (Sukiam & Likitsarun, 2021). It is important to instill a sense of unity by involving all employees to work together in a specific direction common in interest and benefit of all stakeholders.

From the questionnaire results, the disabled respondents felt that they were not able to perform at the level of their colleagues (80%). For them, the problem areas were offices (10%) and warehouses (20%), inadequate facilities (66.67%), problems with power sockets (40%), office desks and (30%), elevators (10%), and internal paths/ toilets/ canteens/ warning signs in case of emergency (10%).

The majority of the disabled respondents experienced accidents at work, (58.00%) from electric leak, falling objects, stairs, bumping into objects, knives, and forklifts. They wished for friendly environment and facilities (66.67%). To the researcher, communication is vitally important to the hearing-impaired workers and they need safety when using office furniture and equipment.

The disabled respondents preferred materials made of wood and with smooth surface (41.67%) and in square shape (41.67%). Desks and cabinets should require designs suitable for disabled people (41.67%); computer sets and power sockets should be easily accessible for those with physical disabilities. Communication devices between supervisors, normal colleagues and people with disabilities should deserve a full attention for clear understanding of assigned tasks and safety at work. As for the visually impaired, they certainly need appropriate office furniture to reduce accidents. A handicapped person in a wheelchair needs a new viewshare used for work

and desks suitable for work (58.33%). Office equipment like knives, cutters, staplers, hole punchers were mainly problematic to the visually impaired and physically handicapped (41.67%). The disabled respondents were willing to adapt themselves to obstacles at work (66.77%). Overall, the results from the questionnaire and interviews showed that disable workers need to have work suitable to their functional abilities so that the organization can use their competencies at a full potential for good results from increased work efficiency. It is therefore vitally important to create uniqueness of atmosphere in the workplace as a psychological impact on workers to feel comfortable and perform on assigned tasks efficiently (Ratchavieng, Srinet & Syers, 2021).

7. Conclusion

The researcher found that people with disabilities tried to develop their capacity in other areas to compensate for their physical limitations and they were in need of supportive disable environment. Only if the employer were willing to accommodate disabled workers in a suitable work environment and facilities, disabled employees would definitely contribute well to the growth and success of their selected organization. It is important for all stakeholders concerned to provide sustainable employment with appropriately designed work environment and facilities. According to the conceptual research framework presented by the researcher, it could bring to employers' attention a good balance of social, physical, and mental aspects for a society of equality.

The use of facilities that are friendly to disabled workers can be in conjunction with the government's law and its enforcement. As for people with disabilities in Thailand, the employer's step forward in redesigning work environment and office facilities has revealed good will for disabled members of society to have the opportunity to contribute to the country's economic growth in the long run—not to have manpower wasted due to discrimination against those who are less fortunate in society. In this flow of thought, the researcher felt particularly positive toward Victor's assertion in 2002 that people with disabilities and good talent can inspire underprivileged people to live a normal life in society (Victor, 2002).

8. Acknowledgements

The author would like to thank the Research and Development Institute, Rajamangala University of Technology Rattanakosin for providing financial support for the research project. Sincere appreciation also goes to all departments and government agents for their assistance in giving needed data.

9. The Author

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