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The Process to Improvise Inclusive Design Concepts in NPD for Mobility Design System for PWDS with Proximal Femoral Focal Deficiency (PPFD) Without Limbs and Leg

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ABSTRACTS: Many disabled people are currently still struggling to adapt products specifically designed for them which are manufactured and produced to ease their lifestyle in most environment. The need to integrate relevant design philosophy to address the user requirement has been the main areas of this study. The purpose of this study is to understand **the real needs** of physically impaired person (PWDS) with PPFD without limbs and leg, and to compromise the relevant design Inclusive Design concepts in order to propose a relevant design study for the users in the later stage of the study. The results of this study will benefit the users, as well as designer and manufacturer of specific products development for the intended users in the future.
KEYWORDS: *Inclusive Design, mobility design system, Person with Disabilities (PWDS), PPFD without limbs and leg.*

I. INTRODUCTION

There is a need to develop the type of relevant Mobility Design System applying Inclusive design concept that can assist the mobility of Persons with Disabilities (PWDS) with Proximal Femoral Focal Deficiency (PFFD) without limbs and legs to manoeuvre by themselves. There are a few factors that support the need to develop the mobility design system from this group of people.

Firstly, based on researcher finding, there is no relevant Mobility Design System currently to assist the mobility among Persons with Disabilities (PWDS) with Proximal Femoral Focal Deficiency (PFFD) without limbs and leg. This is due to the rarity of the condition in Malaysia. Secondly, there is no relevant reliable system in assisting mobility among the Persons with Disabilities (PWDS) with Proximal Femoral Focal Deficiency (PFFD) without limbs and leg in Malaysian market. Thirdly, there is no relevant (as far as this research is concern) design that is inclusive of the design concept within the Mobility Design System for the use of Persons with Disabilities (PWDS) with Proximal Femoral Focal Deficiency (PFFD)without limbs and leg in Malaysian market. Therefore, based on the above fact, there is a need to develop an Affordable Mobility Design System with inclusive design concept for Persons with Disabilities (PWDS) with Proximal Femoral Focal Deficiency without limbs and leg for ease of manoeuvring to have equal excess in learning.

II. BACKGROUND

The purpose of this study is to seek the contribution of industrial design with inclusive design concept to assist the development of mobility design system for person with

disabilities (PWDS) with proximal femoral focal deficiency (PFFD)without limbs and leg. This study will begin with observing the daily activity of person with disabilities (PWDS) with proximal femoral focal deficiency (PFFD)without limbs and leg problem faced in their daily activities. After having a deep understanding of the PWDS with PPFD without limbs and legs, the researcher behaviour dan characteristic. Then the researcher will be conducting the market survey to identify the current reliable system to be fitted in at the sometime will be observing on the existing mobility design system with inclusive design concept for of person with disabilities (PWDS) with proximal femoral focal deficiency (PFFD)without limbs and legs. The finding will then be use as reference to develop the mobility design system with inclusive design concept to the support the user to manoeuvring around. Finally, the design outcome will be evaluated by the subject matter expert. The design specification of the mobility design system will be refine based on their comment and will be documented.

As stated by many studies there are clear major differences of physical disabilities symptoms from a variety of categories of physical impaired person (PWDS), including their needs and ability which has not been of major consideration during design process or to model the actual user needs and the products produced. All these and many other factors are integrated (users' studies and Inclusive Design concepts) to become the major consideration for these studies to embark upon. This study will be focus on the study of users' needs of people with PPFD and with the integration of an **Inclusive Design Concepts** within the development of propose design of products (which will commence in the 2nd stage of the study). Results from these studies will then be tested by experts to validate the design process compliance with the user study which has been conducted in the early stage of this research work.

RESEARCH QUESTION

1. What Are the Criteria of Inclusive Design for Supporting PFFD Daily Activity?
2. What Are the Mobility Design System Available in The Market to Assist Person with Disabilities (PWDS) With Proximal Femoral Focal Deficiency (PFFD)?
3. How can inclusive design theory be utilized in designing the best mobility system to assist daily activity of Proximal Femoral Focal Deficiency PFFD in campus life?
4. What Is the Characteristic of PFFD And the Group Associated With PFFD?

RESEARCH OBJECTIVE

1. To Document the Criteria of Inclusive Design for Supporting PFFD Daily Activity.
2. To compile existing mobility design system to assist person with disabilities (PWDS) with proximal femoral focal deficiency (PFFD) in the market.
3. Inclusive design theory can be utilized in designing the best mobility system to assist daily activity of PFFD in campus life through the implementation of satiety and comfort features within.
4. To Validate the Characteristic of PFFD And the Group Associated With PFFD

III. LITERATURE REVIEW

Person with Disabilities (PWDS)

Malaysian Department of Welfare [1] in Persons with Disabilities Act, 2008, defines physical impaired person as "OKU or people with disabilities as those who have long term physical, mental, intellectual or sensory impairments which in there are interaction with various barriers may hinder their full and effective participation in society."They added "Currently more than 2 billion disabled people in the world, that is 37.5% of the world's

population according to the *World Health Organization (*WHO) [2] and they define a disabled person as anyone who has "a problem in body function or structure, an activity limitation, has a difficulty in executing a task or action; with a participation restriction". The Sunday mail reported [3] that "As many as 443,541 disabled persons (OKU) have registered with the Social Welfare Department as of October this year, mentioned by Deputy Minister of Women, Family and Social Department Datuk AzizahMohd Dun. She said the number of disabled persons registered through the OKU Information System (SMOKU) had still not reached the target of 10% to 15% of the total disabled population set by the World Health Organization in 2017. She added "Of those who have registered, 39,999 are disabled persons who are visually-impaired and should be given attention with equal rights as provided in the Disabilities Act 2008 and the Convention on the Rights of Persons with Disabilities (CRPD)," she said at the launch of the Malaysian Blind Association (MAB) Excellence Achievement Awards for Visually Impaired 2016/2017 today.

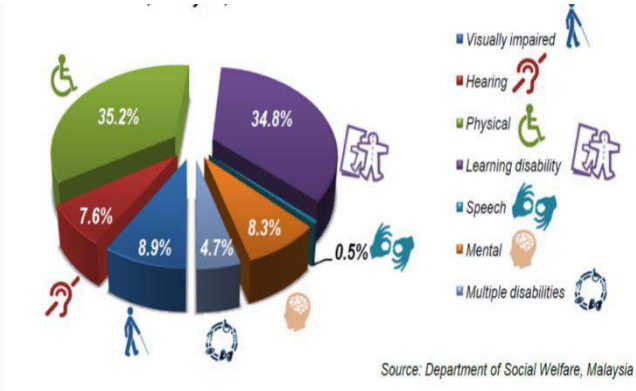

Figure 01 - Percentage of person with disabilities (PWDS) by category of disability in Malaysia,2017

Based on this statement the population of physical impaired person is considering large, therefore the role of industrial design participate in product development are very important. According to research article, responding to the design needs of disabled people Rob Imrie(2010)[4]pointed out the unanswered need of design to structures for the disabled residing in the urban community. According to Imrie, the design of public buildings and transportation excludes the physical and spatial needs of the disabled people. This, however, represents neglect on the part of the individuals responsible for the production of environmental designs.

According to the registered Person with Disabilities (PWD) at the Department of Social Welfare, Malaysia in 2017 were 453,258 persons. PWD in physical category recorded the highest number which was 35.2 per cent, followed by Learning disability category (34.8%) and Visually impaired category (8.9%). Speech category recorded the lowest registration of 0.5 per cent. **[5] .**UNICEF Malaysia (2016) conducted a study on disabilities that engaged 756 participants from Selangor, Kelantan, Sabah, and Sarawak covered a few approaches like surveys, discussions, workshops, and interviews. The findings were Six out of 10 participants (58.4%) were under-informed or ill-informed about disability; 87% said they wanted to know more. Only 20% of the participants saw behavioral and mental conditions as disabilities.

Most regarded children with learning disabilities, hyperactivity, or aggression as being badly behaved. Those with mental disabilities were labeled as crazy or stupid and were often made fun of. The finding was also highlighting the lack of knowledge and misconceptions about

disability and has resulted in stigma against people with disabilities and limited their access to their rights to be a part of society. [6]

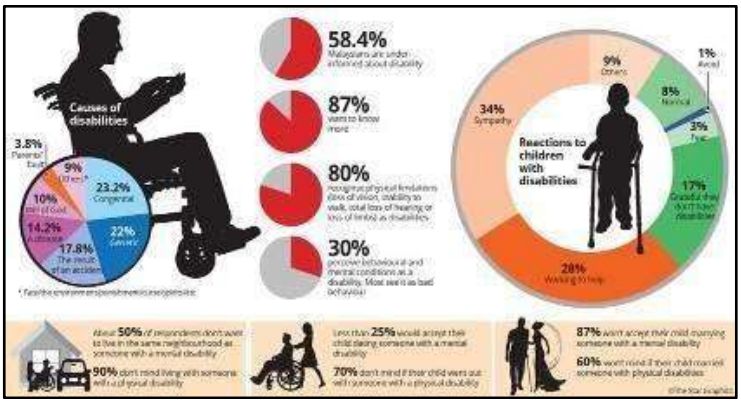

Figure 02 - registered Person with Disabilities (PWD) at the Department of Social Welfare, Malaysia in 2017

Therefore, it is the researcher's responsibility to propose relevant Mobility Design System to assist of Persons with Disabilities (PWDS) with Proximal Femoral Focal Deficiency (PFFD) to move around.

Noor A A M, (2018), mentioned in her journal that the Ministry of Women, Family, and Community Development has outlined seven categories of disabilities in Malaysia. These categories are hearing impairment, vision impairment, speech impairment, learning disabilities, physical disabilities, mental disorder, and multiple there are 365, 677 persons with disabilities registered with the department. (8.10%) with hearing impairment, 29, 403 (8.04%) with mental disorders, 16, 963 (4.64%) with multiple disabilities, and 1, 827 (0.50%) with speech impairment. Figure below illustrates the number of disabled people registered according to their disabilities in Malaysia. [7]

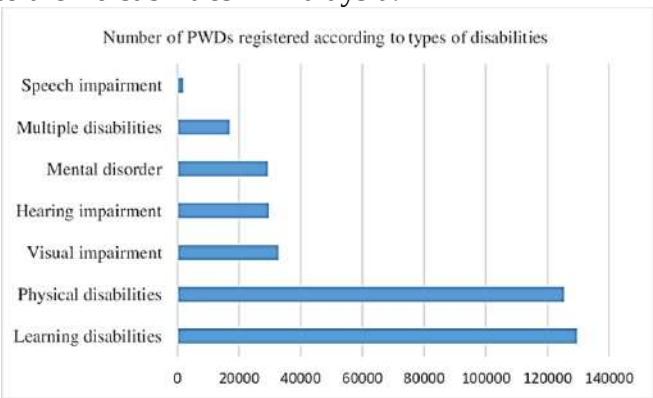

Figure 03- number of PWDS registered according to types of disability

disabilities. According to the Department of Social Welfare's statistics report (2015), currently, this amount of disabled people is further categorized into 129, 550 (35.43%) with learning disabilities, 125, 491 (34.32%) with physical disabilities, 32, 807 (8.97%) with visual impairment, 29, 636.

Therefore, in this diagram, the researcher is focusing only on the physical disability which are the second higher before learning disabilities which relate to loss of arm and legs by nature born.

As for below, the statistic type of PWDS in Malaysia until30th. June,2020 indicate that in Malaysia, out of the all types of disability, Physical disability score the highest with the total of 200,506 numbers of people, while the Selangor had the most of physical disabilities in which accumulate around 35,619 number of people.

No.	Negeri	Penglihatan	Pendengaran	Pertuturan	Fizikal	Pembelajaran	Mental	Pelbagai	Jumlah
1	JOHOR	5,200	4,335	344	24,666	22,305	6,217	3,126	65,613
2	KEDAH	5,085	3,261	307	18,472	14,469	3,939	2,281	47,814
3	KELANTAN	3,572	2,500	251	12,078	15,064	4,373	2,005	39,843
4	MELAKA	1,906	2,259	118	10,077	8,818	2,004	813	25,995
5	NEGERI SEMBILAN	1,912	1,813	88	10,079	8,131	2,051	1,249	25,323
6	PAHANG	2,946	1,992	198	11,973	12,011	2,029	1,592	32,741
7	PERAK	4,254	3,262	179	17,398	16,314	4,917	2,332	48,656
8	PERLIS	759	370	68	2,439	2,409	810	278	7,133
9	PULAU PINANG	3,291	2,533	115	13,505	9,767	2,045	1,225	32,481
10	SABAH	3,112	2,673	305	9,831	15,024	2,696	2,115	35,756
11	SARAWAK	4,310	2,565	226	10,536	13,494	4,317	1,536	36,976
12	SELANGOR	5,654	5,093	353	35,619	30,590	5,874	4,680	89,870
13	TERENGGANU	2,457	2,265	133	8,319	11,353	1,974	1,281	27,782
14	W.P. KUALA LUMPUR	3,749	3,036	126	15,640	12,524	2,739	1,304	39,118
15	W.P. LABUAN	134	82	25	454	905	93	79	1,772
	JUMLAH	49,368	39,009	2,848	200,506	193,168	46,078	25,896	556,873

TOTAL NUMBER OF PERSON WITH DISABILITIES(PWDS) IN MALAYSIA (2020) – 200.506

Figure 04 - The statistic type of PWDS in Malaysia until30th. jun,2020

Based on the above, the researcher will focus on researching the PWDS with physical disabilities without limbs and legs activities within the Klang valley area which is close to all government agencies, medical center and universities which are centralized to gather the data. Within the group of physical disabilities without limbs and legs, researcher is focusing on the PWDS with Proximal Femoral Focal Deficiency (PPFD) without limbs and leg. in the figure below, the researcher will show the picture of the target group of PWDS

Figure 05 - The statistic type of PWDS in Malaysia until30th. jun,2020

Dealing with these types of PWDS with PPFD without limbs and leg, the researcher needs to study their background, their characteristic and daily activities to gain understanding towards their needs. Therefore, the researcher needs to validate and observe their behavior to prioritized their main activity as main criteria to be consider as design statement to come out with inclusive design concept to redevelop mobility design system applying new product development for PWDS with PPFD without limbs and leg.

According to Orozco, P. S. P, (2019),[8]The design and manufacture of Orthopedic Product have recently undergone one great development as it benefits from advances in Industrial

Design and new Advanced Manufacturing techniques based on Rapid Prototyping and Additive Manufacturing. He added that the Industrial Design applied to the Orthopedic Product offers to this sector great possibilities of development in the design and manufacture of the splints or orthosis required, but its real implementation requires increasing the provided advantages to those manufactured by traditional methods.

Sulistiyawan, B. B ,(2020)[9] ,define physical impaired person as " A person who has a physical/body deficiency or abnormality that causes interference with their personal activities and development. "he added "Disabilities has two categories, namely *ambulant disabled* and *wheelchair-bound disabled*. Ambulant disabled persons are persons with disability who can still move around using tools without using a wheelchair, while wheelchair-bound disabled are those who have limitations in mobilization and are certain to use a wheelchair to carry out daily activities.

Inclusive design

The British Standards Institute (2005) defines inclusive design as: 'The design of mainstream products or services that are accessible to, and usable by, as many people as reasonably possible... without the need for special adaptation or specialized design.)[10]

We have defined Inclusive Design as: design that considers the full range of human diversity with respect to ability, language, culture, gender, age and other forms of human difference. [11]

According to inclusive design hub.com, Inclusive Design is the design of an environment so that it can be accessed and used by as many people as possible, regardless of age, gender and disability. An environment that is designed inclusively is not just relevant to buildings; it also applies to surrounding open spaces, wherever people go about everyday activities…... it is important to involve disabled people in the design process. [12]

According to Page.T,(2018),, the use of an „inclusive design methodology", where the end user is incorporated into the design process, would allow the production of inclusively designed products. However, encouraging designers to employ inclusive design methods will only be successful when the impact of new inclusive design methodology is seen through the usability of products and designs (Clarkson and Keates, 2003). The differing values and attitudes in designing for exclusivity and for non-exclusivity are summarized in Table below [13)

Table 1: (Adapted from Sommer, 1983)

Inclusive Design	Non-inclusive Design
Concern with meaning and context	Concern with style and ornament
Participative	Non-participative
Human orientated	Corporate or institution orientated
Client re-defined to include users	Owner as exclusive client
Low cost	High cost
Grassroots design approaches	Top-down design approach
Democratic	Authoritarian
Seeking to change design attitudes	Acceptance of prevailing design attitudes
Use of appropriate technology	Use of high technology
Use of alternate models of development process	Development process controlled by corporate interests
Heterogeneity	Homogeneity

Figure 06- inclusive deign vs Non-Inclusive Design

Therefore, based on the diagram above, inclusive design is more towards Design thinking which is a non-linear, iterative process to understand user needs, challenge assumptions, redefine problems and create innovative solutions to prototype and test.it involving five phases which is —Empathize, Define, Ideate, Prototype and Test, which will directly focus on the problem arise.

III. INCLUSIVE DESIGN (Universal Design) FOR PPFD

This study will adapt the applicability of using Inclusive Design philosophy in the development of design proposal for the end user, especially PWDS with PPFD without limbs and leg. So, what is Inclusive Design concept and how it is applicable to be adapted into this study?

According to *Kari Haugeto,2013* [14]mentioned that the term" universal design" was first entered into usage in the mid 1980's by the American architect, Ronald L. Mace,2013. During the nineties, Universal Design was a concept embraced in several countries. With the UN Convention on the Rights of Persons with Disabilities, which has been acknowledged and ratified by many countries."

As the term accessibility has been mentioned before, one must wonder what it actually means. In the context of design, accessibility responds to the users' needs to use and interact with a design It should be accessible to all, irrespective of the individual's personal, cultural, physical, and socioeconomic status. In the web context, disabled people can understand, perceive, control, and interact with web elements. It tends to improve usability and inclusiveness altogether. Accessibility overlaps with the concept of Universal Design.

The term 'Universal Design', was a handicapped architect who advocated accessibility in every aspect of design. The universal design (aka the design for all or the inclusive design) is a comprehensive term that addresses the needs of every individual when it comes to accessibility. The universal access allows the non-impaired as well as impaired individuals to respond to the design equally. Accessibility deals with the concept of usability, while universal design is more of a user-oriented term. However, it is more important to consider the designing requirements of the disabled people. [13]

Ronald L. (Park, J. I. 2014).[15]**,**define Universal design as the design of buildings, products or environments to make them accessible to all people, regardless of age, disability or other factors. The term "universal design" was coined by the architect, Ronald Mace to describe the concept of designing all products and the built environment to be aesthetic and usable to the greatest extent possible by everyone, regardless of their age, ability, or status in life.

According to Özdemir, Y., &Özdemir, Ş. *(2020),*[16]Universal Design (UD) is the design of products and environments that can be used by all people in the widest possible way without the need for adaptation and custom design. It involves a wide range of design disciplines, including environments, products, and communication design. *He added* "A working group of developers (architects, product designers and environmental design researchers) guided the design process without evaluating existing designs and identified seven UD principles to be used to educate designers and consumers about the properties of more useful products and environments. Özdemir, Y., &Özdemir, Ş. (2020) also mentioned that the aim of universal design; Whether it is buildings, open spaces, communication tools or home furnishings, it is to develop theories, principles and solutions to ensure that everyone uses the same physical solutions as widely as possible. Within the concept of universal design there is both a vision and a concrete initiative to plan and realize all the buildings, environments and products that

can be used by everyone and the children and the elderly in the widest possible extent, in different dimensions and abilities, persons.

Carole Martinez, the Content Manager, inclusive citymaker.com, [17] mentioned that Inclusive design has a major role in enhancing accessibility. Though both concepts don't exactly encompass the same ideas, they are undeniably linked together because of their complementary. Accessibility consists in removing the present obstacles whereas inclusive design consists in creating solutions that from the beginning are perfectly tailored to the needs of several profiles of people: a person with reduced mobility for whom it'll be easier to use an elevator in a shopping mall or a person with a visual impairment who needs a contrasted signage in a subway station for their getting around in complete autonomy for example. She added, therefore, accessibility can be achieved through an inclusive design with a human-centered approach. Putting people first and focusing on their needs permits to respond adequately and to favor their inclusion in society Therefore, the sample of the case study and the product design shown below will determine the contribution of inclusive design theory which applied into industrial design concept that have widen the scope of market user towards the product use.

Figure -07– Case study on Inclusive design theory applied into Industrial design concept

IV. PROXIMAL FEMORAL FOCAL DEFICIENCY(PPFD)

Subbarao,K (2015), mentioned that *Proximal Femoral Focal Deficiency* (PFFD) is a congenital abnormality of the lower limb which can be as simple as the shortening of the femoral head and neck or as severe as the absence of the acetabulum and proximal femur …. [18]

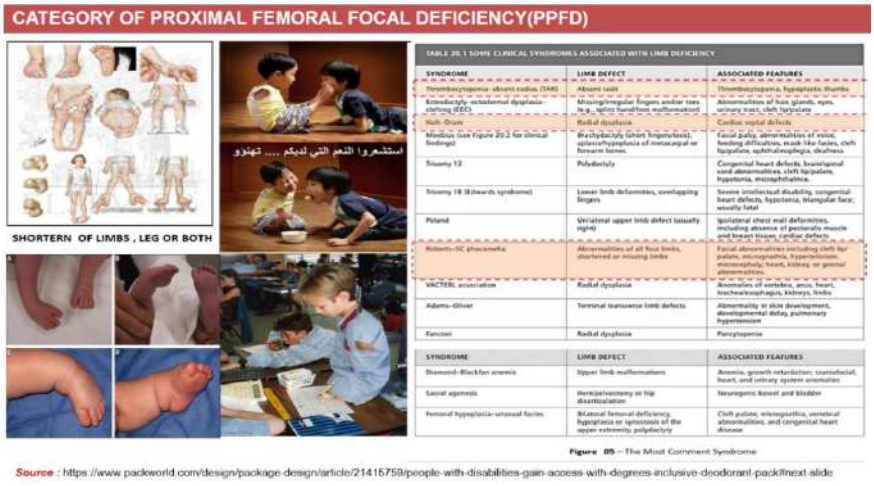

Figure 08 – Category of PPFD which involve disabilities of limbs and leg

According to Murphy, K. P, (2020).[19] Overall congenital limbs deficiencies occur at a rate of 0.26 to 1 per 1,000 live birth. This rate has been stable over time and across many countries. However, birth registries that do not include stillbirth and abortion may underestimate the actual prevalence. The rate of upper limbs deficiency is two -three-fold that of lower limb deficiency.

He added, limb deficiency appears with other major congenital anomalies in 12% - 33% of case. Making it important to be aware of syndromic patterns. However, overall it is more likely to occur a discrete limb abnormality. With improvements in prenatal ultrasonography, many limbs differences are now detached prior to birth. In one study, 64% of fetal limb anomalies were detached on the first-trimester scan, most of which were limb reduction defects.

He mentioned that one of the risk factors is Maternal Cigarette smoking increases the risk of longitudinal deficiencies such a Preaxial deficiencies of the lower extremity. Poor controlled Maternal diabetes during the first trimester can lead to longitudinal deficiencies as well as sacral agenesis with lower extremity hypo- plasma. In addition, an association between maternal thrombophilia and congenital limb deficiencies has been described. The congenital limb difference does not commentary occur in combination with organ abnormalities, however, there are a few syndromes and pattern of limb difference that are important to be aware of. Upper limbs deficiencies are more frequently associated with other anomalies, such as hematologic, cardiac, and craniofacial disorder. We detail the most common syndromes below [19]

V. RESEARCH METHOD

This study conducted a literature survey on selected topics of the characteristic of Persons with Disabilities (PWDS) with Proximal Femoral Focal Deficiency (PFFD) without limbs and legs. The study covers Background needs for the characteristic of Person with Disabilities (PWDS) Proximal Femoral Focal Deficiency (PFFD)without limbs and legs, the available and affordable Mobility Design System for supporting Person with Disabilities (PWDS) Proximal Femoral Focal Deficiency (PFFD) the need to apply Inclusive design concept in their daily manoeuvring activities and analysed data to generate design guidelines by Recognized the characteristic of the Person with Disabilities (PWDS with Proximal Femoral Focal Deficiency (PFFD)

In this study, the researcher are using Design Research Method as per shown below in the diagram below .

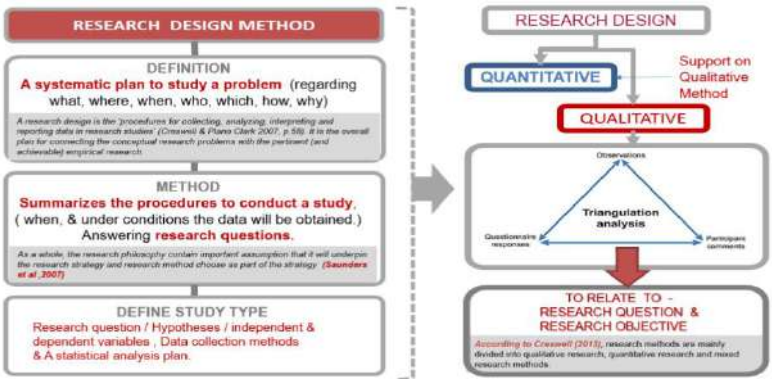

Figure -09 – Design Research Method applied by the researcher.

In this research method, the researcher will plan a systematic plan to study a problem regarding the PWDS with PPFD daily activities. Based on observation toward their whole daily activities, the researcher will narrow down main constrain of among the difficulty faces by PWDS with PPFD that is "to be able to manage the mobility design system to manoeuvre by their own self ". The study presented the major works by prior scholars, how their works could support future studies, and what aspects need to be enhanced for the need to design an affordable mobility design system to assist mobility of persons with disabilities (PWDS) with proximal femoral focal deficiency (PFFD).

The data collection for this research has been classified into several stages and involved in a different process and the used of several methods. In general, it will involve with four major stages as indicated in a diagram below (figure 03) there are identification stage, development stage, application stage and refinement stage or validation stage. All these processes will take place to be operate accordingly to the time schedule of data collection period.

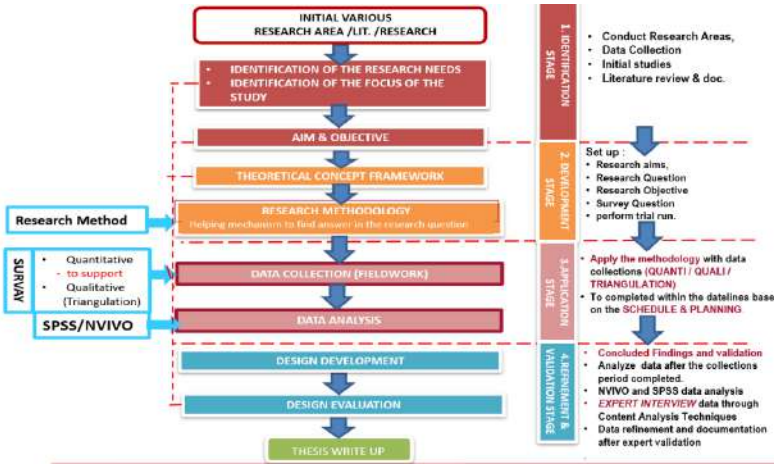

Figure 10: The process of conceptual framework analysis

1. Identification stage

In this stage, the research areas and interest include research opportunities are to be determined and data collection and initial studies need to be conducted and implement. The areas of literature review and documentations related to the research has been gathered and managed.in this stage, the researcher with test the research outcome with the hypothesis based on the theoretical framework set.

Within the Design Research Method, the researcher will be using a quantitative method in the early phase by producing a survey questionnaire to gain the majority of public awareness on the respondents understanding about PWDS with PPFD, the limitation of a person's part of the body interms of functionality, mobility, dexterity, stamina of the individual and the awareness of the daily living and activity that limits the movement of the individual.

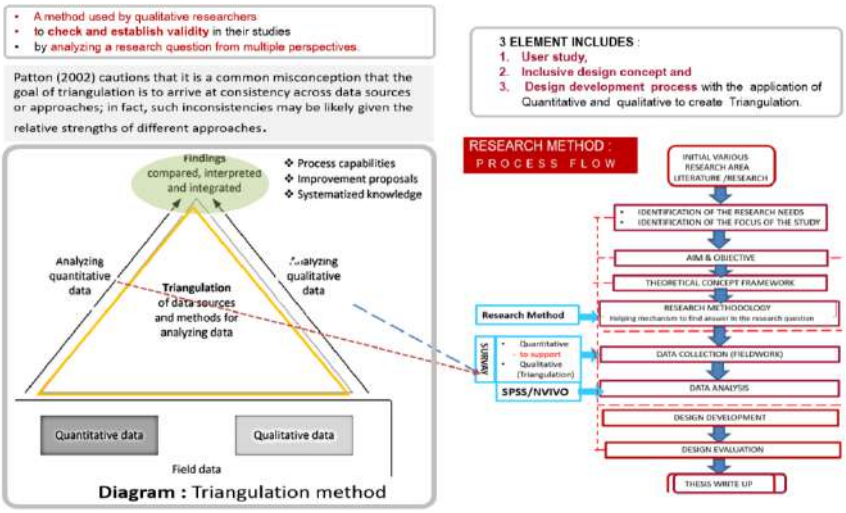

Figure 11: The process of Design Research Design with the application of Triangulation method

As per above diagram, the triangulation process happened during data collection phase where 3 main elements involve which is Perception, Validation and documentation. Perception include individual interviews and survey while Validation includes direct observation, Specific Studies and Group observation. Lastly documentation includes Document review and Data analysis of available information.

At the same time the researcher has conducted the qualitative method by using interview a research tools to gain data from the industrial design practitioner in industry to seek for their opinion and recommendation of designing appropriate mobility design system for PWDS with PPFD. Both qualitative and quantitative data will then be analyzing and turn into a design guideline to develop a mobility design system for PWDS with PPFD.

2. Development stage

During this stage, the aims and objectives has been identified and determined. This will channel the research focus and will clarify what needs to be achieved and completed. Then, the researcher will analyse the characteristics of Persons with Disabilities (PWDS), with the most reliable Mobility Design System in the market which can be integrate to provide potential solutions.

The researcher will conclude with a discussion on the potential integrated solutions for the future development of a theoretical framework for supporting the need to design an

affordable mobility design system to assist mobility of persons with disabilities (PWDS) with proximal femoral focal deficiency (PFFD) with Inclusive design concept. With the establishing of the design guidelines, the researcher is ready to perform the mobility design system with inclusive concept design for PWDS with PPFD.

3. Application stage

Based on the design guideline from stage 1 data collection from the quantitative and qualitative method, the researcher with then developed an inclusive design concept by implementing new product development by using technology base output from 3D modelling CAID software. The 3D data output from the CAID software will then generating the mobility design system with inclusive design part and assembly. The researcher will use the 3D generated data to simulate the animation, and from the CAID data will out put the tangible scale model using 3D printing for expert validation.

The data collections work has been operated within this stage and to be completed within the datelines of the schedule planning. The researcher will then prepare the 3D animation and refining the 3D model for expert validation. The design guidelines and the application towards design are shown as below:

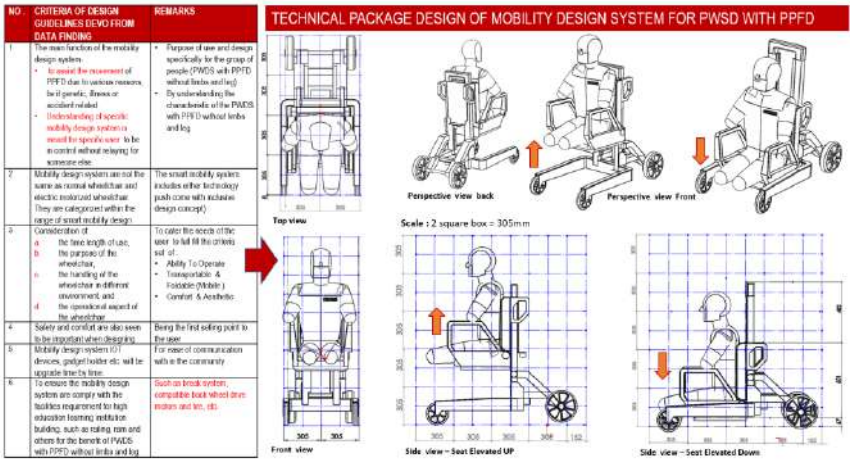

Figure 12: The process of Design Research Design with the application of Triangulation method

4. Refinement stage and Validation.

Basically, there are three (3) different groups that will be involved in the data collection and Expert Validation stages for this research. The subcommittee expert involved in developing products for PWDS with in Klang Valley area. In this stage, the findings and validation of the research has to be finalized and concluded. Therefore, as for this phase, the illustration of the concept 3D modelling has been given to them as below:

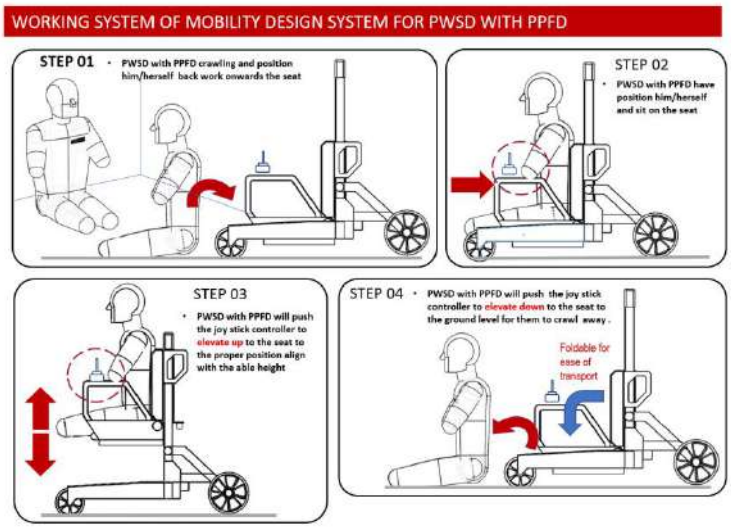

Figure 13: - Mobility Design System with Inclusive Design Concept, Steps of Operation

this table below shows the result of critical findings that have been certified by professionals, academics and specialists in a particular field. From these findings' researcher have developed a concept 3d model to be validate by its capabilities through the Likert scale. The viewers are among the leading experts in each field consist of 5people:1 engineer (Mechatronic) in Fabrication,2 practitioner Industrial Designer and 1 Disabilities subject matter expert. the result of validation is table up as below:

	A	B	C	D	E	F
1		ind. Design 1	ind. Design 2	Fabricator -1	Disable Expert -1	Disable Expert 2
2	ability to operate	4	5	4	4	5
3	transportable & foldable	4	4	4	3	5
4	confort & aesthetic	4	4	5	4	4

Figure 14: - Mobility Design System with Inclusive Design Concept, score data from expert validation

The data will be analyzing accordingly after the Expert Validation session completed. The feedback data will then being transfer to bar chart to be review by the researcher.

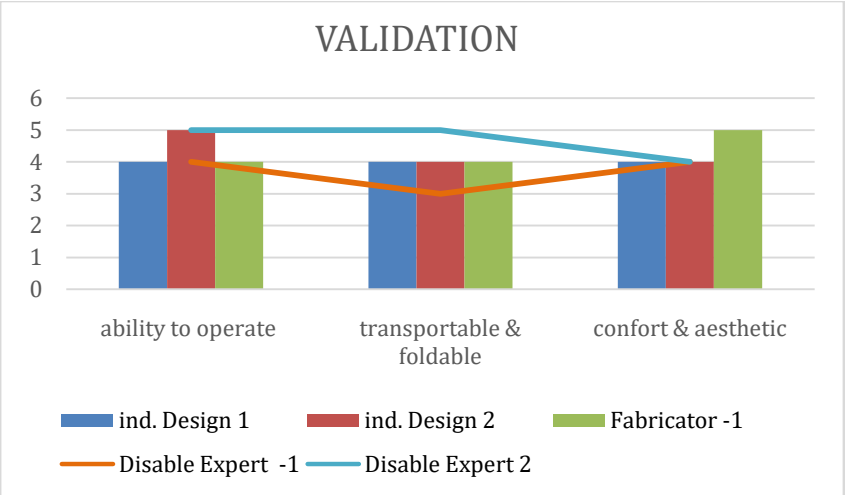

Figure 15: - Mobility Design System with Inclusive Design Concept, score data from expert validation in graph form

Base on the above table, the result show that all the respondent agreed upon the prototype features proposed to the wheelchair because all the reading achieve 4.0 and above which shows the importance of inclusive design being embodied into the mobility design system.

In the area of **ability to operate**, 2 expertise mentioned that it is very easy to use while another 3-person mentioned that it is modularly easy to operate. This area highlights the usage if ergonomic and human factors applied within the mobility design system.

In **transportable & foldable** area, 3 of the experts agreed on Modularly easy, 1 expert agreed on easy while owner agreed at 5.0 score.

As for **comfort & aesthetic**, 2 of the experts giving the high score of 5.0 while 3 other experts agreed on modularly easy.
In conclusion, this data collection shows that the design approached for the wheelchair design are suitable for the user with PPFD symptoms and can be produce in the large quantity.

After gathering the comment from the Expert Validation. The researcher will do the refinement and update the data and documentation to further up for building prototype stage that the data will then be analysed through Content Analysis techniques while the surveys will be quantified accordingly. The use of software such as NVivo will be of assistance for the data analysis processes.

VI. CONCLUSIONS

The design aims are to enable the user to self-operate the wheelchair and to maneuver freely without any assistance to comply the group of PWDS with PPFD without limbs and leg. Based on the evaluation, there will be some area that needed to be refined to allow the user maneuvering freely to access the education leering within campus. The refinement work will still ongoing until the second user testing if needed.

As this research is still an ongoing work of my study, data collections activities could lead us to a various unexpected finding in understanding of users with special needs especially for PWDS experiencing PPFD. However, all the initials findings could lead us to a greater finding in the later stage in developing a design proposal for this group of users. The experience in engaging with users and this disable community has wider our scope to understand disable users and their special needs. As this research is still in ongoing work, we hope that the findings in the later stage will bring beneficial to the audience related to this phenomenon.

KNOWLEDGE CONTRIBUTION

The expected results will lead towards knowledge contribution of the PWDS with PPFD characteristic and recommended towards the affordable Mobility design System and relevant properties.
As for the second knowledge contribution, it would lead to the optimization of Inclusive Industrial design specification for a Mobility design system using affordable system to support Persons with Disabilities (PWDS) with Proximal Femoral Focal Deficiency (PFFD).

The third knowledge contribution is to optimize the system specification for Mobility design system for manufacturer references to support PWDS with PPFD and potential knowledge transfer process.

Expected results

Based on Theoretical proposition

Documenting data of characteristic and recommended towards the affordable Mobility design System and relevant properties towards the PWDS with PPFD.

Documentation on The Existing Mobility Design System to Assist Persons with Proximal Femoral Focal Deficiency (PFFD) in the local market

Identify the existence of inclusive design concept on the existing Mobility Design System to Assist Persons with Proximal Femoral Focal Deficiency (PFFD) in the local market

Proposal of Mobility Design System with inclusive design concept to Assist Persons with Proximal Femoral Focal Deficiency (PFFD) in the local market.

Expected Benefits

I. For the User:

Able to manoeuvre with affordable mobility design system with inclusive design concept to get equal access in education within the campus area by themselves. With this the individuals will feel more independent in managing their daily life.

ii. For the Designer:

The knowledge gained from PWDS with PPFD characteristic and design specification of the mobility design system will be the reference and guidance for other designers to continue their studies in this area.

iii. For Public awareness:

The application of inclusive design concept within the community-based product will increase the public awareness such as mobility design system for PWDS with PPFD, a special group of people which also have their rights to improvised their daily life. By having public awareness upon community services, there will be more Inclusive design-based product cater for other type of people, not only the PWDS.

iv. For the manufacturer:

Manufacturing opportunities as a benchmark to pursue new range of Inclusive design-based product to create the new opportunity for the small group of people weather they are elderly, PWDS with other means of disabilities.

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