

FDRE TECHNICAL AND VOCATIONAL TRAINING INSTITUTE

FACULTY OF TEXTILE, APPAREL AND FASHION TECHNOLOGY

DEPARTMENT OF TEXTILE TECHNOLOGY

SCHOOL OF GRADUATE STUDIES

FABRICATION OF INCLUSIVE HANDLOOM FOR LEG-DISABLED PERSONNEL USING LOCAL MADE CORD TREES TO PRODUCE FABRIC

BY: ALEMU KEBEDE

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ADDIS ABABA, ETHIOPIA

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Fabrication of inclusive handloom for leg-disabled personnel to produce fabric using local made cord trees

BY: ALEMU KEBEDE

ADVISOR: TOLERA ADERIE (PHD)

March, 2026

ADDIS ABABA, ETHIOPIA

DECLARATION

I am now pleased to announce that the work that is being presented in this thesis titled as Fabrication of inclusive handloom to leg-disabled personnel to produce fabric using cord trees made locally is my original work done under supervision of Tolera Aderie (PhD). It has not received any degree in any other university, and it is acknowledged that all sources of materials used in this thesis are valid.

Name of candidate	**Signature**	**date**
Alemu Kebede	_____	_____

This is to certify that the above declaration made by the candidate is correct to the best of my knowledge

Name of advisor	**Signature**	**Date**
Tolera Aderie (PHD)	_____	_____
Name of Co-Advisor	**Signature**	**Date**
	_____	_____

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FABRICATION OF INCLUSIVE HANDLOOM FOR LEG-DISABLED PERSONNEL TO PRODUCE FABRIC USING LOCAL MADE CORD TREES

By:

ALEMU KEBEDE

APPROVED BY EXAMINING BOARD

Name of Advisor	Signature	Date
TOLERA ADERIE (PHD)	_____	_____
Name of Co-advisor	Signature	Date
_____	_____	_____
Name of Examiner, Internal	Signature	Date
_____	_____	_____
Name of Examiner, External	Signature	Date
_____	_____	_____
Name of chairperson	Signature	Date
_____	_____	_____

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ABSTRACT

This thesis deals with the innovative design model and the production of inclusive handloom to be used by the leg-disabled personnel to make cloth out of the local made cord trees products adapted to suit the needs of leg-disabled persons. By making it creative, functional, and sustainable, it aims to meet the needs of the users who have mobility difficulties by incorporating natural materials and inclusive design to enable the products to provide comfort, support, and cultural values to the users in addition to promoting environmental-friendly practices. It also brought a long-term and culturally meaning material include a user-driven design solution, which involves an ergonomic factor, functionality needs, and cultural responsiveness to develop a handloom that would maximize the accessibility and usability of this particular user. Through the needs assessment that will be conducted to establish the challenges affecting the leg-disabled people in the traditional handloom weaving process and incorporation of feedback of the stakeholders, including the users, healthcare professionals, and local artisans, the study will design a design that would satisfy the specific needs of the target population, the Emphasis on sustainability and ethical considerations will mean that the sourcing of cord will be done in a mindful way to preserve the environment and respect the local communities. It also takes into account how culture will influence the design process with the intention to entrench the traditional weaving and the practices of the locality in the design of the handlooms in order to foster cultural relevance and acceptance. Engagement and feedback through working with the stakeholders will be one of the major components of the study, which will enable the active work, gathering feedback and further testing of the handloom prototype to suit the interests of the diverse needs of people with legs disability and will contribute to the sustainability, cultural preservation and empowering of the local community.

The keywords are as follows: Fabrication, Leg-Disabled, Handloom, Tailored, Cord Trees, Mobility challenge, inclusiveness, empowering, ergonomic.

Table Contents

DECLARATION..... ii
ABSTRACT..... v
List of Table..... xi
List of Abbreviations xii
CHAPTER ONE 1
INTRODUCTION..... 1
1.1 Background of the Study 1
1.2 Statement of the Problem..... 3
1.3 Research Questions..... 6
1.4 Objectives of the Research..... 6
1.4.1General Objectives..... 6
1.4.2 Specific Objectives 6
1.5 Significance of the Research..... 7
1.6 Scope of the Research..... 8
1.7 Limitation of the Research..... 9
1.8 Definition of key Terms..... 10
CHAPTER TWO 13
LITREATURE REVIEW 13
2.1 Introduction..... 13
2.2 Raw Materials for Loom..... 14
2.3 Cord African Tree and availability in Ethiopia..... 14
2.4 Bamboo plant in Ethiopia 15
2.5 Overview of Weaving..... 16
2.6 History of Weaving..... 17
2.7 Weaving Machines..... 17
2.7.1 Types of Weaving Machines 18
2.7.1.2 Classification of Manual Handloom 19
2.7.1.2.1. Based on Size..... 19
2.7.1.2.3. Based on Functionality 20
2.7.1.2.4. Based on Material 20
2.7.1.3 Power-operated Weaving Machines 20

2.7.2. Categories of Weaving Machines Based on Functionality 20
2.7.3. Specialized Weaving Machines 21
2.7.3.2. Tapestry Looms 21
2.7.3.3 Circular Looms 21
2.7.4 Modern Innovations 21
2.8 Factors Influencing Functionality of Inclussive Handloom designed for leg-disabled individuals 21
2.8.1 Ergonomics 21
2.8.2 Accessibility Features 22
2.8.4 Material Selection 22
2.8.5 Adjustability and Customization 23
2.8.6 User Feedback and Testing 23
2.9 Comparative Analysis of Traditional and Inclusive Handloom Concepts 23
2.10 Application of inclusive handloom design-based disability from wood 24
CHAPTER THREE 25
MATERIALS AND METHODOLOGY 25
3.1 Introduction 25
3.2 Lists of materials and equipments 25
3.2.1 Lists of Material Selection 25
3.2.2 Lists of Tools and equipments for manufacturing machine 26
3.3. Methodological process of the machine manufacturing 28
3.4 Detailed methodological studies of the research 29
3.4.1 User-Centered Design Approach 29
3.4.2. Need Assessment Based on Observation and Identification of Research Gaps 29
3.5.1. Design and Technological Gaps 31
3.5.3. Ergonomic and Usability Gaps 32
3.5.4 Methodological process of research gaps 32
3.5.5 Socio-Economic and Cultural Gaps 32
3.6 Need Assessment Based On Interview And Questionnaire 33
3.6.1 Study Area And Population 33
3.7 Study Period 34
3.8 Sampling Technique 34
3.9 Sample Size Determination 35

3.10 Proportional Stratified Allocation 35
3.11 Sample Design Procedure 35
3.12 Data Collection Methods 35
3.12.1 Quantitative Instruments 35
3.12.2 Qualitative Instruments 36
3.13 Pilot Testing 36
3.14 Ethical Considerations 36
3.15 Research Design 37
3.16 Gender of Respondents 37
3.17 Age of Respondents 37
3.18 Type of Walking Disability 38
3.19 Responses toward Design Features of the Inclusivity status 39
3.19.1 Appropriateness of Height Adjustability Factor 39
3.19.2 Shuttle Reachability Factor 39
3.19.3 Leg Clearance and Frame Accessibility Factor 40
3.20 Responses toward Usability and Performance 40
3.20.1 Ease of Completing Weaving Tasks Factor 40
3.20.2 Error Reduction during Weaving Factor 41
3.20.3 Independence during Weaving Factor 42
3.21 Responses toward User Support and Training 42
3.21.1 Training Support Factor 42
3.21.2 Appreciation and Motivation Factor 43
3.22 Response toward Overall Inclusiveness Factor 44
CHAPTER FOUR 45
RESULT AND DISCUSION 45
4.1 Expected Outcomes Design 45
4.2 Prototype Development and Sample Design 45
4.3 Dimensional preparation of the machine 47
4.4 Development and Performance Evaluation of an Inclusive Handloom 48
4.5 Fabrication steps / Manufacturing Methodology 49
4.6 Accessibility Features 54
4.7 Safety Considerations 54

4.8 Discussion 54
CHAPTER FIVE 56
CONCLUSION AND RECOMMENDATION 56
5.1 CONCLUSION 56
5.2 Recommendations 57
5.3 Future research 59
REFERENCE 60
APPENDIX 1 63
APPENDIX 2 67
Questionnaire 67

List of Figure

Figure 1.1 Disabled Persons 4
Figure 1.2 3D design machine 5
Figure 2.1 Cord African tree grown in Ethiopia from plantation and maturity to timber 15
Figure.2.2 Bamboo plant of Ethiopia 16
Figure 3.1 Flow diagram of manufacturing inclusive handloom 28
Figure 3.2 Ethiopian Traditional Pit Loom 30
Figure 3.3 Waddessa Woreda Disabled Persons Association 33
Figure 3.4 Gender Response 37
Figure 3.5 Age of Respondents 38
Figure 3.6 mobility impairment categories 38
Figure 3.7 Height Adjustability Factor 39
Figure 3.8 Shuttle Reachability Factor 39
Figure 3.9 Leg Clearance and Frame Accessibility Factor 40
Figure 3.10 Ease of Completing Weaving Tasks 41
Figure 3.11 Error Reduction 41
Figure 3.12 Independence 42
Figure 3.13 Training Support Factor 43
Figure 3.14 Motivation Factor 43
Figure 3.15 Inclusiveness Factor 44
Figure 4.1 3D Expected machine design using AutoCAD and its parts name 46
Figure 4.2 3D Expected machine part Dimensional measurement and its specification using CAD 47
Figure 4.3 Selection and Preparation of Construction Materials 49
Figure 4.4 Structural Frame Design and Assembly 50
Figure 4.5 Elimination of Foot Treadles and Development of Hand-Operated Control 51
Figure 4.6 Installation of the Heddle Lifting Mechanism (Without Springs) 52
Figure 4.7 Integration of Traditional Weaving Elements 52
Figure 4.8 Structural Stability and Safety Assessment 53
Figure 4.9 Functional and Performance Testing 53
Figure 4.10 Finishing and Surface Protection 54

List of Table

Table 2.1 Comparison between Ethiopian Traditional Pit Loom and Proposed Inclusive Handloom 23
Table 3.1 Lists of Material Selection 25
Table 3.2 Tools for manufacturing for the designed inclusive machine. 26
Table 4.1 Dimensional preparation of loom part from wood 48

List of Abbreviations

PWD:- People with Disabled

HCM:- Hand Crafts Man

WB:- World Bank

WHO:- World Health Organization

CRPD:- Convention Rights of Persons with Disabilities

ENPAPWD:- Ethiopian National Plan of Action of Persons with Disabilities

EDA :- Ethiopia Disability Association

GR:- Gender Response

AG:- Age of Respondents

MIF:- Mobility Impairment Categories

HAF:- Height Adjustability Factor

SRF:- Shuttle Reachability Factor,

LCF:- Leg Clearance Factor

FAF:- Frame Accessibility Factor

UC :- Usability Factor

PF:- Performance Factor

WTF:- Weaving Task Factor

ERF:- Error Reduction Factor

IWF:- Independence Weaving Factor

TSF:- Training Support Factor

MF:- Motivational Factor

M/c:- Machine

3D CAD:- Three Design Computer Aided Design

MA:- Mobility Aid

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Inclusion handloom fabrication of the leg disabled peoples with wood is the invention of a weaving loom that is aimed at people with leg disabilities. The development of handloom fabrication products that work with leg-disabled people with the use of the African tree cord is a specific sphere of interconnection of the creativity, functionality, and sustainability. According to this design, wood is used as the major material used to build the loom, which is study and long lasting. The design includes the features of the adjustable height, easy accessibility, and the ergonomic features that should meet the needs of the users with leg disabilities.(Management & Science, 2021).

A handloom is an easy machine that is used to weave. It is a manual operating system. It is shed by pressing of the treadles handle and pick and beat by hand. In vertical-shaft wooden loom, the heddles are attached permanently in the shaft. This loom is powered by hand(H. Stephen Kaye 2021). The warp yarn brush the heddle alternately with a heddle (the shed), and with a gap between the heddles (the raised half the threads, the lowered half the threads), the threads going through the gap between the heddles(Sreenivas 2020).

The handloom industry is special in our economy. It has been maintained through imparting skills to one generation to another. The advantage of the industry is its exclusivity, versatility of production, openness to innovations, the ability to fit to the demand of the supplier and the abundance of tradition (Management & Science, 2021).

Weaving is most likely as old as humanity and clothing is one of the fundamental needs of man. It envelops our bodies and shields us against external influences as also the work environment. Weaving is an active art that has seen the fashion industry and many people make a lot of developments by regarding it as a source of livelihood(Divine et al. 2021).

Since the invention of the hand loom in various civilizations, it has passed through a few innovations. The warp is wound on a beam and the separate ends of the warp stretched through the eyes of the healds and then through the dents of the reed(Divine et al. 2021).

Another cottage industry of major concern among the developing nations such as India, Pakistan, Bangladesh, Iran, Turkey and China is the handloom where traditional means of weaving are highly practiced. The informal sectors which also accommodate the cottage industries contain the vast majority of workforce in South Asia. These are significant industries in terms of employment, particularly to women and the human workload evaluation would be crucial in these industries to enhance the working conditions(Pandit, Kumar, and Chakrabarti 2021).

Under the current times of mechanization and homogenization, the handloom industry offers a very special richness of various Ergonomic Problems Prevalent in Handloom Units of North East India individualistic skills, the cultural and traditional art forms. One of the largest employments in terms of industry generation in India after agriculture is the handloom industry which employs 77.9 percent of the workforce in this sector, which is reportedly, women dominated. These are out of the national figure NE India is recorded to have the largest number (99) of women weavers (Pandit, Kumar, and Chakrabarti 2022).

Handloom industry is an important aspect in economic development of the rural masses in the North Eastern States of India. With the commercial aspect of weaving having been adopted by many small units in the handloom sector, the weavers are practicing a profession closely connected to weaving, which is part time or full time employment by more women. The tasks that women used to do out of their home need in their free time, have now been converted in their occupation (Pandit, Kumar, and Chakrabarti 2022).

Handloom is now the means of livelihood of several millions of craftsmen and their families throughout the world. Within the confines of the third world nations, there are a few countries that have continued to preserve the ancient hand weaving tradition, side by side with the power looms as the representatives of the cultural heritage(Albaugh et al., 2021). Even in the times when man is attempting to conquer the space, people do not stop considering the handloom as the symbol of the great past in whole human cultural ethos and desires of people generations to save the best of culture race. The products of handloom are not simply some decorations, but it also represents the culture and civilization. Other than that, it is the time-tested heritage that has been bequeathed to us by our forefathers (S. S. Mishra & Das Mohapatra, 2020).

Ethiopia has different types of rare handicraft due to the unique history, tradition and culture developed by different people of the nation (Japan Embassy, 2023).The production of handmade

textiles is also a long-standing tradition in Ethiopia and the country is certainly the most significant producer of handmade cloth in the Eastern African region and has always been the center of pre-eminence. The textile sector in Ethiopia has proved to be extremely robust, vibrant and resistant to change. The visual traditions in Ethiopia are very numerous and dynamic due to the ethnic and cultural diversity of the country. Among them, there is the weaving of the Gamo Highland in the Gamo Gofa zone; the Dorze weaving. A lot of Dorze weavers reside in Addis Ababa, the capital of Ethiopia and in their native country Chencha District(Freeman & Pankhurst, 2022). Weavers of Gamo Highlands are reputed as one of the pioneer weavers of the country and highly regarded by their excellent work and the production of quality textiles and clothes that differ in design, style and form in complexity and location(Dubois, 2021; Kedir, 2020; Silverman, 2023). The art of handicrafts of the Dorze ethnic group is passed on between generations. Production is done in their own homes, by use of simple looms and the goods sold primarily in the country. It is dynamic and flexible to change. Moreover, it is one generation to another and there is a tradition and validity in it which are deeply entrenched in the knowledge functionality(Zone 2020).

When creating the handloom products to suit the leg-disabled using the African trees cord, it is a special process that does not only require creativity but also functionality and sustainability. Using the cord of African trees, it is possible to develop new and convenient designs that can meet the needs of people who have mobility deficiencies. The design of handloom that should be used by persons with disabilities of legs should put into consideration the element of ergonomics, comfort and ease-of-use so that the products may not only be practical but also attractive (Hailu 2022).

The use of African trees as a cord to make hand loom products to leg-disabled people is a creative and sustainable way of solving mobility problem. The fusion of the old craftsmanship and new design strategies will help us produce functional, fashionable, and greener goods and enable the people, with disabilities, live a more independent and comfortable life(Zone 2020).

1.2 Statement of the Problem

The data presented by World Bank and WHO 2011 indicate that the percentage of people with disable (PWD) in Ethiopia is about 17.6 or 18 million of the total population. Out of this data 24.7 percent or 4,618,900 of them are complete or partial leg disables naturally occurring or caused problems such as car incident. A significant majority of the disabled are in the rural side where

they have little access to basic services. It is estimated that 95 percent of all persons living with disability live in poverty in Ethiopia. There are many who rely on family and begging as a means of earning a living. A survey in the Oromia region, as an example, established that 55 percent of the persons who were surveyed with the disability depend on their family, neighbors and friends to earn their living and the rest make their daily income or monthly income through self-employment, begging and offering house maid services(ILO 2021).

Problem:- Today with the movement activity of peoples spreading to struggle of life, road traffic accidents, political instability, which causes war in various regional parts of the Ethiopia that caused the reason behind lifeless, up to death, and the rests alive survived(disabled) is growing daily which makes them unemployable. Disability persons face greater risks to lose their jobs as compared to the non-disabled persons. most persons living with disabilities do not enjoy equal employment opportunities nor associated with disease services they need, and are denied the everyday aspects of life. However, the existing all types of hand loom machine operate on pedal leg system which can not afford leg incapacitated individuals to operate it. In the present, the majority of the Disabled, both genders, were the poorest of all, most unrespected, socially and economically deprived, in debts and virtually in bad conditions in the bottom level society as the next sin in the picture.



Figure 0.1 Disabled Persons

Finding:- this problem discovery is highly elucidated and highly significant to develop crippling of legless centred and inclusive design and producing of fabrication of inclusive handloom weaving machine. The Design machine is entirely operated by hand, Shedding is by pressing the

treadles handle and picking and beating is by hand, easy to run and make it favourable to the leg challenged people as well as the challenged peoples to work on it running by hand operation system, no effects on any environment life and is the best and convenient method to solve this problem by creating job opportunity to this less challenging type of work hand weaving type of Ethiopia Tibeb art cloth, Gabi, Cultural cloth, Fota and many others just on their behalf and the market to earn daily income just like the normal persons.

Fill the gap in the design of a handloom machinery to fabricate inclusive handloom machines inclusive of leg-disabled individuals through the introduction of cord trees to create fabric as a sustainable material, apply the principles of user-centered design, ergonomics, cultural values, and stakeholder responses to develop a custom handloom system to increase accessibility, usability, and inclusivity of handloom machines to leg-disabled individuals in traditional weaving methods as the following pictures shown.

Legend

1. Harness frame rope guide
2. Harness frame separator holder
3. Main side beam harness frame holder
4. Ratchet wheel (Gear) lock and unlock
5. Ratchet wheel (Gear)
6. Beater
7. Handle lifting holder
8. Handle lifting holder (metal)
9. Weavers take up guide
10. Horizontal leg supporter
11. Warping take off guide Weavers beam
12. Main beam and take off guide supporter
13. Harness frame
14. Handle lifting holder (metal)
15. Overall machine basement holder
16. Machine leg
17. Beater holder
18. Side beater supporter
19. Warping beam

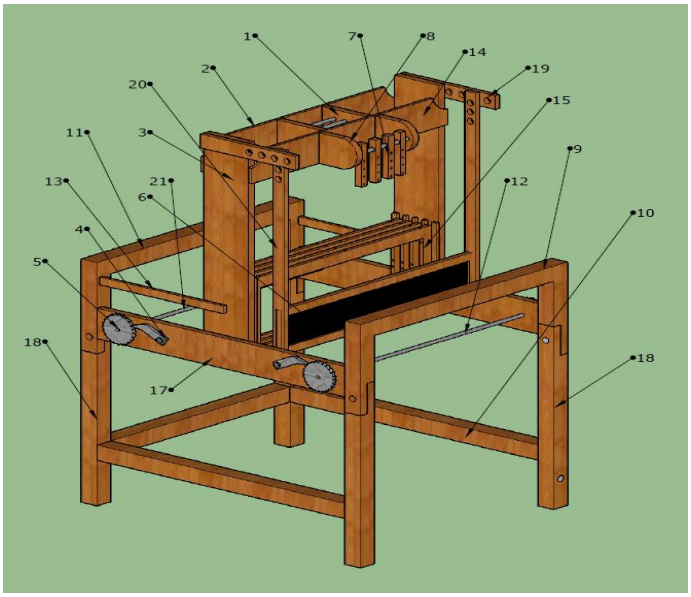


Figure 0.2 3D design machine

1.3 Research Questions

The research purposes are to research the design inclusive handloom weaving machine fabrication to leg-disabled peoples that utilize the use of cord African Trees to analyze the achievement used to make the weave Textile fabric. This study goes to measure the following basic research questions:

- What are the challenges encountered by leg-disabled people particularly in the use of handloom designs?
- What do you consider are the main considerations in designing handloom products that are accessible and user-friendly to leg- disabled people?
- What can be the possible barriers or restrictions in using African cord tree to implement handloom designs to leg-disabled persons?

1.4 Objectives of the Research

1.4.1General Objectives

- The overall aim of this project is to produce inclusive handloom with leg-disabled staff to create fabric that meet exclusive requirements of the leg disabled populations.

1.4.2 Specific Objectives

- To determine the targeted challenges and needs of the leg-disabled people in their use and access to the handloom products
- To create a variety of inclusive designs of handlooms, which are accommodative of the physical abilities and visual tastes of leg-disabled people
- To produce an inclusive handloom machines using the user centric design method and 3D CAD using local produce cord trees.
- To test usability, comfort and durability of inclusive handloom designs those who are challenged.

1.5 Significance of the Research

The objective of the study of the inclusive handloom design and fabrication among the leg-disabled persons is to the needs and preferences of the same disabled peoples with the potential of facilitating inclusiveness, accessibility, empowerment of disabled persons in the design and textile fabrication industry, in creating awareness regarding the capabilities and contributions of persons with disabilities in designing and textile manufacturing, facilitating social inclusion and diversity, and promoting design practices around the inclusion, accessibility and sustainability of design in the textile manufacturing.

The most important thing about this research is.

Inclusivity and Accessibility:- The project will involve designing handloom machinery that is inclusive and accessible to people with leg disabilities in order to ensure inclusivity in its traditional crafts. This improves the involvement of the industry in the textile and a sense of belonging in the hand made fabric.

Empowerment in Skill Development:- The project will empower individuals with disabilities by availing resources to them so that they can obtain information and train on the weaving skills which will result in increased self-sufficiency and economic autonomy.

Cultural Heritage Preservation:- The handloom weaving is an important cultural activity. The increased accessibility further assists in maintaining this tradition by implicating various parties and therefore, making sure that it continues in various communities.

Innovation in Design:- The manufacturing process inspires new design thinking thus coming up with equipment that is not only useful, but also accommodating to ergonomic concepts of users with their legs affected and other normal users.

Economic Impact:- The project will help the local economies by making people with disabilities a part of the workforce, which will provide employment opportunities and economic entrepreneurship.

Social Awareness:- By putting the focus on the needs of people with disabilities, it increases the society awareness about inclusivity and accessibility, promoting more significant shifts in other sectors.

The importance of this research performances because it fosters inclusivity, empowers people, supports cultural heritage, stimulates innovations, and has economic advantages as well as increased social awareness.

1.6 Scope of the Research

The scope of this thesis research work is wide and contains numerous issues connected with the development and realization of starting with stating with.

- Problem Finding regarding handloom machine to leg-disabled peoples and analysis
- Differenciating the gap that exists between the pre-design and prototype design,
- Communicating leg challenged peoples at selected area on their interests fabrication of this inclusive machine,
- Researching and choosing material that is eco-friendly and sustainable materials to this inclusive loom fabrication.
- Development of user- centric research design approach where leg-disabled people are involved in design to make sure that loom can be effective in addressing the needs of the disabled individuals.
- Proceeding with the 3D CAD of the prototype and carrying out of minimum viable product(MVP) of the machine as per the normal user centric design process.
- Designing prototypes in trying out different materials and mechanisms to add more functionality to the users with reduced mobility.
- Coming up with ergonomic designs that are comfortable and usable by the leg-disabled users.
- Gathering data specially raw materials that are used to carry out the machine within the particular selected areas.
- Promoting production locally to help the economies of communities and minimize transportation effects.

faceting and polishing the parts of the machine.

- Assembling of the machines.
- Carry out finishing operation of the machine such as painting other mechanisms.
- Encouraging local manufacturing to support community economies and reduce transportation impacts.
- Cutting and smoothing the parts of the machine.
- Assembling of the machines.
- Perform finishing process of the machine like painting other mechanisms.
- Caary out draw-in and prepare plain sample fabric product.

- Perform sample weave fabric; The loom was fabricated so that people with disabilities such as legs could work in the field thus becoming independent and creative.

This machine was carried out in Ethiopian Technical and Vocational Training Institute in textile work shop room.

1.7 Limitation of the Research

As all studies have a limiting factor that can prevent the desired outcome, such features of the design or study has a potential limitation that affects or influences the interpretation of the findings of the study that is the designing of inclusive hand loom machines to people with leg disabilities.

In formulating this thesis, it must pay close attention to the above limitations to come up with wood-based solutions to improve access and usability to people with mobility problems when making the production of textile machines.

The only way to deal with these limitations is to use a multi-layered approach which includes cooperation with specialists in design, user testing, and funding bodies which focus on disability awareness and support in the second step.

- User and Market commercialization feedback process.
- Modifiable and reconfigurable as opposed to other materials (Second phase project).
- Maintenance and durability will influence the quality of practicality and efficiency of handling this type of wood material.
- There is no transfer of technology as a component of this thesis up to date but will be discussed on the subsequent step.
- Technical There are design constraints that support a given mobility requirement without compromising on usability and locating material options that constrain design.
- The needs of the users are extremely diverse and they may be of different types and levels; therefore, it is challenging to design a universal solution of such peoples.
- The validity of findings (2 nd phase) may be restricted due to limited user testing that could be having an adequate and a wide sample group to be tested.
- The development and production of an inclusive loom might be expensive thus restricting access among the low-income challenged people.
- Second phase can be the accessibility in such a way that the product is available when necessary, particularly in rural or underserved regions.

- Then there is the fact that additional resources such as time and the teaching materials may be needed to train the users to use the loom effectively.
- People may require different periods to get accustomed to the new equipments.
- Market acceptance of target audience might not be familiar with product or they might have a pre-conceived notions concerning the usefulness of said product.
- There can be little finance and resources available to support research in assistive technology and the effort of collaborating with organizations that have second phase orientation.
- Regulatory and Safety Standards that will be used to make sure that a design is not violating safety and accessibility requirements may introduce restriction to the development process.

1.8 Definition of key Terms

Fabricate: It is the idea of producing/constructing or creating something, either physically or conceptually.

Inclusive: It must be open and accessible to all people who possess abilities but mostly to the disabled ones.

Handloom: This machine is somehow operated by hand and is used in manufacturing of cloth normally of frame and thread interlacing machine.

Cord Tree: It can be named so to refer to a particular type of material or pattern to the act of creating the handloom that could be some plant or natural material.

Persons with legs disability: The physically challenged persons have their legs challenged physically to an extent that they cannot use them hence they are limited in terms of movement and ability to perform certain functions.

Accessibility: is the possibility of an environment, service or a product to be accessible to individuals who are disabled.

Ergonomics: It may be defined as the design of the equipment and machinery, how it is shaped in human form and mental ability to achieve a comfortable and productive output.

Assistive Technology: they are the machines or the systems that have been invented to help the people with the disabilities do their work otherwise they would not do some of the work or even do the work.

Weaving: This is referred to as the act of interweaving a weft and a warp or strands to produce a textile or cloth.

Textiles: Tarp, garments and other furnishings and furniture manufactured through the use of fibers.

Prototype: prototype This is a prototype of a product, a miniature of a product produced to prototype an idea or a process, and then is produced in mass.

User-Centered Design: It is in this school of thought that the pressure and the need of the end user is taken as the most influential aspect in the design.

Mobility Aid: Mobility equipment purchased to assist physically challenged people to move around e.g. wheelchairs, and crutches or walkers.

Hands craftsman: This is the man who was bragging about his hands and quality of work.

Disable: It is making something incapable or incompetent or unability to be efficient or competent.

Tailored: There is the adapted or customized product to satisfy some of the requirements, tastes or preferences.

Exclusive: This is one of the conditions, that apply to a particular group, in which the individual is not a member.

Artisan: Master artisan who prepares the products using the conventional processes by hand.

Therapist: It is a person who considers him/herself as a person who not only gives but treats the mentally, emotionally or psychologically challenged on the other side.

Therapeutic: Something related to the healing of illness or the alleviation of pain or distress.

Factor: Factor is anything contributory that will be in a position to affect the situation, outcome or circulation.

Anthropometric: This refers to science of measurement of human body in regards to height, Weight, Body circumference and proportions.

Sustainability: Ability to maintain certain processes/ states which usually appear to be a part of the alterations in the environment and use of resources.

Community Engagement: Is the community involvement or the individuals in the decision making process regarding the matters of their concern.

Customization: This is a process that will involve alteration of a product to an extent that will be appropriate to the need or the requirement of a specific user.

Durability: The property is the ability of a product to withstand the wear pressure or damage as time goes by.

Social Inclusion: is the process in which the individuals in the situation are put in a position where they can experience the society and where they find themselves in the same situation where they stand equal chances and equal opportunities.

Design Thinking: It is a problem-solving model, the primary peculiarities of which are empathy, ideation, and experimentation as the methods of creating new solutions.

Cultural Heritage: a legacy of materialistic property and intangible attributes of a grouping or a society that is imposed by the past generations.

Fabrication Techniques: It may be known as the technology that is utilised in the manufacturing of the product by the help of raw materials.

User Feedback: This implies the reaction of the user on his/her experience on a product or a service used to enhance the service.

Aesthetics: Aesthetics: Aesthetics are the philosophies of beauty and appreciation of the beauty in visual art.

Functionality: It is the actual use or the usage of a product and deals with the capability of the product to do its duty.

Safety Standards: It has developed standards that will regulate the safety of the products, which will be applied by the end-users.

Economic Strengthening: It is worrying to make people overly independent by providing them with the means and physical to strengthen their economy.

Social Innovation: Innovation, ideas or concepts that have a tendency to satisfy the needs of the society and improve the welfare of the society.

CHAPTER TWO

LITREATURE REVIEW

2.1 Introduction

Handloom as a form of fabric production is a very old and widespread age-old practice dating back to the time immemorial. By the close of 19th century, Nepalese had perfected their own cloth making by conducting successful handloom business. This was one of the periods when Nepal had prospects as it turned handlooms production into a significant cottage and small-scale industry. One of the instruments that are common in textile arts is the loom. It entails various techniques that comprise netting, wattling, basketry, spinning of yarns and cloth weaving. The weaving as described incorporates entwining of the warp thread at angles of right angles to waft threads. The warp strands are then crossed across the length of the cloth beam apron and the weft strands across at right angles to the warp. The weft is passed around one of the warp threads circumscribed over one or a few, depending on the manner of the weaver, around one of the selvages to the other. (Silwal & Giri, 2024).

The oldest type of cloth making involves handloom. It is a stage of cloth production that is extremely early. Handloom has turned out to be a source of living to some millions of artisans and their entire families worldwide. Amid the third world countries, the ancient tradition of hand weaving was the only one that is still proudly maintained in the countries side by side with power looms as the images of cultural heritages. In these days when man is struggling to win the space, people still perceive the handloom as a reminder of the glorious past of the whole cultural ethos of humanity and generations of people dreams about saving the best part of the culture race. The handloom products are not just some decoration, but also they represent the culture and civilization(S. Mishra et al., 2021).

The printing of handloom machines is important because it enhances the quality of life and gives the disabled people authority. Design-wise solutions can be innovated to be independent and have creative expression opportunities in the case of a person with a disability of the legs, especially with people who may lack the mobility or power in their lower body parts. One of the tools that have been used to combine functionality and artistic ability is the hand looms, which were traditionally made of wood. Modifications to the hand loom designs to suit leg-disabled staff would

not only resolve the issue of accessibility, but also consider inclusivity and maintaining skills within the weaving community(Kolgiri et al., 2022).

To reinforce the theoretical base of this paper, and to make it unique, desperate attempts have been made to consult similar literature in different sources like the internet, books and monograms. The review was conducted in the following sub headings: Overview of Weaving, History of Weaving, and weaving machines. (Divine et al., 2020).

2.2 Raw Materials for Loom

Raw material to make this loom is readily found here and in our country and market especially kind tree of cord Africa (locally, Wanza/Waddeessa) is available in this country at local area, waste metal sheet used in gear motion is available in this country, beater is made of Banboo and it is adjustable, water used in warp and weavers winder is available and waste pipe water is also available, binder of wood is available. This section of the thesis and the data derived to study the thesis is further divided into Tools and Materials, Design and Construction of the Loom and Mode of Operation(Silwal & Giri, 2024).

2.3 Cord African Tree and availability in Ethiopia

The Cordia africana or the African Cordia or the Abyssinian Plum is a flowering tree species indigenous to East Africa. It is a plant of the genus Cordia of the botanical family of Boraginaceae. Cordia africana is a tree that may be up to 20 meters tall and is known to have a wide and thick layer of dark green shiny leaves cover it. The tree is also appreciated due to its timber that is strong and durable and is applied in many carpentry and construction works. The Cordia africana wood is usually used in making furniture, carving, and firewood. Besides the impact it has in the economy, the tree has also been used in traditional medicine in some African cultures where the Cordia africana tree is used in its various parts to treat a wide variety of diseases. Besides, the tree attracts pollinators and provides shelter and food to the native wildlife and is a contribution to the ecosystem in its natural habitat. The Cordia africana has a characteristic appearance and positive impact on the environment and thus it is a remarkable species among the African flora, indicating the value and biodiversity of trees in the area(Negash, 2021).

The ressearch study thesis work involves; inclusive handloom weaving manual hand pedalling machine prototype and pattern specification to be used by the leg-disabled peoples using strongest tree in Ethiopian known as cord African Tree(Wanza /Waddeessa in local language Amanic and Afaan Oromoo respectively) and also Bamboo and west metal sheet. Those raw materials are found in most of the Ethiopian regions, including, Oromia:Jimma, woliso, Ambo, Shoa, wollega, Shashamane) and Amhara region: Gojam, Gondar, Debra Birhan..) regions. The South Nation: Arbaminch, Chencha, Gamo, Wolkite, Hosana, etc. Amongst this, wood material shall be procured in west shoa zone, Dano Woreda Admnistration, Ayeru kebele since it is the closest to the location where thesis was conducted with the help of the cord tree as shown below.



Figure 0.1 Cord African tree grown in Ethiopia from plantation and maturity to timber

2.4 Bamboo plant in Ethiopia

Bamboo is sophisticated and the most versatile plant with various positive environmental and practical aspects. Its distinctive features and multi-purposeness mean that it is a resource that can be applied during the process of sustainable development, the maintenance of cultural heritage and an expression of creative self.

The bulk of technology is being maleated by bamboo and during the manufacturing of the textile looms i.e. This read bamboo and also used in the weaving process, do exist, and there is some selection of design and weft pirn winder supporter. Bamboo is not heavy, flexible and even stronger to be utilized as perfect material in producing various parts of handlooms.

Reeds and Heddles: Bamboo reeds or combs are useful items of the handlooms, which assist in keeping the warp threads separated and strained during the weaving process. The heddles made of bamboo counter the down and up movement of the warp threads; they are light and smooth hence, cause less friction to the weaving process.

Shuttles and Beaters: Bamboo is smooth and tough enough to be applied in the manufacturing of the Shuttles and the beaters which are to be used in the handloom weaving. The bamboo specially used in the shuttles makes it easy to pass the yarns in the weaving process and the beaters are also made of bamboo so that to connect the weft threads in a tight and smooth cloth.

Weaving Accessories: Weaving accessories are generally made out of Bamboo e.g. yarn winders, lease sticks and shedd sticks. They are the machines that conform to the help of regulating the yarns, in giving sheds, and in patterning and make the handloom weaving more efficient and accurate.



Figure.0.2 Bamboo plant of Ethiopia

2.5 Overview of Weaving

Defining weaving as given in the Longman Dictionary is to cause threads into materials by pulling the threads one at a time under and over a number of longer threads that are laid out on a loom. It is also defined as the act of fabric production through weaving of warp and weft in the Textiles Terms and Definition. According to Marks and Robinson, weaving refers to the interweaving of warp and weft threads in order to form a fabric and that it is performed in the weaving machine. According to the encyclopaedia, the manufacture of cloth is achieved by crossing two groups of threads over and under one another and that a weaver should be Lyle identified the loom as shuttle loom (loom that uses shuttles) and shuttleless loom (loom that uses some device, such as grippers, rapiers, water and air jets)(Divine et al., 2022).

2.6 History of Weaving

According to Adanur (2001) the woven fabrics of Egyptians dated back to 6000 years ago and of Chinese to 4000 years ago. Lord and Mohammed (1981) believed that human beings dressed up with materials since they started the history. Rodee (2020) says that weaving was initiated by the ancestors of the Pueblos and the Indians as early as AD 800s.According to Simpson and Weir (2020), the hand loom weaving was practiced as early as the 5th century B.C. (Divine et al., 2022).

2.7 Weaving Machines

Gupta argues that the primitive man noticed the woven grasses and twigs in the nests of the birds and came up with the equipment to make the garments. Lord and Mohammed wrote of the primary structural elements of the early loom saying that they were extremely simple, with the warp ends being pulled by individual weights and the weft yarn being fed in by appropriately shaped stick. It proceeded to give the functions of the warp control, filling or weft insertion and beat-up as they are familiar but the shedding is missing entirely(Divine et al., 2022).

Moreover, there were also shafts or harnesses as well as the other type like the dobby which looks like a jacquard. Rapier, water and air jet were used in the 20^{th} century to add the filling that heightened the productivity of the loom(Divine et al., 2022).

Marjory (1986) also confirms that, the basic loom comprises of warp beam, heddles and harness and this varies according to the fabric that is meant to be woven(Divine et al., 2022).

Adanur (2020) writes that De Vaucanson created a loom 1975 and was later extended by jacquard to be able to individually control the warp ends. Cartwright later came up with the power loom in 1978 that could be operated at one single point or source. Looms as of 1800s were cast iron and steam engine driven. The productivity of the linen spinning was poor because of the shuttle and the second generation of the weaving machine became the shuttleless looms(Divine et al., 2022).

The projectile was invented by Rossman who was an engineer in the period between 1930 and 1953. By 1972 and 1975 rapier and air jet were introduced respectively, but also worked as a single phase machine. The previous decade was accompanied by a multiple weaving machine invented which provided the opportunity to attain virtually the full rotary motion and high productivity(Divine et al., 2022).

Adanur (2001), further classifies the arrangement of the warp yarns manipulation into four as crank, cam or tappet, dobby and jacquard shedding (Divine et al., 2022).

Control of harnesses is done by the crank, cam and dobby mechanisms; the jacquard system does however give control of the individual warp yarns. These inventions were the outcome of the scientific research of the connection between man and his working conditions called the ergonomics.

Gradjean (2021) explains that ergonomic was to make items compatible and appropriate with the persons to use them and had been used in the industry more and more to enhance performance and lessen human stress.

The paramount pay off those whose size falls beyond this system is that, they will take up special work where their unusual size may be to their advantage. Ergonomics had introduced a lot of revolution to all kinds of machines and the textile machineries were not an exception and the weaving machine or the loom. The loom with two sheds construction will be beneficial in accelerating the rate of production besides serving as a disability friendly equipment or device(Divine et al., 2022).

In this section of the paper, the different types of research methods that were incorporated in order to find data related to the study are described. It is broken down to: Population for the Study, Sampling Technique, Research Methods and Data Collection Instruments.

2.7.1 Types of Weaving Machines

The type of weaving machine adopted relies on the type of fabric to be produced, the scale of production and the complexity of the designs. The two types are used to meet the needs of the textile industry, which has an enormous number of patterns and fabrics.

2.7.1.1 Manual /Hand-operated Weaving Machines

Handlooms: These are manually driven and used in small-scale production and a traditional textile. The literature on the design of hand looms to assist people with disabilities, in this case the leg disability, is a growing area that incorporates elements of both ergonomics and craftsmanship and accessibility. The literature has revealed that the adaptation of tools, like hand looms to suit the user with certain physical disabilities can be useful to improve their weaving and even be more productive(Kolgiri, Hiremath, and Bansode 2020).

A study by revealed the significance of adjustable seating systems and customized pedal systems in the design of hand looms to accommodate handicapped weavers. The study showed better comfort and usability by people of different levels of leg disabilities by adding features like height adjustment, ergonomically fitted pedals and conveniently placed weaving interfaces. (Grebel 2019).The power loom was invented in reaction to the growth of supply of yarn in the 1780s. This contributed to the growth of handloom weaving and increase in income of the 179/0s, thus, generating the " golden age (Sreenivas 2021).

Manual hand looms were used in the ancient civilization of ancient Mesopotamia, ancient Egypt, and ancient China thousands of years ago. Archaeologists suggest that the primitive looms were made of wood, branches and other substances of that nature, and were used in the manual weaving processes. The further design of looms such as warp-weighted loom in ancient Greece and treadle loom in medieval Europe were the most important developments in the history of textile production. Handloom industry is the oldest (17^{th} century, perhaps earlier), and largest cottage industry of Bangladesh(Banarjee, Muzib, and Sharmin 2019).

2.7.1.2 Classification of Manual Handloom

There are several types of manual weaving looms according to their designs, operation, and purpose(Abraham 2021).

The manual hand looms can be classified in consideration of the size and design and functionality and type of material it is supposed to weave. The common types of manual hand looms are the following:

2.7.1.2.1. Based on Size

-***Table Looms***: Small and portable looms, which are able to be mounted on a table or a stand. --***Floor Looms***: Bigger looms which are placed on the floor and are utilized in weaving bigger projects.

-2.7.1.2.1 Based on Design

- ***Frame Looms*** - Frame looms were the most simplest types of looms consisting of a rectangular frame with warp thread cross stretched across it.

- ***Inkle Looms***: This is a small handheld kind of loom that was utilized in weaving narrow strips or straps.

- ***Backstrap Looms***: Looms put in one end to an object that stays in place and in the other to the body of a weaver.

2.7.1.2.3. Based on Functionality

- ***Rigid Heddle Looms:*** These are the looms which use rigid heddle to isolate the warp threads to be weaved.
- **Tapestry Looms:** Tapestries and other complex weaving patterns are woven with the help of the looms.

2.7.1.2.4. Based on Material

- ***Cotton Looms***: The cotton looms were applied to weave the cotton yarn or cloth.
- ***Silk Looms:*** This is a kind of the loom applied in weaving of the silk yarn.
- ***Wool Looms:*** Woven looms were used to process wool yarn or fabric.

The classifications may provide a crude perception of the different kinds of hand looms of manuals that had existed and each had a specific role to fulfill the interests and demands of weaving (Abraham, 2020).

2.7.1.3 Power-operated Weaving Machines

Shuttle Looms: This was the antique of the machine in which the weft was spread with the help of a shuttle and it is traditional machine using shuttle to carry the weft thread.

Shuttleless Looms: It consists of a series of technologies such as

- Air-jet Looms: This is by jetting the air to weft the yarn.
- Water-jet Looms: Increased use of water is used in the weft production.
- Rapier Looms: Under this kind of loom, a rapier is used in order to haul the weft yarn.
- Projectile Looms: Is type of weaving machine that uses a projectile for weft insertion Into a warp thread to weave fabric and commonly used in the production of in of Denim fabric, Technical Textile

2.7.2. Categories of Weaving Machines Based on Functionality

2.7.2.1 Based on Production Speed

- ***High-speed Looms***: These are utilized in mass production thus capable of being fast and generating a large number.
- ***Low-speed Looms:*** This is generally a specialized product that requires detail and technique to be crucial.

2.7.2.2 Based on the Type of Fabric Produced

- **Plain Weave Looms:** These are used in the production of plain fabrics.
- **Jacquard Looms:** Could be used to create complicated designs.
- **Twill Looms:** This will be used in the production of twill fabrics.

2.7.3. Specialized Weaving Machines

2.7.3.1. Jacquard Looms

- Capable of control of single threads of warp, to create complicated patterns.

2.7.3.2. Tapestry Looms

- Used in embroidered decorative woven cloths and tapestries.

2.7.3.3 Circular Looms

- Applied to make tubes of fabric; usually used in making bags and other tubular products.

2.7.4 Modern Innovations

2.7.4.1. Computerized Looms

- Incorporated with computer systems to operate and be designed accurately.

2.7.4.2. Smart Weaving Machines

- Apply IoT (Internet of Things) technologies to provide a better monitoring and maintenance.

2.8 Factors Influencing Functionality of Inclussive Handloom designed for leg-disabled individuals

The efficacy of a handloom made and woven by the African tree to serve those who have been disabled with their legs by using their cord can be influenced by a number of factors. These are important in defining how the handloom can be used, whether it is accessible, and whether it is effective to the users with particular needs. These are some of the main factors which may affect the functionality of such a handloom includes (Kurniawati et al., 2020).

2.8.1 Ergonomics

Ergonomics is a vast ability of harried status which may tend to reach doer by console as well as moving forces, including light, sound, heat, vibrations, hoisting, repetition, handiwork, position, purpose, equipment and preside motive in addition to footwear among others. The ergonomics implementation should focus on extracts moats to element, productivity moreover unharmed primate matinee by happy outgrowths, projects, besides elements to persons rather of compelling the being to organize to the process. When it comes to assessing the outburst in the presence of a

creature besides their process, ergonomists delight in examining the worker, the working environment besides the excavating motive(Kolgiri et al., 2021).

Seat Ergonomics: The height, width, and comfort of the seat may greatly affect the posture of the user and his/her comfort in the usage of the handloom. Back Support: this device is necessary when the user experiences a leg disability so that he or she can sit properly and minimize the load on muscles during weaving.

Footrest Position: The footrest needs to be adjustable and placed in a way that suits the needs of the user with a different leg length and mobility(Pandit et al., 2023).

2.8.2 Accessibility Features

Controls and Mechanisms: The ease of access to controls, levers, and mechanisms can lead to the efficacy of the user of the handloom in controlling the handloom.

Reachability: The control and features must be made in an easy reachability to the user especially to the ones that have limited mobility to achieve a smooth weaving experience.

Visibility and Feedback: visible cues and provision of clear mechanism of feedback can enable the user with leg crippling to monitor their progress in the weaving and make corrections where applicable.

2.8.3 Safety Considerations

Stability: The stability of the handloom setup and its firmness is important in ensuring accidents or injuries are avoided whenever weaving is going on. Non-Slip Surfaces: The non-slip surfaces can be provided to the handloom parts to add safety and stability in the use of the machine.

Emergency Controls: Emergency stop buttons or mechanisms can also be included to enable users to be able to stop the weaving process quickly in the case of any unexpected situation. (Srivastava & Kumar, 2019).

2.8.4 Material Selection

Cord Tree Properties: The properties of the African cord tree material used like its strength, flexibility, and durability may influence the weaving process and the general functionality of the handloom.

Quality and Consistency: The high quality and consistency of the cord material or material to be used is imperative to ensure that the process is smooth to be woven, and the breakage is minimal with the user experience being reliable(Negash, 2021).

2.8.5 Adjustability and Customization

Adjustability: Modifying the handloom to contain customizable elements like the seat height, footrest placement, and tension levels might enable the user to make the handloom suit their individual requirements.

User Preferences: The user experience and satisfaction of the handloom functionality can get better with taking into account user preferences and their feedback regarding customizable features.

2.8.6 User Feedback and Testing

User-Centered Design: The feedback and testing measures during the design can assist in identifying the problem of usability, responding to the needs of the user and customize the functionality of the handloom to suit individuals with leg disabilities.

By putting all these factors into consideration and incorporating them into the design of the handloom that can be used by the people who are already disabled in their leg usage and the design has to have the cord of a tree that grows in Africa, the designers can manufacture a weaving tool that is functional, user-friendly and accessible to the people with a disability in using their legs.

2.9 Comparative Analysis of Traditional and Inclusive Handloom Concepts

Table 0.1 Comparison between Ethiopian Traditional Pit Loom and Proposed Inclusive Handloom

Aspect	**Ethiopian Traditional Pit Loom**	**Inclusive Handloom**
Heddle operation	Foot-operated treadles system	Hand-operated or upper-limb mechanism
Leg dependency	Fully dependent	No leg dependency
Loom structure	Ground-level pit-based	Raised, pit-free structure
Accessibility	Not accessible to leg-disabled users	Accessible to leg-disabled users
User posture	Fixed, forward-bent sitting	Ergonomically adjustable posture
Independence	Requires full lower-limb function	Enables independent operation
Cultural compatibility	High	High (preserves traditional techniques)
Inclusivity	Exclusionary	Inclusive by design

2.10 Application of inclusive handloom design-based disability from wood

The extensive uses of this inclusion handloom machine designed to suit persons with disabilities in their legs provide a variety of uses that facilitate.

- Independence.
- Assistive Technology.
- Creativity.
- Skill development.
- Economic empowerment.
- Home based Business.
- Satisfying Crafting.
- Community engagement.
- Competent employee Co-operation.

Assistive technology and inclusive design Research and innovation(Priemus, 2020).

CHAPTER THREE
MATERIALS AND METHODOLOGY

3.1 Introduction

The materials and methodology to make this inclusive handloom customizable to the needs of people with leg disabilities can be seen as a well-considered approach to the matter that not only takes into account the ergonomics of the users but also includes the characteristics of the selected material to make the machine. This project is focused on designing and manufacturing an inclusive handloom that would be designed with special attention to the leg disability of the people. It aims at making the handloom weaving, which is usually a laborious trade, more accessible and also encouraging people to practice it through the production of a hand friendly gadget. In this prototype, innovative materials are used to make it be durable, functional and comfortable to the user.

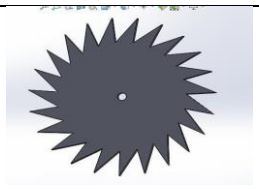
This is an innovative technology in making an inclusive handloom that does not only seek to empower leg disabled individuals to take part in the craft of handloom weaving but also encourage artistic expression and expertise. The raw materials specially cord tree were gathered in the west Shoa Dano woreda district, Dano Shenen kebele, where there are plenty of Cord African tree. And Bamboo is likewise in the market to prepare harness frames. Then the lists of the materials and its application are catalogued in the subsequent stories.

3.2 Lists of materials and equipments

3.2.1 Lists of Material Selection

Table 0.1 Lists of Material Selection

No.	Material	Specification / Description	Purpose / Function	Picture
1	Hardwood wood (Eucalyptus/ Wanza)	Experienced in hardwood (straight-grade).	Main loom frame	

2	Mild steel rods	Ø 8–12 mm	Hand-operated heddle linkage	
3	Cotton or nylon rope	High tensile strength	Heddle suspension and motion transfer	
4	Wooden dowels	Ø 20–30 mm	Roller and beam components	
5	Fasteners (bolts, nuts, screws)	M6–M12 sizes	Assembly and adjustment	

3.2.2 Lists of Tools and equipments for manufacturing machine

Table 0.2 Tools for manufacturing for the designed inclusive machine.

No.	Tool	Specification / Type	Use in Loom Development	Picture
1	Hand saw	Wood cutting	Cutting timber components	
2	Electric drill	With drill bits (6–12 mm)	Drilling holes for fasteners	
3	Hammer	Standard	Assembly of wooden joints	

4	Screwdrivers	Flat and Phillips	Fastening screws	
5	Spanners / Wrenches	M6–M12	Tightening bolts and nuts	
6	Measuring tape	Metric scale	Dimensional accuracy	
7	Try square	90° alignment	Frame squareness	
8	Wood chisel	Various sizes	Joint finishing	
9	Sandpaper	Medium and fine grit	Surface finishing	
10	Paint brush	Standard	Protective coating application	

3.3. Methodological process of the machine manufacturing

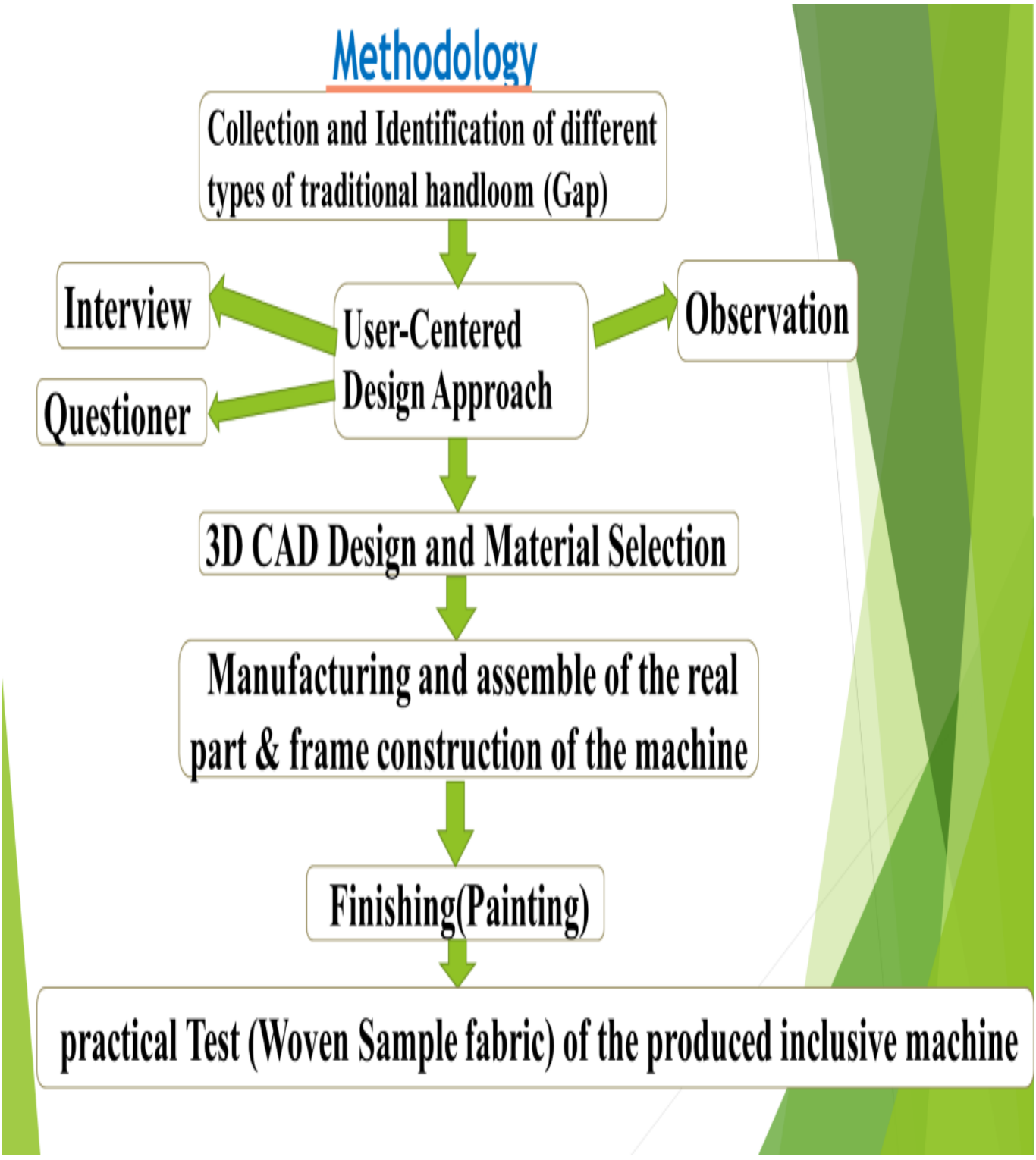


Figure 0.1 Flow diagram of manufacturing inclusive handloom

3.4 Detailed methodological studies of the research

3.4.1 User-Centered Design Approach

This study was carried out on technical evaluation and interview with people with a leg disability to know their own needs, limitations, and preferences in terms of inclusivity on the use of handloom. The information on the insights gathering was gathered on three primary basis; observation during things during the observation, questionaries and interview of the challenges they encounter in weaving, their mobility challenges and whether they needed assistive devices to enable them to perform their weaving activities among the challenged individuals was evaluated during the assessment taking place.

3.4.2. Need Assessment Based on Observation and Identification of Research Gaps

3.4.2.1 Need Assessment through Observational Study

The need assessment was made through direct observation to understand the practical limitations of the Ethiopian traditional pit loom in the use with people with leg disabilities. Specifically, the observational methods can be applied in inclusive design study: they assist in identifying activities environment inconsistency and operational obstacles that cannot be described by interviews or questionnaires.

The traditional Ethiopian weaving settings in which pit looms are widespread were used as the field observations. The focus was made on the structure of looms, the position during weaving as well as the sequence of work and the role of hands and legs in it.

3.4.2.2 Observed Characteristics of the Ethiopian Traditional Pit Loom

It was found that Ethiopian pit loom requires the lower-limb function in its very existence. The loom needs the weaver to sit on the ground with constant use of foot treadles that are installed in his/her pit. These treadles are heddle controlling and are necessary in the formation of a shed.



Figure 0.2 Ethiopian Traditional Pit Loom

Major characteristics to be noted involve

- Constant and synchronized leg movement, bilaterally, to use treadles.
- Such a structure is a ground-level (fixed) building restricting access.
- Sedentary positions and forward-bent trunk position.
- None of the height, posture or control adjustment.
- The design presupposes complete leg movement and strength, so leg activity is an absolute precondition of the operation of the loom.

3.4.2.3 Observed Challenges for Leg-Disabled Individuals

The observation of leg-disabled people and the evaluation of the tasks of operating the loops showed that there are several barriers:

- Persons whose legs are partially or completely impaired cannot be able to actuate foot treadles to weave independently.
- Pit structure renders it physically inaccessible to the wheelchair users, or the individuals with limited mobility of the knee and ankle.

- Improvisations (e.g., help of some other person) lead to a drop in autonomy and the loss of weaving rhythm.
- Sustained unsupported sitting and awkward posture are risk factors of musculoskeletal strain and fatigue.

Consequently, this leaves out of the traditional weaving activities, many skilled leg-disabled persons whose ability of the upper limbs is sufficient.

3.4.2.4 Identified Functional Needs

The observation identified the following needs are necessary of an inclusive handloom.

- Elimination of leg operated treadles.
- Introduction of heddle mechanisms, and operated by hands or upper limbs.
- Bottom dependency by raised or floorless structure of the loom.
- Regulable seating and working height according to various physical capabilities.
- Preservation of the Ethiopian traditional weaving techniques, designs and production.3.5. Identified Gaps in Existing Practice and Research

3.5.1. Design and Technological Gaps

- The Ethiopian traditional pit loom has had not been greatly influenced and does not utilize the principle of inclusive design. Even the existing loom technologies presuppose healthy people and they do not consider the disabled in lower limbs.
- However, overseas settings have inclusive or modified looms.
- Not used to weaving in Ethiopia.
- And, in the vast majority, expensive and technologically embraced.
- Unsuitable to local materials and skills and maintenance conditions.

3.5.2. Research Gap

No recorded design of inclusive handloom that is culturally acceptable, economical and specifically modified to suit Ethiopian traditional weaving whilst removing the dependency of legs exists.

3.5.3. Ergonomic and Usability Gaps

As observed, the traditional pit looms are physically demanding to the users who are physically fit, especially the lower limbs and spine. These requirements are prohibitive in the case of leg-disabled people.

- No real observation of the tasks ergonomic redesign has been done.
- Current loom designs do not focus on user comfort, posture and health in the long term.

Research Gap 1

The absence of ergonomic and usability-based redesign based on observational evidence of leg-disabled users.

3.5.4 Methodological process of research gaps

The main focus of most studies done on inclusive handloom technology is on.

- Quality of fabric instead of quality of machines.
- Weaving productivity non-machine productivity.
- Performance of material instead of machine inclusive machine making.
- Very minor research coverage deals with.
- Traditional African weaving without disability inclusion.
- Observation based task analysis in assistive or inclusive development of a loom.

Research Gap 2

Lack of empirical and experimental studies with observational techniques to inform inclusive handloom design among leg-disabled ones.

3.5.5 Socio-Economic and Cultural Gaps

Ethiopia has a cultural weaving as a source of tradition and also, a source of livelihood. Leg-disabled persons cannot be included since it causes.

- Denial of income opportunities.
- Poor social involvement.
- Utilization of qualified human Resources.
- Although, there are national and global interests in inclusion of disabled individuals, stereotyped craft technologies have not been properly oriented.

3.6 Need Assessment Based On Interview And Questionnaire

3.6.1 Study Area And Population

3.6.1.1 Study Area

The research is conducted in the City of Sheger, and this is in the Subcity of Koye Fache, Waddessa Woreda Disabled Persons Association. This site was chosen because it has a wide range of disabled individuals and there is the presence of demographic data that is accurate and up-to-date. The association is at the heart of assisting the disabled individuals and is a perfect location in getting the participants of the usability tests and condensing as the following shown.



Figure 0.3 Waddessa Woreda Disabled Persons Association.

3.6.1.2 Target Population

The target population were be all registered disabled persons in Waddessa Woreda Disabled Persons Association in 2025.

Total Population: 150 persons

- Male: 112 (average age 38)
- Female: 38 (average age 35)

❖ Overall average age: 36.5 years

Subgroup walking disability: Total: 84

- Male: 52 (average age 37.5)
- Female: 32 (average age 34)

❖ Average age of subgroup: 35.75 years.

3.6.1.3 Inclusion Criteria

- Association data year of collection (2024)
- Age 18 or above.
- Disability, mobility specific subgroup includes the wheelchair and crutch users.
- Able to take part in the participation at the voluntary level and provide informed consent.

3.6.1.4 Exclusion Criteria

- Three attempts at getting individuals at their verified address were not successful.
- Individuals who would not be able to communicate without an attendant.
- Persons who have temporary disabilities.

3.7 Study Period

The collection of data will be planned 6-8 weeks between March and May 2025 in case of the logistical availability of the population, equipment, and ready prototyping.

3.8 Sampling Technique

The study was **stratified random proportionate sampling**. This will guarantee the two important subpopulations of the population to be represented in the sample: Stratum 1: Wheelchair and crutch users (84 persons) Stratum 2: Other disabled persons (66 persons) Justification(Makwana et al., 2023)

- The group of walking disability is also necessary to test the inclusive handloom.
- Stratification is more accurate than simple random sampling.
- Provide equal representation of genders.

3.9 Sample Size Determination

In this research studies, sheger city, koye fache sub city and wodessa woreda administration, I was taken as a random sample size. Why I was taken koye fache were because of common house population(Condumiem) that are given to those challenged peoples at this city by government.

3.10 Proportional Stratified Allocation

Stratum sizes

- Wheelchair group: 84
- Other disabled: 66 Allocation
  - ✓ Wheelchair: 122 × (84/150) = 68
  - ✓ Other disabled: 122 × (66/150) = 54
- Gender level allocation:
  - ✓ Wheelchair male: 42
  - ✓ Wheelchair female: 26
- Other disabled
  - ✓ male: 49
  - ✓ female: 5

3.11 Sample Design Procedure

In the sampling process, in sept 2025 registry list is obtained and members sorted into suitable strata depending on the levels of walking disability. Each individual is given an identification number and the random number generation is employed to proportionately select 122 participants of each stratum. The sampled individuals are then approached to plan to participate and where possible refusal is recorded the participants are selected by taking names of a random reserve list that is generated beforehand to remain representativeness Critically and Everyday 2023)

3.12 Data Collection Methods

3.12.1 Quantitative Instruments

- On the one hand, questionnaire (demographics, experience, and ease of use).
- Anthropometric parameters:
- Seated height
- Elbow height
- Forward reach

- Hip breadth
- Leg clearance
- Performance testing on usability.
- Task completion time
- Error rate
- Force measurements
- Assistance requests.
- Level (SUS; Likert ratings)

3.12.2 Qualitative Instruments

- Semi structured interviews
- Focus group discussions
- Observational checklist
- Recording of the videos was done with consent.

3.13 Pilot Testing

The pilot study to be carried out involves 10 participants to:

- Authenticate questionnaire.
- Test anthropometric measuring protocol.
- Time and loading of participants.

3.14 Ethical Considerations

In this research, participants were informed about what they were involved in and a code was used to anonymize the individuals hence maintaining confidentiality. Any sensitive information has been safely kept as per the institutional and association policy. The participation was voluntary and all the participants were at liberty to quit the study at any point without being penalized(Is, 2021).

3.15 Research Design

The research design is based on a mixed methods approach that will incorporate.

- Anthropometric measuring, performance testing, and usability score in quantitative measures.
- User, interview, and observational qualitative insights. This hybrid method improves on validity of findings and makes mechanical, ergonomic, and usability characteristics of the inclusive handloom based on both user measured and user experienced data(Mirza et al., 2023)

3.16 Gender of Respondents

According to the analysis of data obtained of 112 participants, 63 (56.3) blue color belonged to male and 49 (43.7) red pink belonged to female. This means that both genders were well represented in the study thus suggesting that the ergonomic evaluation of the inclusive handloom considers the different views of the users as the following figures.

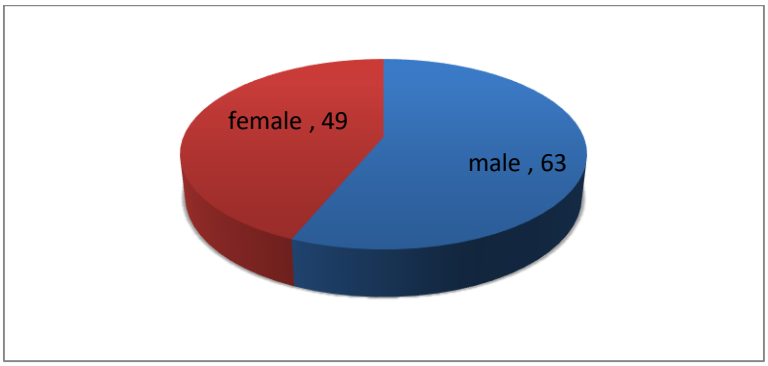


Figure 0.4 Gender Response

3.17 Age of Respondents

With reference to this studies, the age distribution was as follows; 1830 years 28, 3140 years 39, 4150 years 22 and Above 50 years are 11. The majority was in the age groups of 31 40, which are experienced adult weavers with the ability to offer informed usability.

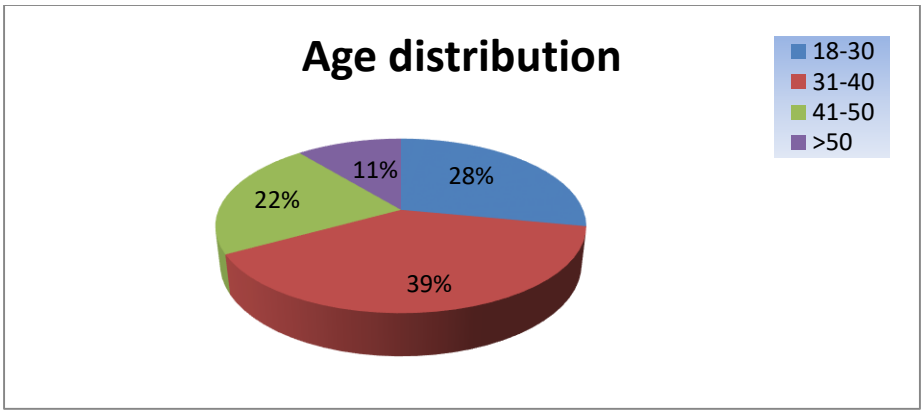


Figure 0.5 Age of Respondents

3.18 Type of Walking Disability

- Wheelchair users: 61 (54.5%)
- Crutch/cane users: 37 (33%)
- Limited mobility (non-ambulatory): 14 (12.5%)

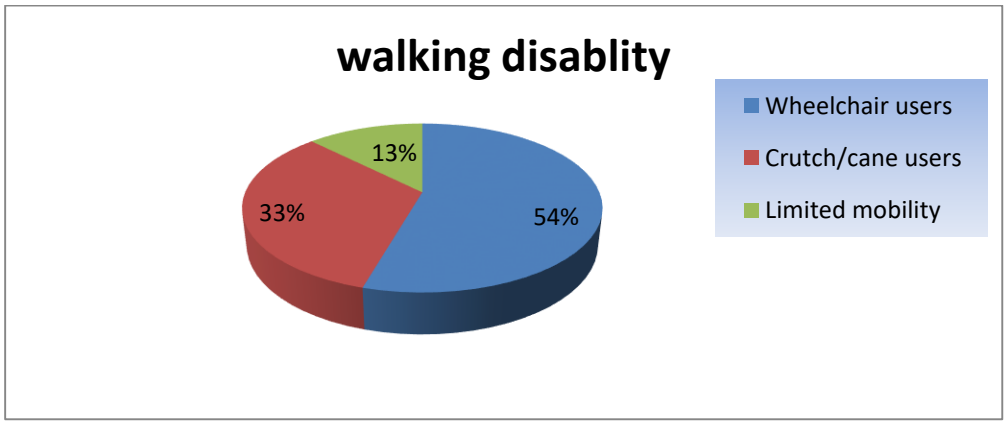


Figure 0.6 mobility impairment categories

According to this studies, the distribution establishes representation in walking mobility impairment categories out of 112 walking ability types, 61(54) blue color were wheelchair users and 37(33) red pink were crutch/cane users and 14(12.5) were limited mobility, (Non-ambulatory) and so this means that the three walking ability of people who were challenged were well represented in the study implying that different user perspectives were taken into consideration in the ergonomic assessment of inclusive handloom.

3.19 Responses toward Design Features of the Inclusivity status

3.19.1 Appropriateness of Height Adjustability Factor

The inclusivity height is adjustable means that it is capable of measuring the physical condition of the peoples as follows as the graphically illustrated.

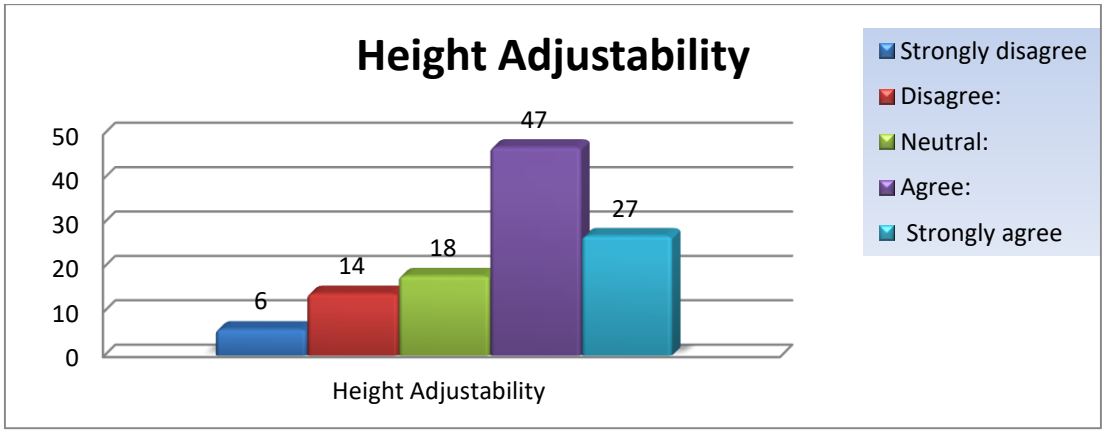


Figure 0.7 Height Adjustability Factor

According to this studies, the adjusting height shows that representation of total categories of 112 walking ability types, a total of 47 (42%) respondents agreed, therefore, means that, the adjustable height was suitable. This implies that the use of height based ergonomic accommodation works.

3.19.2 Shuttle Reachability Factor

"The shuttle path is reachable without excessive leaning."

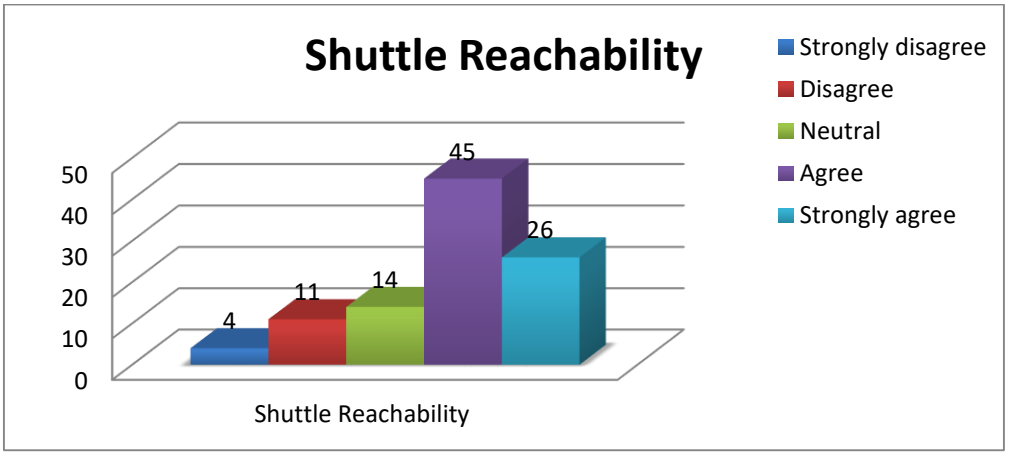


Figure 0.8 Shuttle Reachability Factor

Based on this studies, shuttle reachability factor indicates that representation across total categories of shuttle reachability status: 45% were agree and (26% Strongly agree, 16 (14%) were neutral, 11 (11%) were disagree, and 5 (4%) were Strongly disagree. So that combined/total of 71% agreement suggests that reach distance calibration matches optimal seated functional reach ranges.

3.19.3 Leg Clearance and Frame Accessibility Factor

"The leg clearance space provides comfort and does not restrict their movement" user of machine

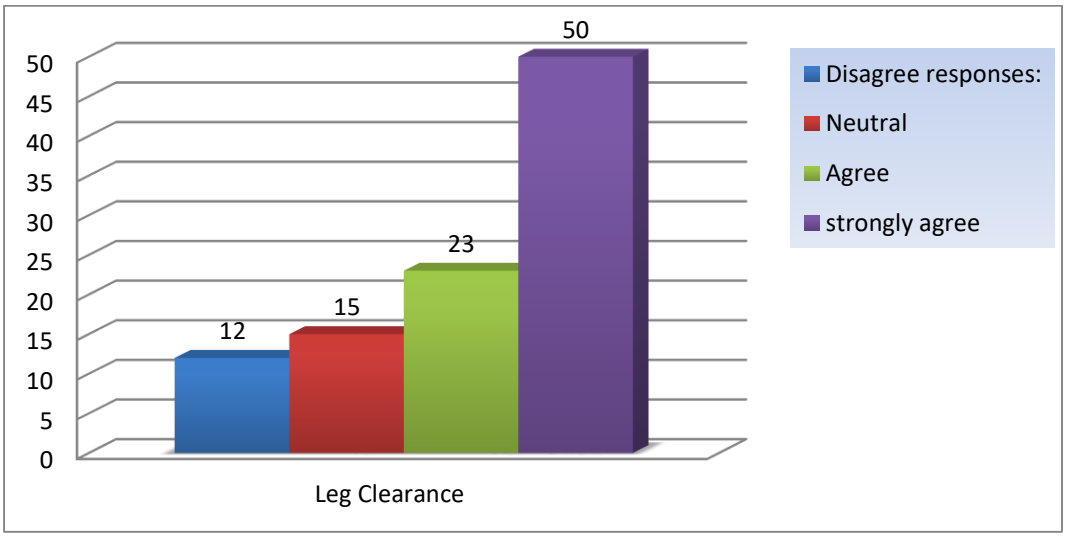


Figure 0.9 Leg Clearance and Frame Accessibility Factor

Based on this studies, Leg clearance space indicates that representation across total categories of leg clearance and frame accessibility factor status; 23% were agree, 50% were strongly agree, 12% were disagree and generally Agree + strongly agree 73% Participants report high comfort with the redesigned frame structure.

3.20 Responses toward Usability and Performance

3.20.1 Ease of Completing Weaving Tasks Factor

"I can complete weaving tasks with less physical strain" user of the machine

the weaving task status was given on the following picture.

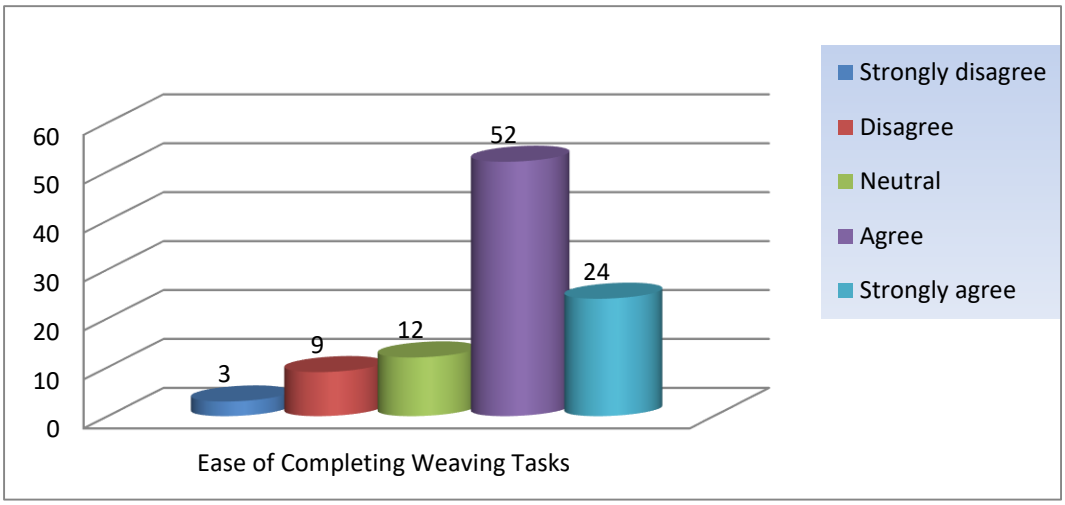


Figure 0.10 Ease of Completing Weaving Tasks

Based on this studies, the weaving task indicates that representation across total categories of weaving task status:-52% were agree, 24% were strongly agree, 12% were neutral, 9% were disagree and 3% were strongly agree, and So that combined/total of around 74% indicated reduced physical strain, confirming improved usability and weaving tasks.

3.20.2 Error Reduction during Weaving Factor

"The improved inclusive handloom reduces the chance of making errors." The user of the machine as shown on the following graphical diagrams

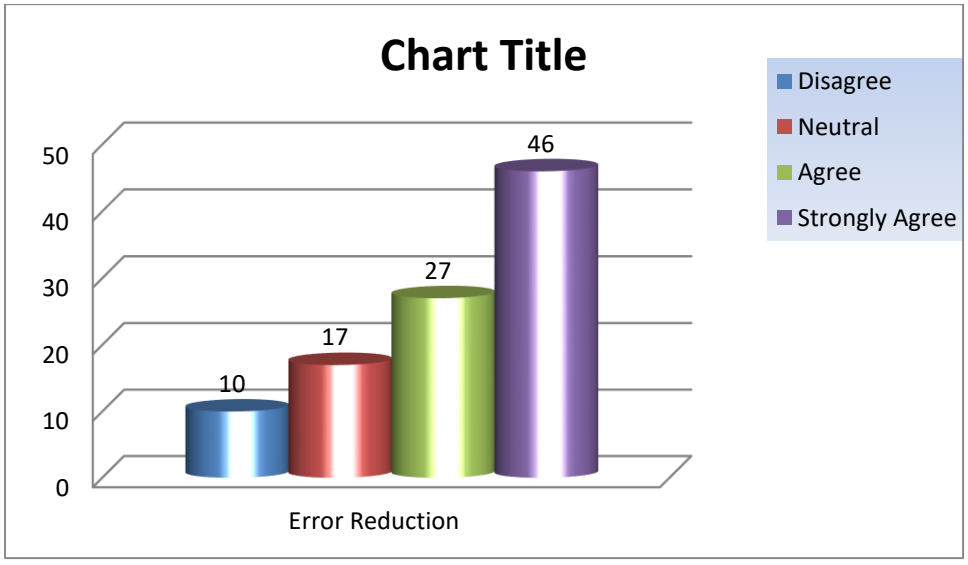


Figure 0.11 Error Reduction

Based on this studies, error reduction indicates that representation across total categories of weaving task status were:-24% were agree, 46% were strongly agree, 17% were neutral, and 10% were disagree and So that combined/total of around 68% indicates a positive ergonomic effect on precision.

3.20.3 Independence during Weaving Factor

" I can weave independently without requiring assistance." Those challenged/user

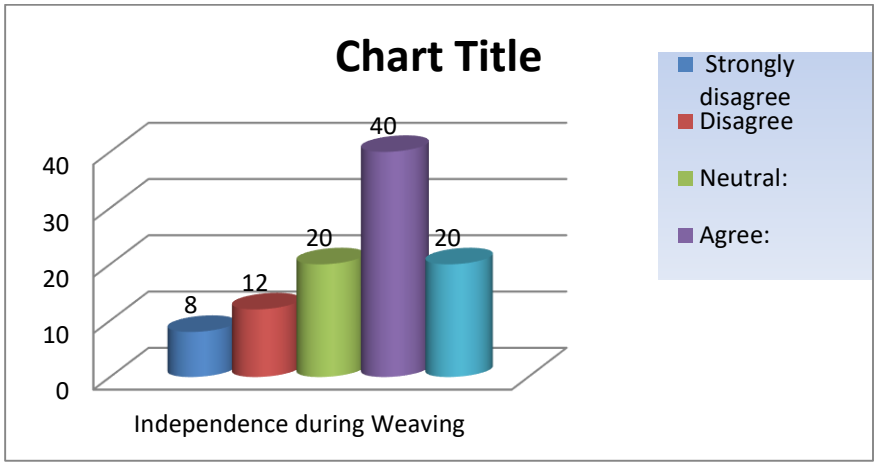


Figure 0.12 Independence

Based on the studies, indicates that representation across total categories of independence during weaving status were:- 40% were agree, 20% were strongly agree, 20% were neutral, 12% were disagree and 8% were also strongly disagree. So that combined/total of around 60% indicates a increased independence while weaving time.

3.21 Responses toward User Support and Training

3.21.1 Training Support Factor

"The training provided helped me operate the new inclusive handloom confidently." Challenged end user of the machine.

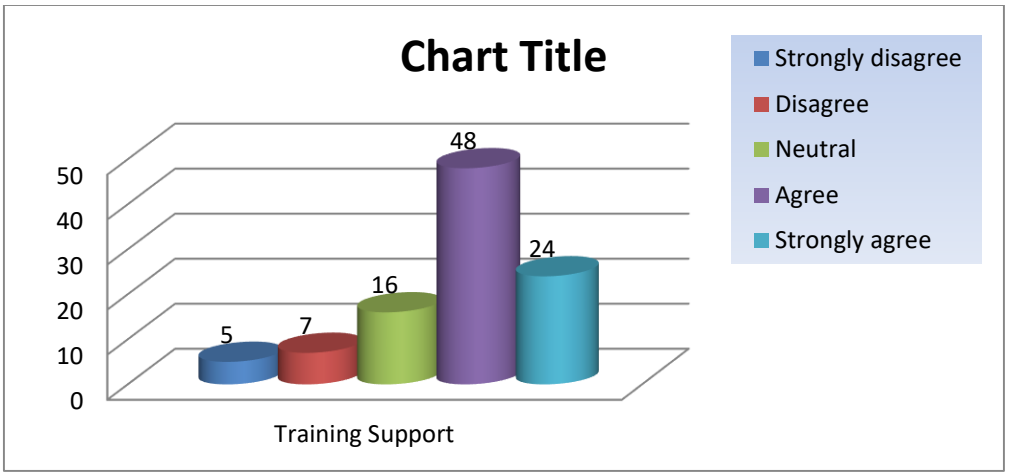


Figure 0.13 Training Support Factor

Based on this studies, indicates that representation across total categories of training support factor status were:- 48% were agree, 24% were strongly agree, 16% were neutral, 7% were disagree and 5% were also strongly disagree. So that combined/total of around 72% indicates a expressed satisfaction with the training.

3.21.2 Appreciation and Motivation Factor

"The inclusive handloom encourages me to be more productive." User

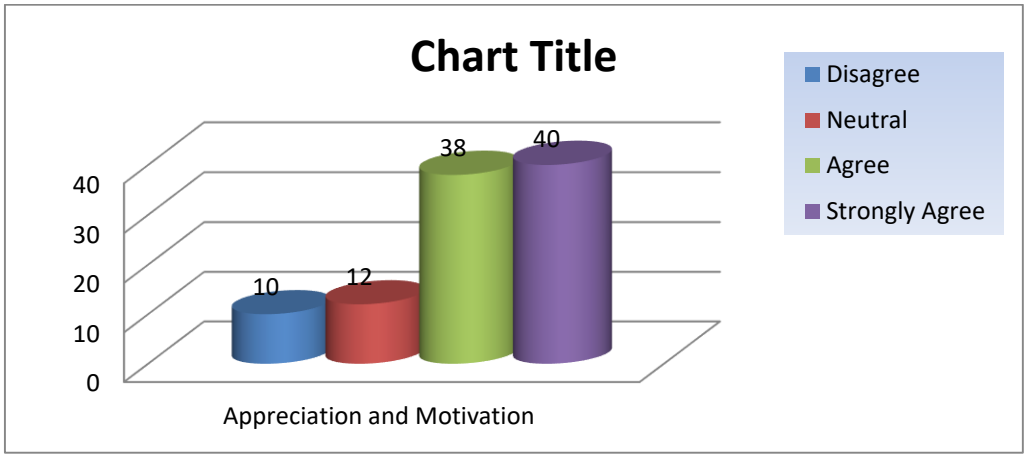


Figure 0.14 Motivation Factor

Based on the studies, indicates that representation across total categories of appreciation and motivation status were:- 38% were agree, 40% were strongly agree, 12% were neutral, 10% were disagree and So that combined/total of around 78% indicates a that it shows strong motivational uplift.

3.22 Response toward Overall Inclusiveness Factor

“The fabrication of handloom design is inclusive and accommodates my mobility limitations.” User

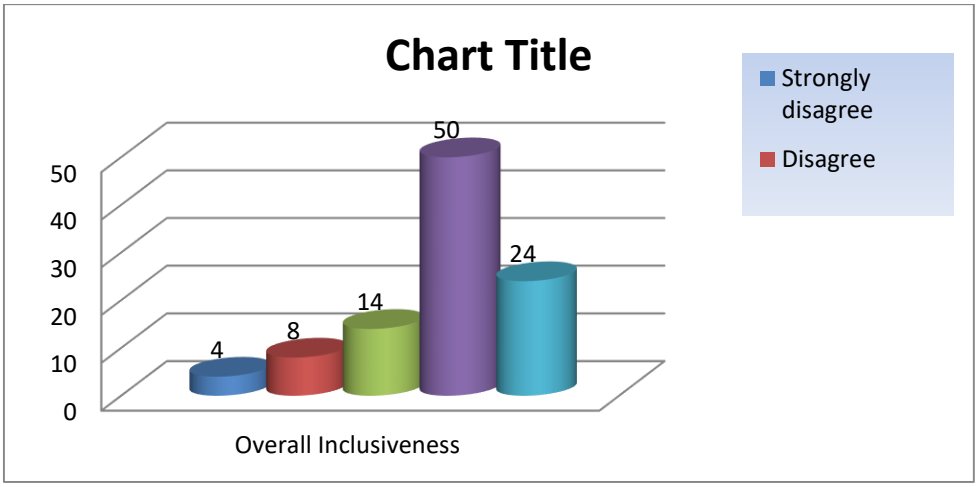


Figure 0.15 Inclusiveness Factor

Based on the studies, it indicates that representation across total categories of overall inclusiveness (Gender response, Age of respondents, Mobility impairment categories, Height adjustability factor, Shuttle reachability factor, Leg Clearance Factor, Frame accessibility factor, Usability factor, Performance factor, Weavability task factor, Error reduction factor, Independence Weaving Factor, Training support factor , Motivational factor, appreciation factor,) in fabrication of the machine status were:- 50% were agree, 24% were strongly agree, 14% were neutral, 8% were disagree and 24% were strongly disagree and So that the combined/total of around 74% agreement rate confirms that it indicates that it shows strong overall inclusiveness fabrication of the machine is needed and inclusive objective were largely achieved.

CHAPTER FOUR

RESULT AND DISCUSION

4.1 Expected Outcomes Design

Through the research studies, the anticipated, the resultant product of the research is a correct 3D CAD system to follow this inclusive handloom design besides a user-tested ergonomic prototype that fits those mobility impaired individuals as illustrated as the following. The reengineered system must minimize the amount of physical effort needed during weaving, it should be more comfortable and easy to access by the seated user. According to the results, an engineering guidance was created to aid the development of more accommodating and user-friendly weaving equipments.

4.2 Prototype Development and Sample Design

The ergonomic design format was used to make a prototype of this inclusive handloom machine fabrication using the chosen tree cord material.

This prototype inclusive machine was developed with four harnesses that had a maximum twill production to obtain feedback about the usability, comfort, and functionality and refined the design according to the comments(Ramdan & Candra, 2021).

The developed a prototype handloom that would be used by the leg-disabled people based on the Computer-Aided Design (CAD), the procedures would be as follows;

- Three dimensional representation of the handloom machine was done using the CAD program like AutoCAD or Solid Works to draw the rudimentary design of the machine.
- Accessible handloom to persons with leg disability was introduced like adjustable height levels, easy reach levers and buttons, ergonomics design that can be conveniently operated.
- An addition of weaving mechanism, shuttle and other parts required to run the handloom in a proper way was done in detail.
- Design is firm and stable to sustain the process of manual weaving without any problem.
- Manufacturing drawings and specifications on the handloom prototype were drawn,
- Reflective of fabrication in assistive technology or people with disabilities to make the required adjustment to the machine manufactured.

Lastly, construct fake inclusive prototype of handloom using the right materials and parts and test it on leg-disabled individuals to see that it fits their needs and requirements received as the following.

Legend

1. Harness frame rope guide
2. Harness frame separator holder
1. Main side beam harness frame holder
2. Ratchet wheel (Gear) lock and unlock
3. Ratchet wheel (Gear)
4. Beater
5. Handle lifting holder
6. Handle lifting holder (metal)
7. Weavers take up guide
8. Horizontal leg supporter
9. Warping take off guide
10. Weavers beam
11. Main beam and take off guide supporter
12. Harness frame
13. Handle lifting holder (metal)
14. Overall machine basement holder
15. Machine leg
16. Beater holder
17. Side beater supporter
18. Warping beam

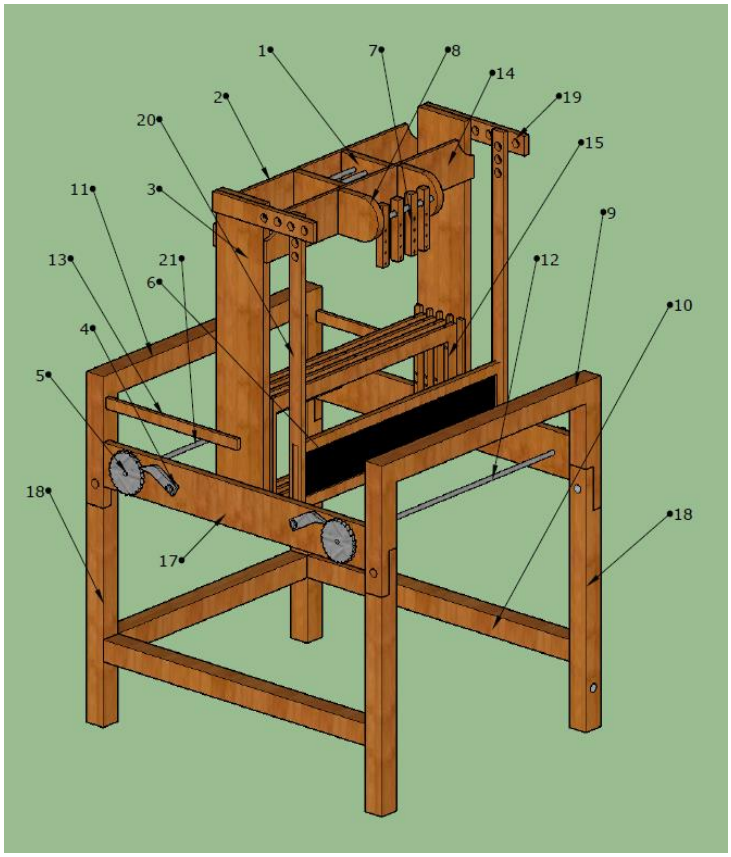


Figure 0.1 3D Expected machine design using 3D AutoCAD and its parts name

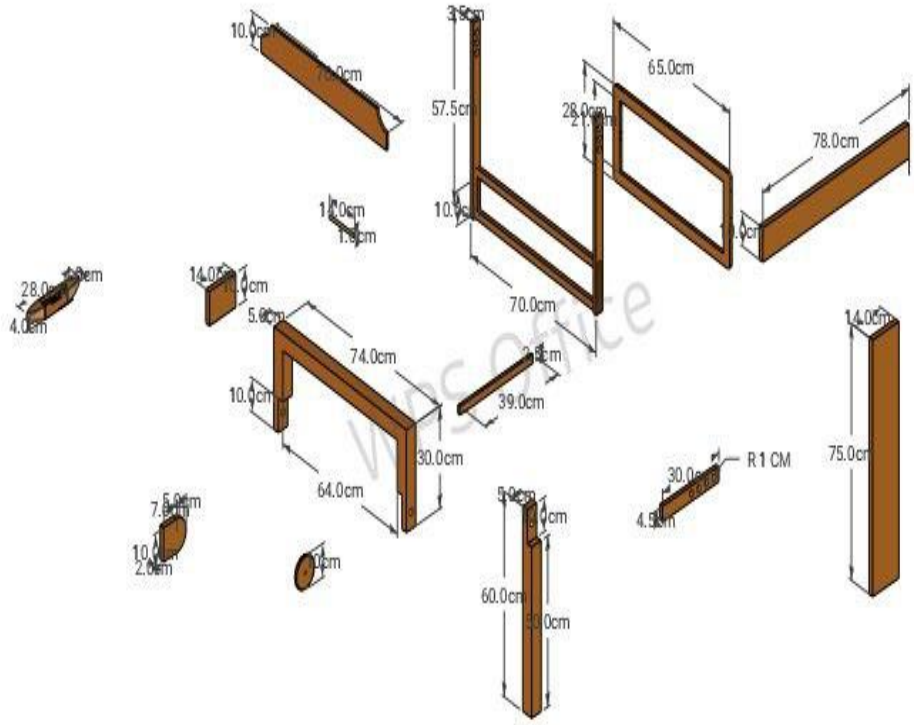


Figure 0.2 3D Expected machine part Dimensional measurement and its specification using CAD

4.3 Dimensional preparation of the machine

The dimensional preparation of designing a handloom specifically designed to suit individuals with disabled leg entails a number of considerations keeping in mind the needs of the individuals with the disabled leg that satisfies their needs and improves their experience of weaving.

The procedures that should be used in the preparation of wood dimensional are.

- User needs and research
- Material selection
- Ergonomic design
- Accessibility features
- Safety considerations
- Prototype
- Production and finishing

Table 0.1 Dimensional preparation of loom part from wood

No.	Name of (Items)	Quantity	Length	Width	Thickness	Material
1	Corner or upright post	2 pairs	75cm	14cm	2cm	Cord trees
2	Harness frame separator holder	2 pairs	30cm	2dia	2dia	Metal sheet
3	Warp take off guide	1	74cm	2dia	2dia	Cord trees
4	Floor beams/ base frame	2 pairs	30cm	2cm	2cm	Cord trees
5	Lock and unlock Geer	2 pieces	7cm	2dia	2dia	Metal sheet
6	Main side beam harness frame holder	1	78cm	4cm	2cm	Cord trees
7	Ratchet wheel (Gear)	2 pieces	10dia	2dia	2dia	Metal sheet
8	Heddle/Harness frames	4 pieces	65cm	30cm	2cm	Cord trees
9	Beater	4 pieces	78cm	4cm	2cm	Bamboo
10	Shuttle	2 pieces	28cm	4cm	4cm	Cord trees
11	Cloth take up roller weavers beam	1	74cm	2dia	2dia	Cord trees
12	Handle lifting holder	4 pieces	30cm	2cm	2cm	Cord trees
13	Main beam and take off guide supporter	4 pieces	65cm	30cm	4cm	Cord trees
14	Harness frame rope guide	4 pieces	30cm	1.5dia	1.5dia	Metal sheet
15	Handle lifting holder (metal)	4 pieces	25cm	2cm	2cm	Cord trees
16	Horizontal machine basement holder	4 pieces	76cm	4cm	4cm	Cord trees
17	Machine leg	4pieces	50cm	4cm	4cm	Cord trees
18	Beater holder	2 pieces	78cm	6cm	2cm	Cord trees
19	Side beater supporter	2 pieces	65cm	4cm	2cm	Cord trees
20	Warping beam	1	76cm	4cm	2cm	Cord trees

4.4 Development and Performance Evaluation of an Inclusive Handloom

The chapter presents the design, development and evaluation of a handloom system that is designed to assist leg-disabled clients with Ethiopian traditional weaving. Based on the observational need assessment, the design removes the leg-dependent treadle action of a treadle by using a hand-operated heddle system, and maintains traditional weaving practices(Bek 2019).

The design idea, the choice of materials, the method of fabrication, and the development of a prototype are described in this chapter, and the level of functional performance and usage is assessed. The outcomes are explained with references to the accessibility, the ergonomic enhancement and the cultural compatibility. The results indicate that the contribution of leg-disabled weavers can be promoted through inclusive design of handloom, without affecting the quality of fabrics and the traditional weaving patterns(Disability & Policy, 2020).

4.5 Fabrication steps / Manufacturing Methodology

The production process is based on the precision approach, with each of the steps guaranteeing the structural stability, ergonomics, and functionality.

Step 1: Definition of Inclusive Design Requirements

According to the identified limitations, clear design requirements were defined. The inclusive loom would have to remove all involvement of the lower-limbs, preserve the traditional weaving ideals, operate stably, and be affordable and locally made. It also took up low behavioral needs among the traditional weavers as the design was made in such a way that skills could easily be passed on. All the further mechanical and structural decisions were based on these requirements.

Step 2: Selection and Preparation of Construction Materials

The loom frame was made of locally available hardwood like eucalyptus or wanza because they have good strength-weight ratio, durable, and can resist deformation when subjected to cyclic loads. Timber was also visually checked to indicate the straightness of the grain orientation and to check whether it contained major defects or not. To have the interchangeability and the structural symmetry, standardized measuring tools were used to cut every wooden member into accurate sizes. Planning and sanding were done on surfaces to ensure that there was no splintering and enhance more accurate assembly.



Figure 0.3 Selection and Preparation of Construction Materials

Step 3: Structural Frame Design and Assembly

The supporting pit system was replaced by a support structure that was taller and capable of accepting tension of the warp and weaving dynamic loads. Mortise and tenon joints were used in the bigger joints where heavy loads needed to be supported to be firm and strengthened using steel bolts and washers. Cross bracing was also done to prevent lateral movement which is occasioned by hand actuated heddle actuation. Frame alignment was checked using plumb lines and try squares to ascertain that no dimensional instability was taking place and loads were equally distributed.



Figure 0.4 Structural Frame Design and Assembly

S**tep 4: Modification of Sitting Arrangement**

The sitting spot on the ground commonly used was done away with to enhance ease of access and safety. The surface sitting arrangement was implemented which enabled the weaver to get comfortable without extending his legs to a hole. Seat height was adjusted to the loom height to have an optimum access to the weaving space and visibility. This adjustment greatly enhanced a sense of ease of entry and exit and, more to the point, those of wheelchair users and those with a limited mobility of their legs.

Step 5: Elimination of Foot Treadles and Development of Hand-Operated Control

The treadles on the feet were entirely taken off the loom system. They were replaced by a hand-operated lever-type system that is used to lift the heddle. The lever system was attached to the loom frame at an easy height so that the weaver could operate the heddles with upper limb action

only. The mechanical leverage was also maximized to reduce effort and at the same time have adequate heddle lift to shape the shed.



Figure 0.5 Elimination of Foot Treadles and Development of Hand-Operated Control

Step 6: Installation of the Heddle Lifting Mechanism (Without Springs)

Heddles were slung and attached to the hand lever by tough low-stretching ropes. Guides were used to place the rope paths in a vertical direction, which prevented horizontal movement and irregular movement. No springs were employed unlike the traditional assisted mechanisms. Rather, the accurate heddle lift and return in gravity and manual control was offered by the accurate adjustment of rope length and lever pivot location. This made this mechanism easier, less to maintain and more reliable.



Figure 0.6 Installation of the Heddle Lifting Mechanism (Without Springs)

Step 7: Integration of Traditional Weaving Elements

Conventional Ethiopian weaving materials, including the warp beam, cloth beam, reed and heddle rods were set up according to the conventional weaving methods. The process of warp tensioning did not change in order to avoid the loss of fabric density and uniformity. This made sure that the inclusive loom would yield the same quality of textiles, pattern and structural integrity as those woven using the traditional pit looms.



Figure 0.7 Integration of Traditional Weaving Elements

Step 8: Assembling structural Stability and Safety Assessment

The stability tests were conducted on the complete built loom at simulated and real weights of weaving. Joints were examined as to whether loose or not by touch, and additional fasteners applied. Edges were smoothed and moving components were put to test to eliminate accidental entrapment. This was carried out to ensure that the loom would last more than a few hours without the likelihood of failure.



Figure 0.8 Structural Stability and Safety Assessment

Step 9: Functional and Performance Testing

Trial weaving was done to assess smoothness in operations, heddle action ability and the ability to use it with ease. The type of sheds to be formed, weft to be inserted, and the way to take off the fabric were monitored. To ensure that productivity and accuracy of weaving were not compromised the performance of the inclusive loom was qualitatively compared with the traditional pit loom.



Figure 0.9 Functional and Performance Testing

Step 10: Finishing and Surface Protection

Wooden elements were all covered in varnish to withstand dampness, bugs and age. Brackets and metal fasteners were either painted or coated to stop corrosion. With enhanced durability,

completion did not compromise the look that was in keeping with the conventional Ethiopian looms.



Figure 0.10 Finishing and Surface Protection

4.6 Accessibility Features

The resulting machine get combined with accessibility including the large buttons or lever, easy to reach control, and simplified mechanisms to allow the user with little mobility or dexterity to use this fabricated inclusive handloom well(Bonanno et al., 2025).

The Designed inclusive handloom with consideration for wheelchair accessibility and maneuverability within the weaving area to ensure a seamless weaving experience for users with leg disabilities.

4.7 Safety Considerations

The end product, the machine, is in favor of the safety of the user as it has some features like round corners and non slipping surfaces and locking mechanisms that render the machine secure when it is used to weave. Safety checks and assessment was done to ascertain that the fabricated machine is compliant to the regulation and offers safe weaving condition to people who can walk (have no leg disability).

4.8 Discussion

The findings indicate clearly that the inclusive handloom is used to deal with the fundamental ergonomic and accessibility shortcomings of the Ethiopian conventional pit loom. The great

agreement rates in the adjustability, accessibility and leg clearance support the choice to drop pit-based geometry and leg-sensitive treadles. Notably, the spring-free, hand-operated mechanism of the hedge was effective, reliable and less difficult to maintain, which was an advantage in low-resource settings(López 2024).

The conservation of ancient elements of weaving guaranteed that the quality of fabrics, pattern and cultural authenticity had not been lost. This proves that inclusivity and tradition do not have to be mutually exclusive, and they can be effectively merged when the process of the engineering development is carefully considered.

The notable growth in autonomy and drive is in line with inclusive design theory, which focuses on autonomy, dignity, and participation. The research offers empirical data on the relationship between inclusive mechanical design and social and economic empowerment of people with disabilities compared to previous works that were primarily centered on the concept of productivity or the quality of fabric.(Textiles manu, tech, 2022).

CHAPTER FIVE
CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

Based on the concluding findings of this research studies has shown that, through solid empirical and user-based data, fabrication of a system of inclusive handloom, specifically crafted to suit leg-disabled people can effectively remove the long-standing impediments of accessibility to the Ethiopian traditional pit-loom, without in any way compromising the functional, cultural, and aesthetic integrity of the traditional weaving practices. Based on an intensive user-friendly and observation-based design, the study converted the reported ergonomic and functional constraints to a practical engineering solution that will substitute the leg operated treadles with a hand operated heddle system underpinned with elevated and pit free structural arrangement.

The results of the evaluation verify that the created version of creating an inclusive handloom has great advantages in terms of accessibility, usability, and independence by leg-disabled users. The fact that the design is highly suitable in ergonomic terms is evidenced by the high degree of consensus on the design in terms of height adjustability, accessibility, leg clearance, and less physical effort. Notably, most of the subjects were capable of undertaking weaving activities on their own, which is a significant change of the level of dependency and exclusion to that of autonomy and productively spend their time.

Technically, the research study confirms the statement that a spring free, hand operated heddle mechanism is not only possible but beneficial in a low resource setting because it simplifies the mechanical aspects, lowers the maintenance needs and reduces the risks of failure over time. The incorporation of traditional weaving elements was a success that allowed keeping the quality of fabrics, weaving precision, and cultural patterns the same and proved that the inclusive innovation can be applied alongside the preservation of the heritage.

In addition to technical performance, the results demonstrated more general social and economic consequences. There is an indication of increased motivation, confidence and eagerness to participate in the weaving activities, which suggest that inclusive handloom technology will play an important role in restoring livelihoods, dignity and social inclusion of persons with disabilities. The research consequently confirms its main hypothesis that inclusive handloom design has a

positive impact on productivity, participation and well being of leg-disabled persons. In conclusion, the study is a strong, aggregate evidence on the process of inclusive handloom fabrication of leg-disabled individuals community, conduct analysis, choose local material, which is extremely inexpensive and the perform using 3d CAD system, using dimensional analysis and then list a list of equipment and tools to cut, smooth and finish the machine part minimum viable product, then assemble the machine and therefore makes a great contribution to the domains of inclusive engineering design, assistive technology and the conventional systems of textile in Ethiopia.

5.2 Recommendations

As per the result of this research studies, with reference to this machine fabrication aim of various technical institutions and research based suggestions made to increase the impact of the project; user interaction, sustainability and scalability, in this regard, inclusivity in the handloom fabrication technology would be promoted, I would recommend the following points.

- Conduct interactive user workshop programs with the leg-disabled persons to acquire insights and recommendations on the design improvements.
- Teenagers and Vocational Training Institutes (TVTIs) and training centers based in communities must include the inclusive handloom fabrication and operation in their curriculum.
- Organize design competitions whereby designers are invited to develop innovative and accessible handloom solutions, where the usability is put into consideration by the leg-disabled users.
- Sustainable sourcing of cord tree materials Partnering with local artisans Sustainable sourcing of cord tree materials collaboration will ensure good community relations and resources support.
- Establish user training access programs to learn how to operate the handloom and how to weave to meet their requirements.
- Create online video lessons on how to set up a loom and how to use it so that remote learning opportunities can be availed.

- Develop adaptive tools creation that can assist in the authomating of the machine and administration of the yarn and fabric, simplifying the weaving process of people with less mobility.
- Create peer mentorship program relationships between the old weavers and the new ones to share skills and help.
- Facilities: 24/7 add and receive feedback loops by the users and keep on improving the handloom design after their experiences.
- Work with specialists therapists to evaluate the ergonomic design and make it fit the satisfactory needs of users.
- Publicity: Organize awareness programs on the need to become inclusive in matters relating to crafts and sell the handloom to more people.
- Document and keep success stories in form of case studies of the users who have benefited by the fabricated handloom and show how it has helped them in their lives and creativity.
- Create engagements through social media platforms to present user creations and share experiences to create a community around the project.
- Everyone can contribute by encouraging the implementation of fabrication of handloom as part of the curriculum in vocational training programs to enable individuals to have the skills in the future through employment.
- Apply funding or grants to disability initiatives bodies to maintain the sustainability of the project and facilitate its growth.
- Network and build partnership with non-governmental organizations(NGO's) apt in disability rights and inclusion to find a supporter and increase a wider audience.

5.3 Future research

According to the research studies consider this fabrication of handloom machine, any future research methods that have the capacity to largely contribute to the success of the project, promote engagement among users as well as ensuring that it effectively addresses challenges of the leg-disabled and facilitate inclusivity and sustainability can assist this research that are associated with. Participate the leg-disabled in the participatory design process by conducting workshops, making sure that their feedback directly influences the design processes and innovations, Conduct longitudinal or long-term research to observe the effect of the fabrication of the inclusive handloom on the quality of life of the users, and thus make suitable adjustments, Investigate new materials innovation and technologies to improve the lightweight and durability qualities of the handloom, possibly by studying other fibers and composites, Conduct special research focused on the ergonomics of the handloom, and how the various designs can accommodate different leg Pilot design in community environments to test and refine, promote community engagement and participation, Research the economic feasibility of using the inclusive handloom fabrication, explore how it can be used to generate income for users and local craftsmanship, Research the cultural researches importance of handloom weaving in other communities, make sure that the design considers and embraces the local culture and traditions, Research the effectiveness of various programs of training users how to use the handloom, including peer led-training sessions, Research the potential of the design to be produced at scale to bring the inclusive handloom.

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APPENDIX 1

Assessment of handloom need Development of handloom need Questionnaire.

(As it was mentioned in Ethiopian Traditional Leg-Disabled Weaver Case, the weavers were handicapped people, leg-crippled, who can take care of their children despite being handicapped).

Part A: Background Introduction.

Therefore, when making a decision, a person, who is concerned about the matter, must also remember about the scenario that can lead to the emergence of the problem in question.

1. Gender:

   ☐ Male ☐ Female

2. Age group:

☐ 18–30 ☐ 31–45 ☐ 46–60 ☐ Above 60

3. Weaving experience:

   ☐ No experience

   ☐ Less than 1 year

   ☐ 1–5 years

   ☐ More than 5 years

4. Weaving experience: What sort of weaving?

   ☐ Hands Ethiopian traditional hand weaving.

   ☐ Other (specify): _____

Part B: Disability/Mobility.

(Functional, non-medical)

1. Leg disability (self-report):

   ☐ One leg affected

   ☐ Both legs affected

   ☐ Partial lower-limb mobility

   ☐ Immobility of lower limbs.

2. Foot pedal/treadle skills:

   ☐ Fully able

   ☐ Partially able

☐ Unable

3. Used mobility aid (none, current, etc.)

☐ None

☐ Crutches

☐ Wheelchair

☐ Other: _____

Section C: Experience with Pit Traditional Loom Ethiopian.

1. Have you ever been in an Ethiopian traditional pit loom?

☐ Yes ☐ No (If No, skip to Section D)

2. And everything on the worst about the pit loom?

☐ Foot treadles

☐ Sitting posture

☐ Entering/exiting the pit

☐ Maintaining balance

☐ Coordinating legs and hands

3. How do you rate the conventional pit loom, as far as its being available to you is concerned?

☐ Very-bad ☐ Bad ☐ Fair ☐ good ☐ very good.

4. You want somebody to put you on the loom?

☐ Always ☐ Sometimes ☐ Never

5. Weary or physically unhappy of taking the pit loom?

☐ Yes ☐ No

6. Which part of the body is the most affected in case yes?

Legs ☐ Back ☐ Arms ☐ Neck ☐ Multiple areas ☐

Question D: Perceived Problems and Identified Problems.

1. And weaving single minded, what art Cambers?

☐ Foot-operated treadles

☐ Loom height and structure

☐ Sitting position

☐ Safety concerns

☐ Lack of adapted equipment

2. And never have you stopped and evaded toying at evils?

☐ Yes ☐ No

3. In your opinion, the think of the traditional pit loom is:

☐ Completely unsuited in the case of leg-crippled persons.

☐ Draft (Partial and revised or modification).

☐ Suitable without modification or Apposite as such.

Section E: Inclusion Handloom Design Evaluation Requirement.

1. How significant is the abandonment of the employment of legs in the working of handlooms?

None Not important Important Slightly important Essential

2. Wise would I listen him heddle wise?

☐ Hand levers

☐ Hand cranks

☐ Upper-body motion

☐ None No leg activity.

3. And do you think you require a building of more and non-pit filled looms that will aid you in approach and security?

☐ Yes ☐ No ☐ Not sure

4. How can you say then that you are working alone by yourself?

☐ Not important ☐ important ☐ Very important ☐ Essential

5. Do you believe that you are a productive employee at the workplace due to the comprehensive handloom?

☐ Yes ☐ No ☐ Not sure

Section F: Culture and Economic consideration.

1. Will it be otherwise that the new loom will still bear the Ethiopian traditional weaving patterns?

Not important ☐ Important ☐ Very important ☐

2. Would you inform me that you would be working on an adjusted loom since there would be no suggestion on the caliber of fabrics?

☐ Yes ☐ No

3. Do you think inclusive handloom would create additional income earning of the leg-disabled ones?

☐ Yes ☐ No ☐ Not sure

Section G: Open-Ended Questions.

(Qualitative input - very important design)

1. What is the most difficult or hardest to use or strive to use about one of the traditional pit loom?

_____

_____

_____

2. Which aspects would you prefer the most about inclusive handloom?

_____

_____

_____

2. What do you recommend to make weaving more accessible to leg-disabled people in Ethiopia?

_____

_____

_____

APPENDIX 2

Questionnaire



DEPARTMENT OF TEXTILE TECHNOLOGY

Dear Respondent; I am a Master Degree student presently undertaking a survey on the subject matter of handloom fabrication to be used by the leg disabled personnel to manufacture fabric using cord trees produced locally. This survey presents an innovative design concept and production of handloom to give leg-disabled personnel the opportunity to make fabric with the use of the products of the local made cord trees to suit the needs of individuals with leg disabilities. Consequently, your answer is very crucial. Please fill the questionnaire below by responding to the questions correctly and in as few as minutes as possible. Every data collected in this survey is totally confidential and will not be representative of any single respondent. The responses to all the queries will be retrieved together to facilitate in the conclusion analysis of the data presented in this study. As such, no probability of tracking a single respondent on the information. It is not applicable to practice. I would like to thank you, once again, because you took your time to complete the survey. We value your contribution to this study.

Kind Regards,

Alemu Kebede

MA. FDRE technical and vocational training institute, student in Science in textile technology.

Mobil No; +2519-12-38-92-53/+2519-20-98-76-60

INCLUSIVE HANDLOOM USER QUESTIONNAIRE

Instructions | መመሪያ

Please specify the extent to which you agree with the subsequent statements by choosing one of the options.

እባክዎን ከተከታታይ መግለጫዎች ጋር ልክ ምን ያህል እንደሚስማሙ ያመልክቱ።

Scale	Likert Scale
1	**Strongly Disagree** በጣም አልስማማም
2	**Disagree** / አልስማማም
3	**Neutral** / መካከለኛ
4	**Agree** / እስማማለሁ
5	**Strongly Agree** / በጣም እስማማለሁ

SECTION A: Background Information

ክፍል 1 የተሳታፊ መረጃ

Gender/ፆታ

☐ Male / ወንድ ☐ Female / ሴት

Age/እድሜ

☐ 18–30 ☐ 31–40 ☐ 41–50 ☐ Above 50 / ከ50 በላይ

Type of Walking Disability | የእንቅስቃሴ ጉዳት አይነት

☐ Wheelchair user / ዊልቸር

☐ Crutch or cane user / ክራች

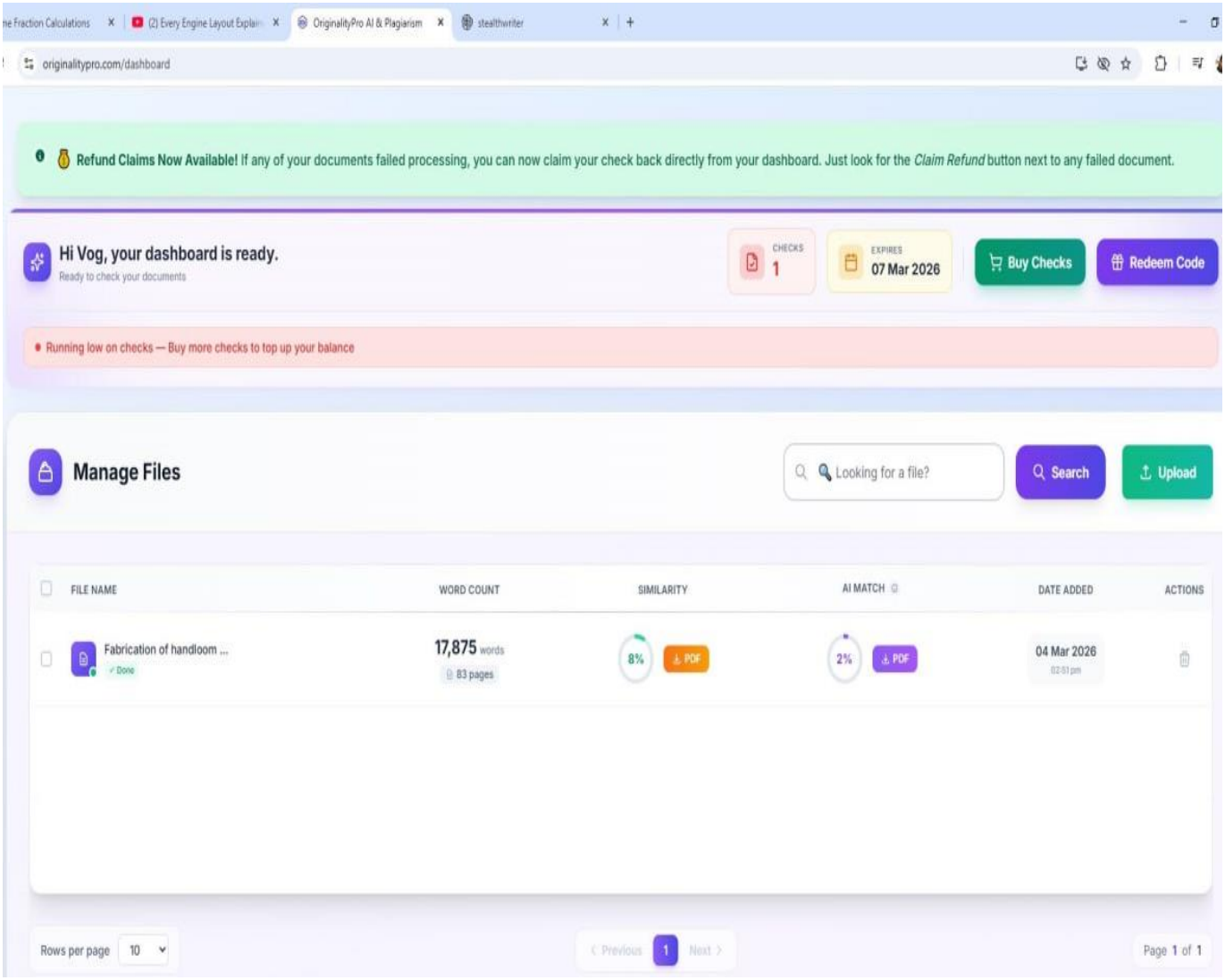
☐ Limited mobility / ዝቅተኛ እንቅስቃሴ

No	SECTION B: Ergonomic Design Features	Likert Scale					
		1	2	3	4	5	Remark
1	The height of the handloom is adjustable to my physical status. የመሸመኛው ቁመት ከአካላዊ ሁኔታዬ ጋር ይስማማል።						
2	Access to the shuttle route does not require overstretching or leaning. የሹትል መንገድ በቀላሉ ተደራሽ ነው እና ብዙ መግለል አያስፈልግም።						

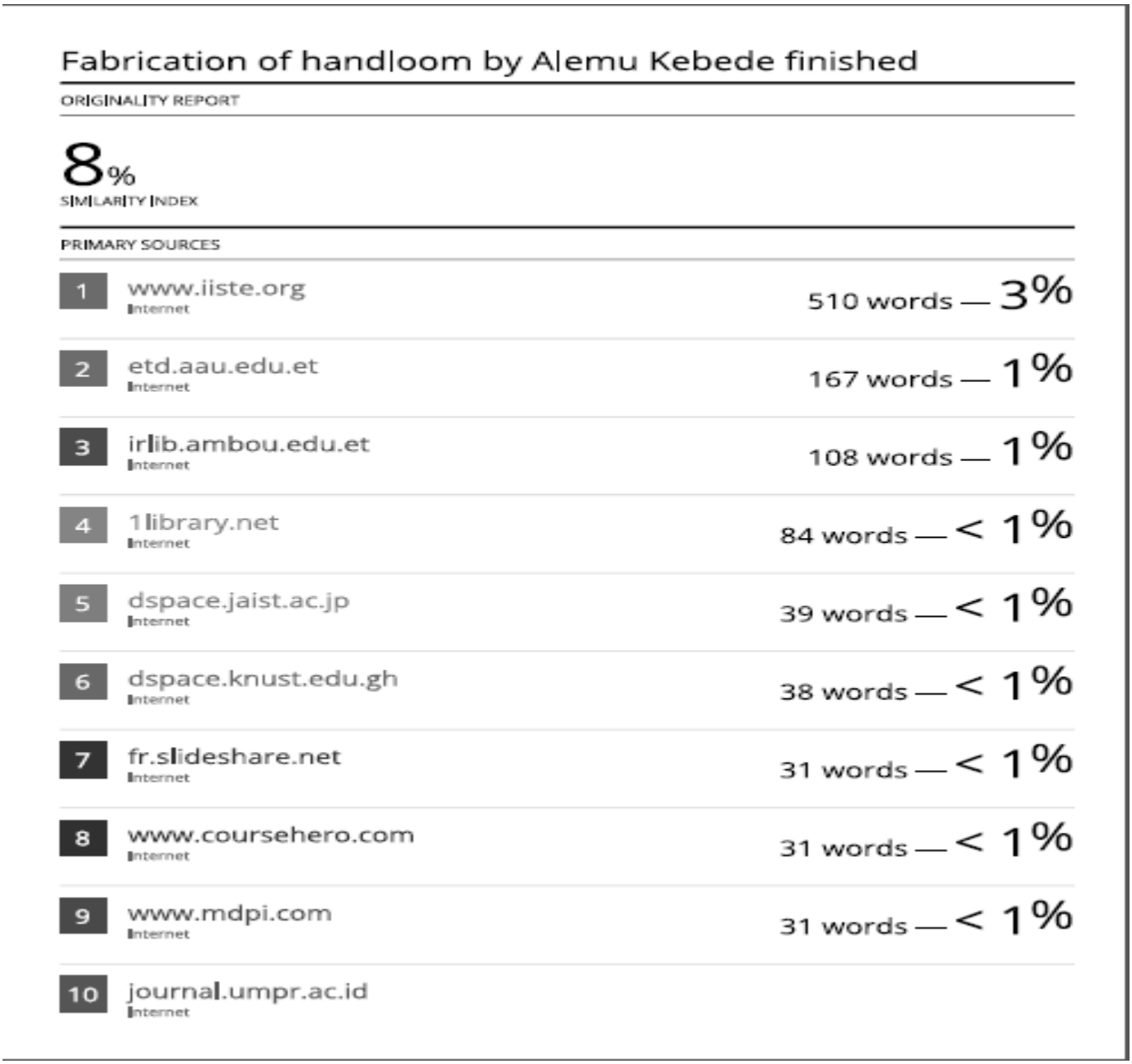
3	During weaving, the leg-clearance space is quite comfortable. የእግር ቦታው በምርት ወቅት ምቾት ይሰጣል።						
SECTION C: Usability and Performance **ክፍል 3 አጠቃቀምና አፈፃፀም**							
1	I am able to accomplish weaving without much physical effort. የምርት ስራዬን ከዚህ በፊት በነበረው አካላዊ ጫና በታች እጠናቀቃለሁ።						
2	The handloom minimises the possibility of committing any weaving errors. ማሽኑ በስራ ውስጥ ስህተቶችን ይቀንሳል።						
3	I am able to work the handloom without any help. ያለ እገዛ ራሴ በራሴ ማሽኑን መጠቀም እችላለሁ።						
SECTION D: Training and User Support **ክፍል 4 ስልጠናና ድጋፍ**							
1	The training was also useful to make me operate the handloom with confidence. የተሰጠው ስልጠና ማሽኑን በእምነት መጠቀም እንደምችል ረድቶኛል።						
2	The application of the inclusive handloom makes me work harder. ይህ አካታች ማሽን የስራ ሙያዬን ያበረታታኛል።						
SECTION E: Overall Inclusiveness **ክፍል 5 አጠቃላይ አካታችነት**							
3	Its handloom design helps me because I have mobility issues. የማሽኑ ዲዛይን የእኔን የእንቅስቃሴ ገደቦች ያካትታል።						

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