

**A FRAMEWORK DEVELOPED USING
ERGONOMIC PRINCIPLES AND MODIFIED
PRE-DETERMINED MOTION TIME SYSTEMS
(PMTS) TO INCREASE THE OPPORTUNITIES FOR
PHYSICALLY DISABLED POPULATION
TO WORK IN INDUSTRY**

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Declaration

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Abstract

One billion of the world population are estimated to have some form of disability, and governments spend huge amounts of money to provide welfare facilities to protect their rights and make them inclusive. The literature reveals that people with disabilities (PWDs) are willing to work if they are provided with necessary job support. People with only mobility impairments are commonly named as people with physical disabilities (PPDs). It is a subset of PWDs. PPDs can effectively contribute towards economic growth if their residual physical capabilities are correctly identified. However, employers as well as PPDs themselves find it difficult to identify their residual physical capabilities. Work norms explained in Pre-Determined Motion Time Systems (PMTS) such as Method Time Measurement (MTM) is present for the normal people. These work norms assume that the people have normal capabilities and that they do not have any physical disability. However, there are no such work norms developed to cater for the PPDs. Therefore, the aim of the research was to develop a framework to increase the ability of PPDs to work in industry. The objectives were to explore typical manual work-activities (WAs) similar to those prescribed in PMTS that could potentially be carried out by PPDs, with their residual physical capabilities, explore essential range of movement (RM) of each of the body regions/joints required to perform the identified WAs, formulate a framework mapping RMs of each body regions/joints required to perform typical manual WAs and finally to evaluate and validate it for its purpose, user-friendliness and functionality.

In this pursuit, research was carried out in five distinct phases. In the first phase, typical manual WAs were identified that can be performed by upper and lower extremities using industrial engineering experts (n=3). Then, essential RM of each body region/joint required to perform the identified WAs were determined using relevant medical experts (n=9). Orthopaedic surgeons (n=4) then mapped the RMs that are needed to carry out the WAs to form a framework. These three phases used a modified delphi approach for data collection. In the fourth phase, the framework was evaluated for its purpose and user-friendliness by the intended users of the framework (n=22) in different industries. In the fifth and final study, the functionality of the framework was evaluated with PPDs (n=92) and mapped the work capability of a randomly selected sample of PPDs (n=6) using the framework. The results were compared against the WAs that they were engaged in at the time of the study. The developed guide was named as the WARM mapping tool. Ethical clearance was granted from the Medical Research Institute (MRI), Sri Lanka to carry out the study.

This research proposes a novel philosophical work-related capability and limitations analysis tool to help employ PPDs by identifying suitable WAs based on the degree of disability of the body regions/joints in terms of the corresponding RMs. It is a step towards extending the work norms for PPDs. WARM mapping tool has been developed to guide the employers to recruit PPDs to carryout physical work tasks. All that participated in the usability study proved that it is a convenient and simple tool to use. All 22 practitioners also said that it can also be used as a self-assessment tool by the PPDs. The usability was rated over 60% by all the participants. This tool may be used as a platform to decide on the equipment, facilities, procedures and training that the PPDs will need for effective performance in industry.

Keywords: People with Physical Disabilities, motion capability, employment, PMTS

Dedication

My Grandparents, in memorium,
my parents, Milton Wijewickrama and Bhadra Wijewickrama, in memorium,
and my teachers
in appreciation of sacrifices they had made for me
and
for all who have been sharing their life with me.

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List of Abbreviations

AADL	Advanced Activities of Daily Living
ADA	Americans with Disability Act
ADL	Activities of Daily Living
AHP	Analytical Hierarchy Process
BADL	Basic Activities of Daily Living
CMJ	Metacarpophalangeal joint
DGHC	Director General of Health Services
DIPJ	Distal Interphalangeal Joint
DMS	Dimensional Motion Times
FRCS	Fellows of the Royal College Surgeons
GSD	General Sewing Data
IPJ	Interphalangeal Joint
MBBS	Bachelor of Medicine Degree
MECA	Microcomputer Evaluation of Careers & Academics
MMH	Manual Materials Handling
MRI	Medical Research Institute
MS	Masters' Degrees
MTA	Method Time Analysis
MTM	Motion and Time Measurement
MTS	Method Time Standards
P and O's	Prosthetists and Orthotists
PCS	Physical Capability Study
PIPJ	Proximal Interphalangeal Joint
PMTS	Pre-Determined Motion Time Systems
PPDs	People with Physical Disabilities
PWDs	People with Disabilities
RM	Range of Movement
ROM	Ranges of Motion
REBA	Rapid Entire Body Assessment
RULA	Rapid Upper Limb Ass
SAH	Standard Allocated Hours
SLSPO	Sri Lanka School of Prosthetists and Orthotist
SLMA	Sri Lanka Medical Association
SLMC	Sri Lanka Medical Council
SLOA	Sri Lanka Orthopaedic Associatio
SMV	Standard Minute Value
WA	Work-Activities
WMSD	Work-related Musculoskeletal Disorders

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