

## Simple Arm Muscle Model for Oil Palm Harvesting Process

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**Abstract.** Arm are essential in order to perform manual material handling work that normally involves lifting, handling, placing, push and pull, carrying and moving heavy loads. When these work elements are performed over prolonged periods repeatedly, it will expose workers arm to awkward posture and possible ergonomic risk factor. For example, work element that requires repetitions frequently may lead the arm to face physical stress and mental fatigue. The situation can be extremely risky if the worker task requires higher focus or time consumable. These issues are unavoidable in palm oil harvesting process since the workers are still using manual handling when harvesting the fresh fruit bunch (FFB). The worker using a chisel to harvest the young palms and a sickle mounted on a bamboo or aluminum pole to harvest taller palms. When perform this work element combining with heavy physical workload, it may lead to work-related muscle disorders (WSMDs). This study was conducted to identify the force reaction and inverse dynamic analysis during oil palm harvesting process using ergonomics software called Anybody Technology. Inverse dynamic analysis is a technique for figuring strengths and/or moments of power (torques) taking into account the kinematics (movement) of a body and the body's inertial properties.

### 1 Introduction

Arm are essential in order to perform manual material handling work that normally involves lifting, handling, placing, push and pull, carrying and moving heavy loads [1]. Tasks that require forceful exertions place higher loads on the muscles, tendons and joints of arm. Increasing the force means increasing the body demands such as higher muscle exertion. The weight and height of a load that has to be lifted and the frequency of lifting are the factors that will contribute to the level of exertion on the muscles and joints of the arm.

In addition, when these work elements are performed over prolonged periods and repeatedly, it will expose the arm to awkward posture and possible ergonomics risk factor. For example, work element that requires repetitions frequently may cause physical stress on the arm and also mental fatigue. This situation can be extremely risky if the worker task requires higher focus and time consumable.

This issues are unavoidable in palm oil harvesting process due to the workers are still using manual handling when they harvest the fresh fruit bunch (FFB)[2]. In spite of the fact that there have been a few improvements and interventions have been done on the harvesting tools, the estate are still utilizing the manual tools and depending on the labor strength. The worker is still using a chisel to harvest the palms that are reachable and a sickle that is mounted to or aluminum pole to harvest taller palms.

This work element is causing heavy physical workload to the workers and it may lead to work-related muscle disorders (WSMDs). This may contribute to awkward posture that leads to fatigue discomfort and injury. There are some assessment that has been done to

investigate the posture and possible risk of the worker when using the palm oil harvesting tools. Rapid Entire Body Assessment REBA [3], Rapid Upper Limb Analysis RULA [4] and Quick Exposure Check QEC [5] are some of the techniques used to determine the possible musculoskeletal risk.

REBA techniques are used to investigate the possible risk of the entire body sections for example trunk, wrists, arms and legs. It is a worksheet of survey for whole body movement based on the task of palm oil harvesting process [6]. RULA technique is focusing on the posture of worker.

RULA analysis focuses on time cycle, number of movements, static muscle force and the working posture. These factors will be analyses and resulted in the form of score with the range of 1-7. QEC is a technique used to determine the possible of musculoskeletal disorder. It focuses on four main section of human body which is back bone, shoulder/hand, wrist/arm and neck. This technique also include the psychosocial factor evaluation, the movement and it frequency.

The objective of this paper is focusing on identifying the length of contraction of arm muscle and the reaction force throughout the movement of arm through Inverse Dynamic Analysis. It is a technique for figuring strengths and/or moments of power (torques) taking into account the kinematics (movement) of a body and the body's inertial properties (mass and moment of inactivity).

In this research, the AnyBody Modelling System programming is utilized. AnyBody is an intense devices that immeasurably utilized by examination foundations to recreate the musculoskeletal. It empowers analysts and understudies to assemble and investigate musculoskeletal model, or to make adjustments of existing models.

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