# E-PROCEEDINGS

# INTERNATIONAL TINKER INNOVATION & ENTREPRENEURSHIP CHALLENGE ( i-TIEC 2025)

"Fostering a Culture of Innovation and Entrepreneurial Excellence"


**23 January 2025**
**PTDI, UiTM Cawangan Johor**
**Kampus Pasir Gudang**

**ORGANIZED BY:**

Electrical Engineering Studies, College of Engineering
Universiti Teknologi MARA (UiTM) Cawangan Johor
Kampus Pasir Gudang
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## PREFACE

It is with great pleasure that we present the e-proceedings of International Tinker Innovation & Entrepreneurship Challenge (i-TIEC 2025), which compiles the extended abstracts submitted to the International Tinker Innovation & Entrepreneurship Challenge (i-TIEC 2025), held on 23 January 2025 at **PTDI, Universiti Teknologi MARA (UiTM) Cawangan Johor, Kampus Pasir Gudang.** This publication serves as a valuable resource, showcasing the intellectual contributions on the invention and innovation among students, academics, researchers, and professionals.

The International Tinker Innovation & Entrepreneurship Challenge (i-TIEC 2025), organized under the theme "Fostering a Culture of Innovation and Entrepreneurial Excellence," is designed to inspire participants at various academic levels, from secondary students to higher education students and professionals. The competition emphasizes both innovation and entrepreneurship, encouraging the development of product prototypes that address real-world problems and have clear commercialization potential. By focusing on technological and social innovations, i-TIEC 2025 highlights the importance of turning creative ideas into viable, market-ready solutions that can benefit users and society. The extended abstracts in this e-proceedings book showcase the diverse perspectives and depth of research presented during the event, reflecting the strong entrepreneurial element at its core.

We extend our sincere gratitude to the contributors for their dedication in sharing their innovation and the organizing committee for their hard work in ensuring the success of the event and this publication. We also appreciate the support of our collaborators; Mass Rapid Transit Corporation Sdn. Bhd. (MRT Corp), Universitas Labuhanbatu, Indonesia (ULB), Universitas Riau Kepulauan, Indonesia (UNRIKA) and IEEE Young Professionals Malaysia, whose contributions have been instrumental in making this event and publication possible.

We hope that this e-proceedings book will serve as a valuable reference for researchers, educators, and practitioners, inspiring further studies and collaborations in both innovation and entrepreneurship. May the knowledge shared here continue to spark new ideas and market-ready solutions, advancing our collective expertise and fostering the growth of entrepreneurial ventures.

**B-ST010 - B-ST152**

# B-ST025: ERGO OPTIMA WORKSTATION FOR TERTIARY EDUCATION

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## ABSTRACT

This study investigates the ergonomic efficiency of seating workstations in tertiary education settings by utilizing the Rapid Upper Limb Assessment (RULA) method. The research evaluates the ergonomic risks associated with prolonged sitting and proposes data-driven solutions to enhance workstation design. Prolonged sedentary behavior among students has been linked to musculoskeletal discomfort and health issues, adversely affecting academic performance and well-being. To address this, the study incorporates a systematic approach by estimating a range of human sitting postures, using a detailed manikin model in CATIA for simulation, and calculating RULA scores to identify ergonomic inefficiencies in seating workstations. The study combines advanced simulation tools and ergonomic assessment techniques to provide precise insights into posture-related risks. Its unique focus on integrating technology with ergonomic assessment ensures actionable recommendations tailored for educational institutions. By improving ergonomic workstation designs, the research can enhance student comfort, reduce the prevalence of musculoskeletal disorders, and foster a healthier learning environment. The resulting improvements in academic performance and well-being can contribute to a more productive and engaged workforce in the long term. The findings offer significant potential for commercialization by guiding the design and manufacturing of ergonomic furniture specifically tailored for educational institutions. This opens opportunities for partnerships with furniture manufacturers and institutions aiming to invest in ergonomic infrastructure.

**Keywords:** Ergonomics, Optimized seating workstations, RULA analysis, Tertiary education, Student comfort

## 1. Product Description

The Optimized Ergonomic Seating Workstation is a scientifically designed solution tailored to enhance sitting comfort and minimize sitting and musculoskeletal discomfort for tertiary students. Developed through rigorous analysis using the Rapid Upper Limb Assessment (RULA) method and advanced simulation in CATIA, this workstation integrates adjustable parameters to cater to diverse anthropometric needs, particularly for the Asian demographic amongst tertiary students.

2. **Key Features Include:**
    - Adjustable Height Parameters: The workstation includes an adjustable chair and table heights to accommodate varying anthropometric needs, ensuring proper posture and spinal alignment.
    - Ergonomic Support: Engineered to minimize strain on the neck, trunk, and upper limbs, promoting long-term sitting comfort.
    - Asian Demographic Fit: Designed based on anthropometric data specific to the Asian tertiary student population for precise ergonomic compatibility.
    - Enhanced Stability and Durability: Built with high-quality materials, suitable for extensive daily use in educational environments.
    - Evidence-Based Design: Developed through computational simulations and multi-parametric analysis to optimize seating comfort and reduce musculoskeletal risks.

## Problem Statement

Prolonged sedentary behavior among students in tertiary education institutions has been linked to musculoskeletal discomfort and long-term health issues, negatively impacting academic performance and overall well-being. Existing seating workstations often fail to meet ergonomic standards, contributing to poor posture and increased ergonomic risks. Despite the growing awareness of these issues, there is limited research leveraging advanced simulation tools and ergonomic assessment techniques to systematically evaluate and address workstation design inefficiencies in educational settings.

## Objectives

This study aims to assess the ergonomic efficiency of seating workstations in tertiary education institutions using the Rapid Upper Limb Assessment (RULA) method. By simulating a range of human sitting postures with a detailed manikin model in CATIA, the research seeks to identify ergonomic inefficiencies and calculate RULA scores. The ultimate goal is to propose data-driven solutions for improving workstation designs, enhancing student comfort, minimizing the prevalence of musculoskeletal disorders, and fostering a healthier, more productive learning environment.

## 2. Workstation Set-up and Optimized Outcome

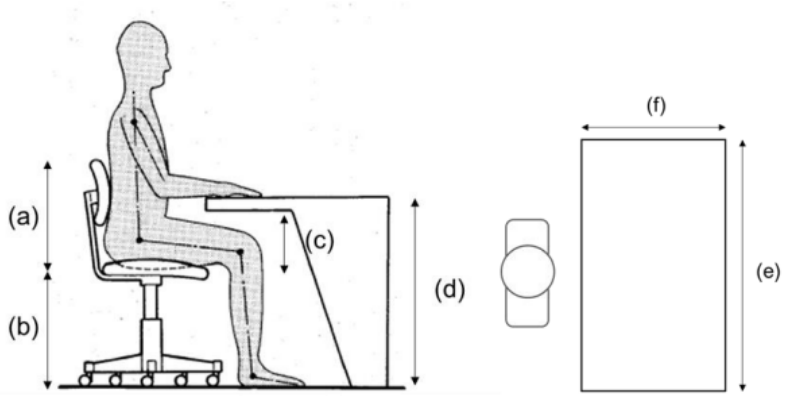


**Figure 1.** Measurement parameter for the workstation

**Table 1** Parameters of the workstation measured in milimetre

| *No.* | *Dimension* | *Workstation* |
|---|---|---|
| ***(a)*** | Back Support Height | 400 |
| ***(b)*** | Chair Height | 450 |
| ***(c)*** | Leg Clearance | 300 |
| ***(d)*** | Table Height | 710 |
| ***(e)*** | Table Length | 1400 |
| ***(f)*** | Table Width | 900 |

The project requires a range of data for modelling, simulation, and analysis which are obtained from a combination of physical measurements and literature reading. The selected workstation for analysis is based upon a standard tertiary education set up. The sample parameters shows the sizes of the tables and the configuration of seats. The dimensions of the table and chair as illustrated in **Figure 1** and **Table 1** was taken by using a measuring. The original height of the table and the chair is also recorded but for the simulation, the heights will change for each experiment according to the appropriate range of table and chair height.

The optimized workstation in **Figure 2** has the lowest overall RULA score of 3. This shows that the combination of physical parameters and workstation height with the values generated offer the most comfortable sitting posture for the user. **Table 2** displays the parametric values for all 9 parameters studied. Prolonged exposure to scores in the **moderate-to-high range (4-7)** may lead to musculoskeletal strain, particularly in the neck, shoulders, or back, commonly reported by students during extended study periods. It is to be noted that no fully safe scores were achieved in this study.

**Table 2** Parameters value for the optimized workstation

| No | Lumbar Flexion (0° to 20°) | | Lumbar Twist (-10° to 10°) | | Head Flexion (7° to 23°) | | Head Rotation (-43° to 41°) | |
|---|---|---|---|---|---|---|---|---|
| | LHS | Angle | LHS | Angle | LHS | Angle | LHS | Angle |
| 11 | 0.2342 | 4.684 | 0.5071 | 0.142 | 0.7780 | 19.448 | 0.3777 | -11.273 |

| Clavicular Flexion/Extension (-8° to 23°) | | Arm Abduction (0° to 20°) | | Forearm Pronation (140° to 160°) | |
|---|---|---|---|---|---|
| LHS | Angle | LHS | Angle | LHS | Angle |
| 0.9038 | 20.0178 | 0.2945 | 5.89 | 0.2666 | 145.532 |

| Table Height (710mm to 760mm) | | Chair Height (450mm to 500mm) | |
|---|---|---|---|
| LHS | Height | LHS | Height |
| 0.6965 | 748.225 | 0.3690 | 468.45 |

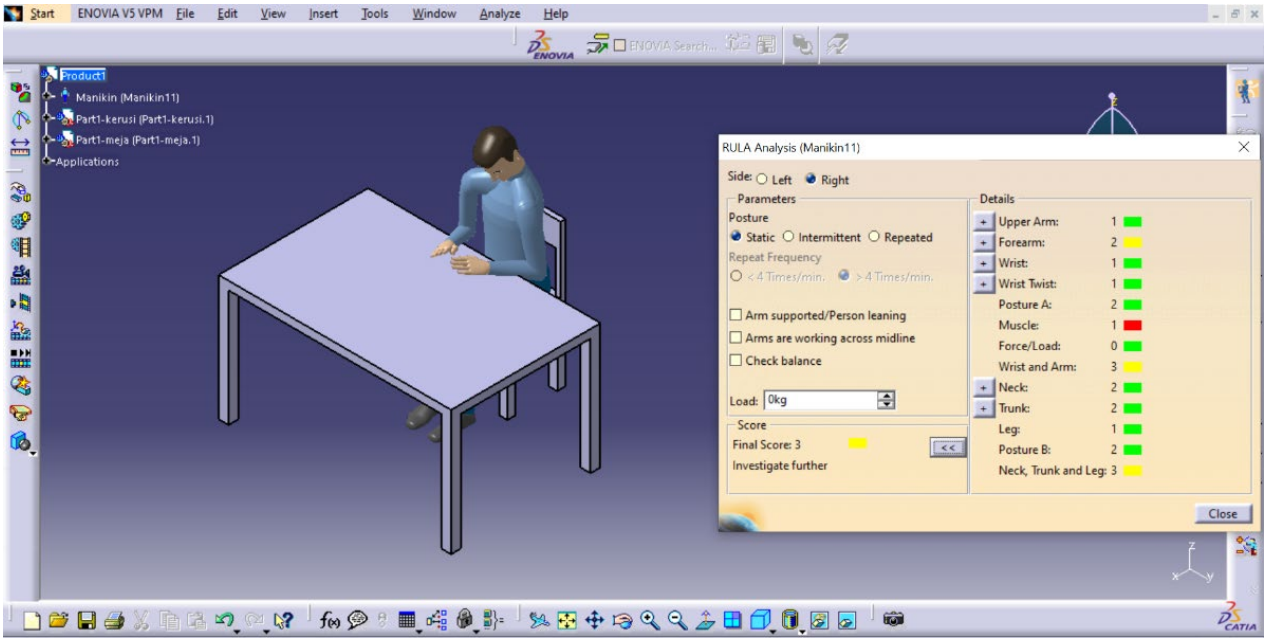


**Figure 2.** RULA analysis on the optimized workstation

## 3. Novelty and uniqueness

This research stands out by employing a multi-parametric approach to optimize seating workstation designs, specifically tailored for tertiary students in educational settings. Unlike previous studies that focus on general ergonomic principles, this work integrates anthropometric data unique to the Asian demographic, providing a region-specific solution to ergonomic challenges. The novelty lies in the combination of Rapid Upper Limb Assessment (RULA) with advanced simulations in CATIA software to analyze and evaluate human postures across a wide range of workstation configurations. This dual-method approach enables precise identification of critical ergonomic risks, such as poor neck and trunk posture, and the development of adjustable workstation designs to address these issues. The study's use of Latin Hypercube Sampling (LHS) for generating random yet systematic parametric combinations is unique, allowing comprehensive exploration of various posture and design interactions. This robust methodology ensures a well-rounded analysis of ergonomic effectiveness. By focusing on educational environments, the research introduces a practical solution that not only enhances student comfort but also improves focus, productivity, and overall academic performance. Its emphasis on adjustable furniture height parameters provides a scalable and customizable design, ensuring widespread applicability in both institutional and home-based study setups.

## 4. Benefit to mankind

This work offers significant benefits by addressing the ergonomic challenges associated with prolonged sitting in tertiary education settings. By optimizing seating workstation designs, the research improves sitting comfort, reduces musculoskeletal discomfort, and minimizes the risk of long-term health issues such as back pain and work-related musculoskeletal disorders (WMSDs). For students, the improved ergonomic design enhances focus and productivity, leading to better academic performance and overall well-being. The incorporation of adjustable workstation parameters ensures inclusivity, accommodating diverse anthropometric needs across populations, particularly for the Asian demographic. The findings also have broader societal implications by promoting healthier learning environments in educational institutions and reducing healthcare costs related to posture-related issues. Additionally, the research encourages awareness of proper posture and ergonomic design, fostering a culture of health-consciousness that can extend to workplaces and homes, thereby improving quality of life for future generations.

## 5. Innovation and Entrepreneurial Impact

This project fosters innovation by integrating advanced ergonomic assessment tools like Rapid Upper Limb Assessment (RULA) with cutting-edge simulation technology in CATIA, offering a novel approach to optimizing workstation designs. The use of anthropometric data specific to the Asian demographic exemplifies user-centric design tailored to underserved populations, setting a benchmark for region-specific ergonomic solutions. By addressing real-world challenges faced by students, the research creates opportunities for developing customizable and scalable ergonomic furniture. This drives entrepreneurship by encouraging partnerships between educational institutions, furniture manufacturers, and ergonomic solution providers to commercialize the designs. The project inspires a culture of

innovation within the institution by showcasing how multidisciplinary research can lead to practical, market-ready products. It also emphasizes the importance of health-focused design in the furniture industry, motivating entrepreneurs to prioritize user well-being while meeting market demands, ultimately contributing to a healthier and more productive community.

## 6. Potential commercialization

This research presents significant commercialization opportunities in the ergonomic furniture market, particularly for educational institutions and home study setups. The development of adjustable seating workstations, tailored to the anthropometric needs of tertiary students, offers a unique selling point by addressing the growing demand for health-conscious, student-specific furniture. Manufacturers can leverage research findings to design and produce ergonomic chairs and tables that reduce musculoskeletal risks, enhancing comfort and productivity. The customizable features based on user height and posture parameters make these workstations suitable for diverse populations, increasing their market appeal. Educational institutions, co-working spaces, and furniture retailers represent primary markets for these products, while home-based learning setups further expand their scope. Collaborations between universities and industry partners can drive the commercialization process, enabling large-scale production and adoption of ergonomically optimized furniture, thus contributing to a healthier and more efficient learning environment worldwide.

## 7. Acknowledgment

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## 8. Authors' Biography

Ir. Ts. Dr. Kausalyah Venkatason is a Senior Lecturer in the Faculty of Mechanical Engineering at Universiti Teknologi MARA (UiTM), Malaysia. With over 20 years of academic and research experience, she specializes in structural dynamics, finite element analysis, and engineering optimization. Dr. Kausalyah has led numerous industrial and academic projects, focusing on vehicle crash dynamics and pedestrian safety. Her expertise extends to CAD/CAM/CAE applications, statistical methods, ergonomics and engineering education. A prolific researcher, she has published widely in Scopus-indexed journals and conferences, earning recognition through awards such as Best Presenter and Best Paper at international events.

Assoc Prof Ir. Dr. Shasthri Sivaguru is an accomplished mechanical engineer with a Ph.D. in Mechanical Engineering from the International Islamic University, Malaysia (2015). With over two decades of academic and professional experience, he is serving as the Program Director in Mechanical Engineering at Heriot Watt University Malaysia. He has contributed to areas such as crash analysis, materials engineering, and design optimization. A Senior Member of IRED, he has published extensively in peer-reviewed journals and participated in international conferences. Dr. Shasthri is also an award-winning researcher, recognized for his contributions to engineering science and education.