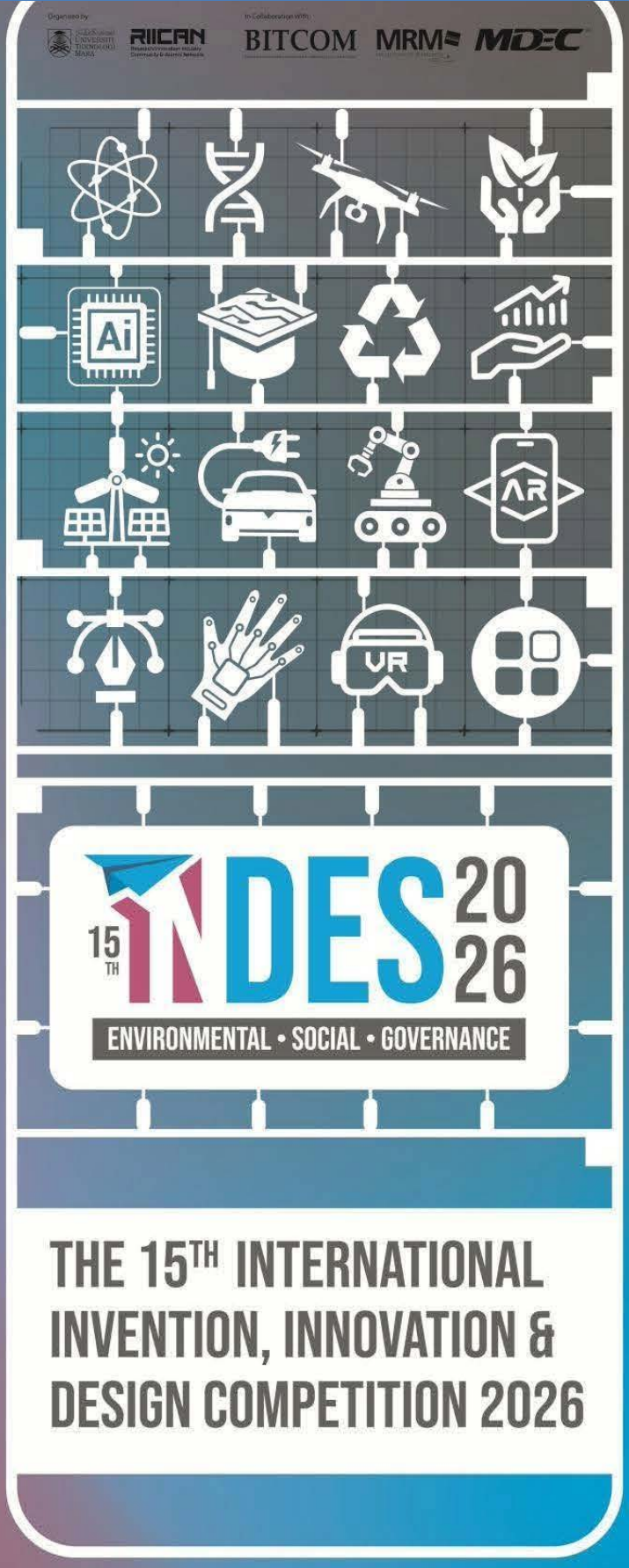


E-BOOK OF

EXTENDED ABSTRACT

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THE 15th INTERNATIONAL
INVENTION, INNOVATION &
DESIGN COMPETITION 2026

Organized by:
Office of Research, Industry,
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FOLD FURNITURE: LEVERAGING LOCAL CULTURAL WISDOM AS THE ROOT OF SUSTAINABLE FURNITURE DESIGN

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ABSTRACT

This research develops a folding furniture system based on Indonesian local wisdom, specifically the "dingklik" tradition, into a universal stool product that is ergonomic, culturally inclusive, and lowcarbon. This innovation integrates three material approaches: (1) structural frames from FSC-certified wood offcuts, (2) composite panels from industrial and household plastic waste, and (3) filler components from local wood industry waste (sawdust, wood shavings, offcuts). Using the Engineering Design Process methodology and comparative Life Cycle Assessment (LCA) in accordance with ISO 14040/14044, the study demonstrates that fold furniture reduces carbon dioxide equivalent (CO2e) emissions by 49.3% per unit compared to conventional furniture from 127.0 kg CO2e to 64.4 kg CO2e with the most significant savings occurring in the distribution (65.6%) and raw material extraction phases (58.6%).The folding system reduces shipping volume by 65%, making this product highly relevant for e-commerce distribution, remote rural areas, and space-sensitive Asian urban markets.

Keyword: fold furniture, dingklik, local wisdom, plastic waste, wood industry waste, Life Cycle Assessment, circular economy

1. INTRODUCTION

The Indonesian furniture industry faces two interconnected structural pressures: (1) high distribution costs due to inefficient conventional furniture volumes, and (2) the dual crisis of plastic and wood industry waste. Indonesia generates 4.22 million tons of plastic waste annually (SWITCH-Asia, 2024), of which only 10% is formally recycled (Budhijanto et al., 2024). Fold furniture offers an integrated solution: a folding design system that reduces shipping volume by 65% while integrating industrial waste as primary materials within a circular economy framework.

1.1 Local Cultural Foundation and Sustainability Values

The tradition of using low seating such as "dingklik" reflects principles of efficient living, space-saving, and minimal material excess, closely aligning with sustainable design.

1.2 Dingklik Transformation: An Asian Cultural Archetype

In this study, the dingklik is transformed into a universal modern stool designed for all Asian user groups, from children to the elderly. This low-seating principle elevates a cultural archetype resonant across Asia, similar to the traditions of jwa-sik (Korea), tabouret (Japan), and the perforated stool (Southeast Asia). The integration of a precision folding mechanism allows for a transformation from traditional seating postures to minimalist vertical storage (8 cm), relevant for space-sensitive Asian urban dwellings.

2. METHODOLOGY

The design utilizes the Engineering Design Process (EDP) extended with Life Cycle Assessment (LCA) components based on ISO 14040/14044 standards (Ulrich, & Eppinger, 2015).

2.1 Needs Analysis and Cultural Mapping

Identification of ergonomic parameters through anthropometric surveys of Asian users (n=120) and ethnographic studies of traditional furniture in Java, Bali, and Kalimantan.

2.2 Exploration of Folding Joint Systems

Prototyping folding joints based on wood offcut frames with a tolerance of ±0.5 mm and fatigue testing for >5,000 cycles.

2.3 Dual Waste Material Processing

Formulation of composite panels from a mixture of HDPE/PP waste (60%) and sawdust (40%) via compression moulding at 180°C.

2.4 Comparative Life Cycle Assessment

Cradle-to-graveanalysis using the Ecoinvent 3.9 database to compare extraction, manufacturing, distribution, usage, and End-of-Life (EoL) phases.

3. FINDINGS

The comparative environmental impact values are systematized in Table 1.

Table 1 Comparison of CO2e Emissions per Unit: Conventional vs. Fold Furniture

LCA Phase	Conv. (kg CO2e)	Fold (kg CO2e)	Reduction (%)
1. Raw Material Extraction	45.2	18.7	58.6%
2. Manufacturing & Production	32.8	22.4	31.7%
3. Distribution & Logistics	28.5	9.8	65.6%
4. Use & Maintenance	12.1	11.4	5.8%
5. End-of-Life (EoL)	8.4	2.1	75.0%
TOTAL	**127.0**	**64.4**	**49.3%**

3.1 Material Innovation: Wood Industry Waste Integration

Integration of wood waste increases panel flexural stiffness by 23% and absorbs 15–20 kg of wood waste per unit. Figure 1 illustrates the accumulated raw wood waste from a furniture factory in the Surakarta

region of Central Java, Indonesia, which serves as the primary source material for the structural frames.



Figure 1. Accumulated Raw Wood Waste From A Furniture Factory In The Surakarta Region of Central Java, Indonesia

3.2 Dingklik Universal Stool Performance

The resulting prototype achieves a static load capacity of 150 kg (under EN 12520 testing standards), features a net weight of 3.2 kg, and maintains folded dimensions of 42 40 X 12cm.



Figure 2. Prototype

4. CONCLUSION

Fold furniture demonstrates that Indonesian local wisdom can be transformed into a globally relevant product. The 49.3% reduction in CO2e emissions per unit provides a strong quantitative foundation for the low-carbon furniture industry.

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