

Teaching LCA as Systems Thinking

Helping Learners Understand Trade-Offs

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LCA teaching should move learners from “impact numbers” to “systems decisions”

A result is only useful when learners understand the assumptions, boundaries, and consequences behind it.

LCA as evidence

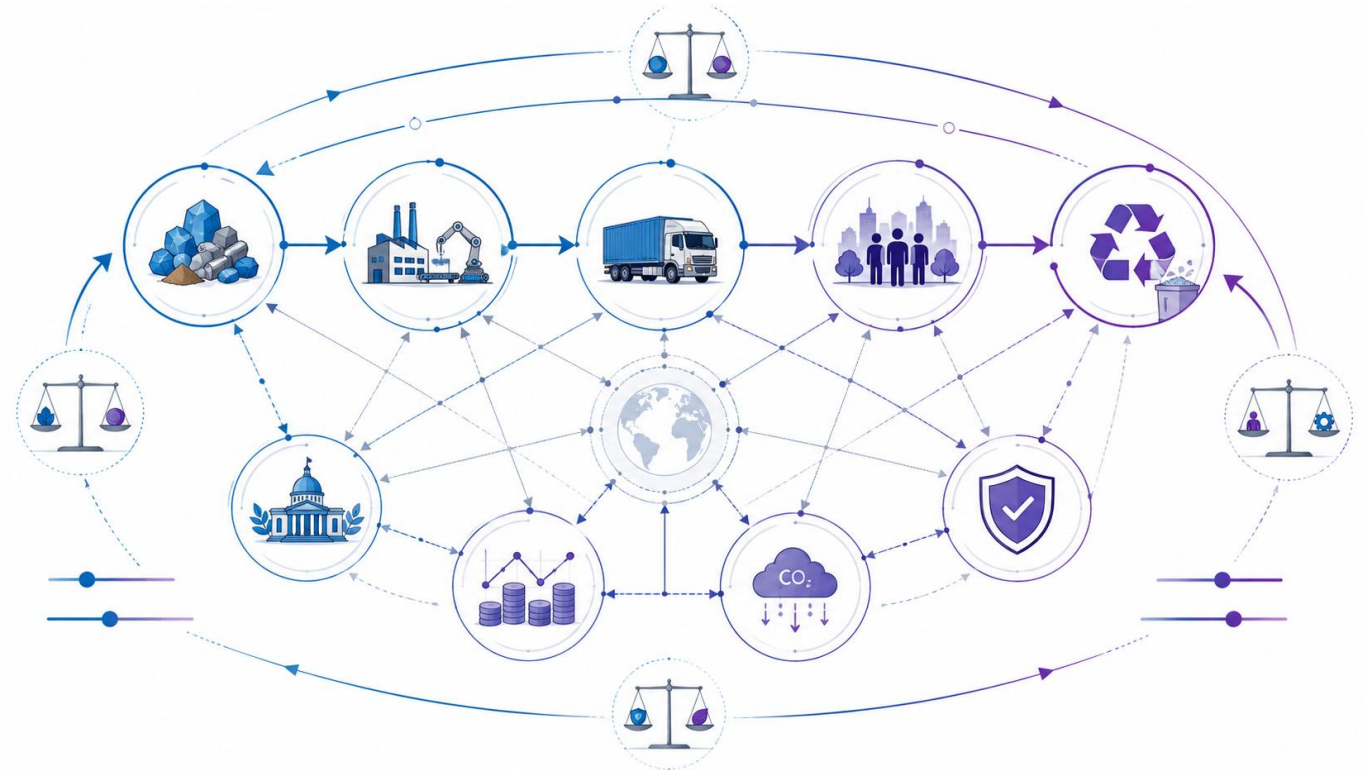
Quantifies impacts across life-cycle stages, not just at the point of use.

Systems thinking as interpretation

Makes visible feedback, boundaries, delayed effects, and shifting burdens.

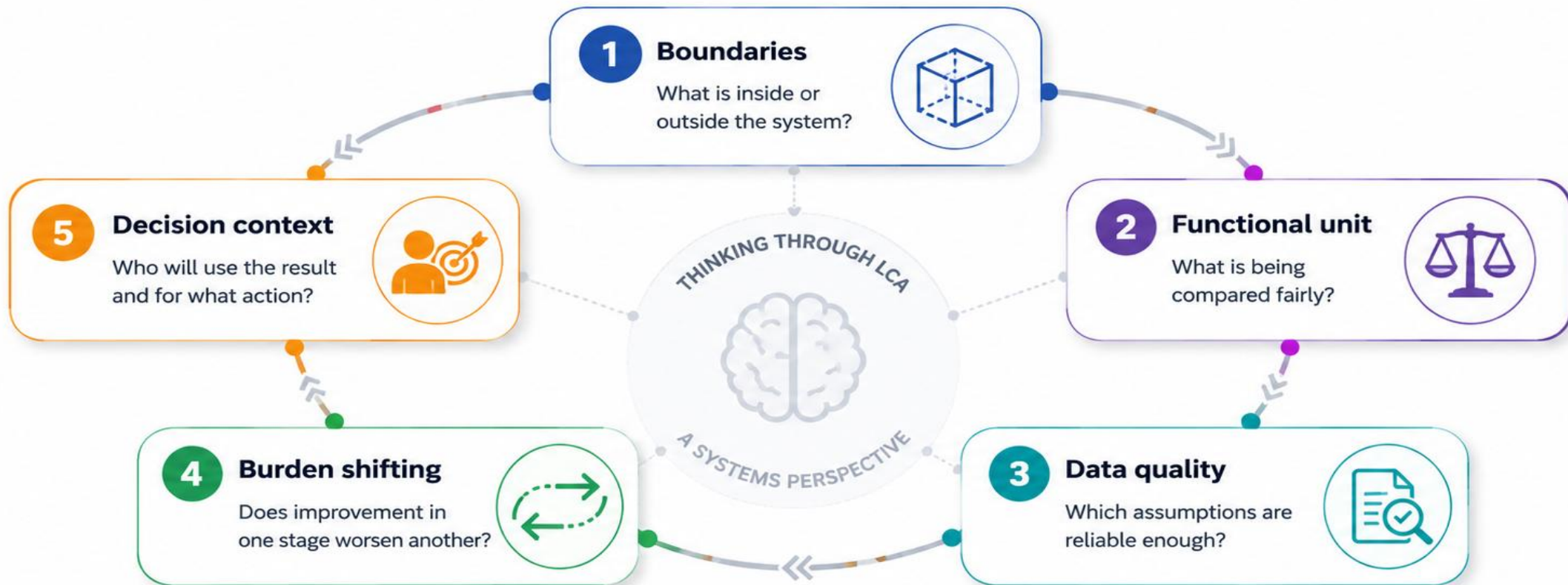
Trade-offs as graduate capability

Prepares learners to defend decisions when environmental, cost, social, and technical priorities conflict.



What learners often find difficult

The difficult part of LCA is not only the calculation; it is learning how to think.



Teaching implication: assess judgement, not only arithmetic.



Experience across LCA teaching, engineering management, and applied sustainability

The talk draws on module design, project supervision, and research dissemination across the UK and Malaysia.

Universiti Malaysia Kelantan (UMK): dedicated LCA teaching

Designed and delivered a Life Cycle Assessment module, with course guides, learning materials, and applied sustainability examples.

NTU: LCA embedded in Engineering Management

Integrated sustainability and life-cycle thinking within modules such as Business Operations & Reliability Management and Global Business Management.

Project supervision as authentic learning

Supervised MSc projects that connect LCA with transport systems, manufacturing, EPDs, carbon decisions, and real organisational contexts.

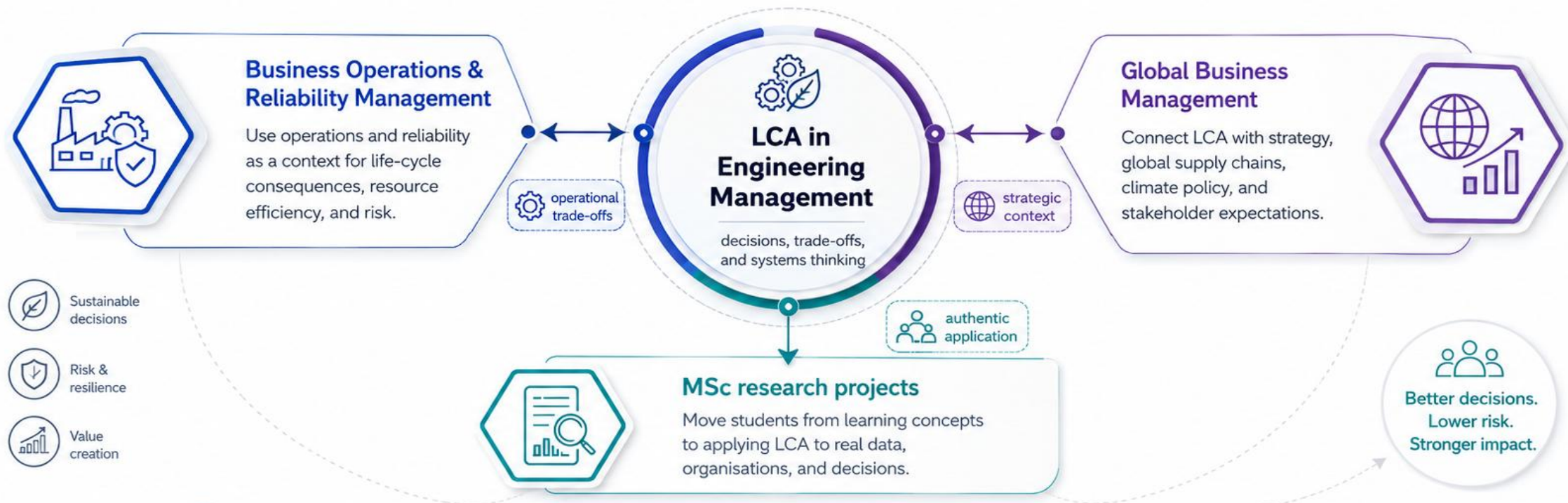


Pertinent experience

Research and public scholarship in sustainable manufacturing, climate simulations, openLCA/EPD use, and simulation-led education.

Embedding LCA where decisions are made: operations, reliability, and business strategy

In Engineering Management (MSc), LCA becomes more powerful when it is taught alongside operational trade-offs.



Teaching move: ask students to justify the decision, not just report the footprint.



Which boundary changes the conclusion?



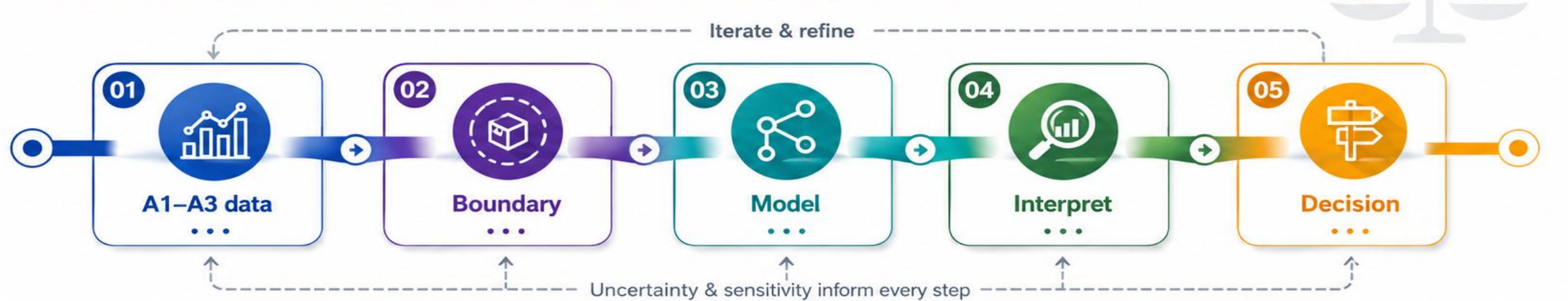
What trade-off would an operations manager actually face?



What data gap changes the decision?

Designing cases that expose trade-offs

The best teaching cases force learners to negotiate between competing objectives.



Transport case

Fleet, passenger demand, route changes, electrification, reliability, and public value create competing priorities.



Manufacturing case

Materials, energy, waste, quality, cost, and production constraints shape what 'sustainable' means.



EPD-to-decision case

Students move from published EPDs to scenario choices, sensitivity checks, and practical recommendations.

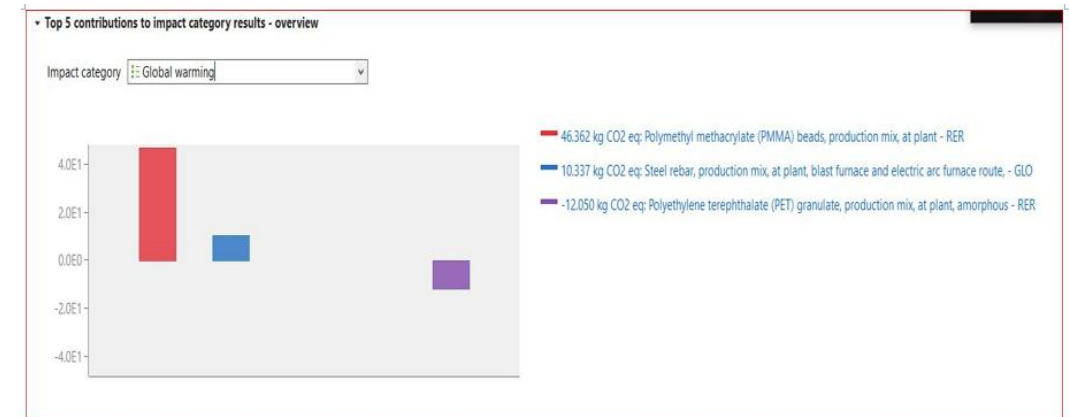
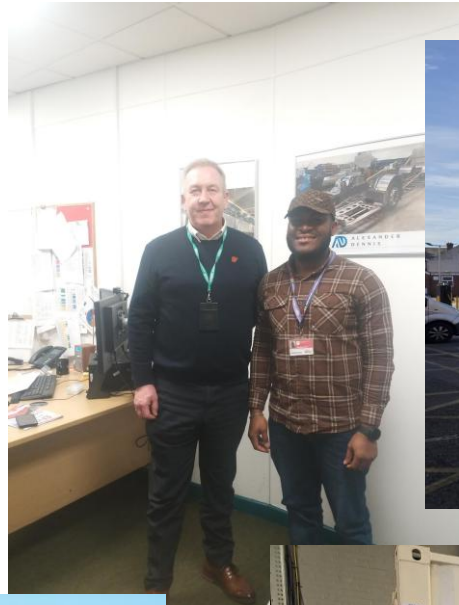


Trade-off question for students: 'What improves the footprint but makes the operation harder, costlier, or less resilient?'



Life Cycle Assessment (LCA) of Nottingham City Transport Ltd. (NCTX) Buses: Evaluating the Environmental Impacts and Opportunities for Sustainability

MSc Transport Systems, Nottingham Trent University (NTU) – Research Project



Article

Life Cycle Assessment (LCA) of Particleboard: Investigation of the Environmental Parameters

Muhammad Aiman Hakim Mohd Azman ¹, Sharizal Ahmad Sobri ^{1,2,*}, Mohd Natashah Norizan ^{2,3,*}, Mohd Nazri Ahmad ⁴, Wan Omar Ali Saifuddin Wan Ismail ⁵, Kamarul Ariffin Hambali ⁶, Mohd Hendra Hairi ⁷, Andi Hermawan ¹, Mazlan Mohamed ¹, Pao Ter Teo ¹, Mohammad Radzif Taharin ⁸ and Noorsidi Aizuddin Mat Noor ⁹

B. App. Sc Forest Resources Technology,
Universiti Malaysia Kelantan (UMK) –
Research Project

<https://doi.org/10.3390/polym13132043>

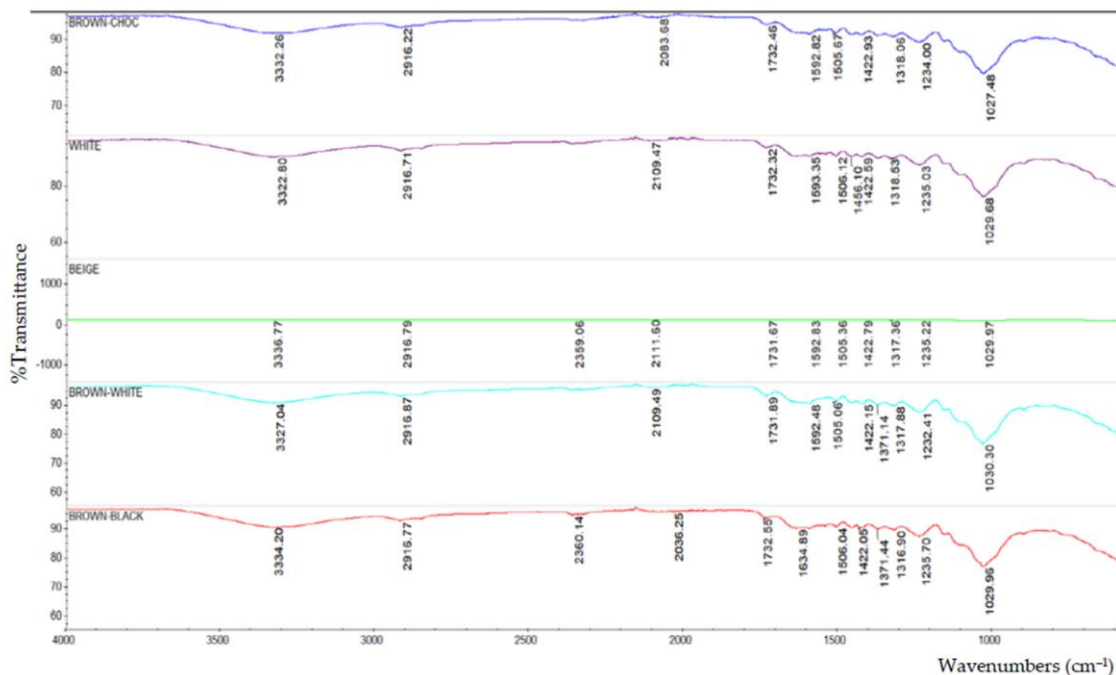


Image Source: <http://www.mtc.com.my/media-Features.php?id=612>

LCA of Particleboard – Malaysian
Wood-Based Industry

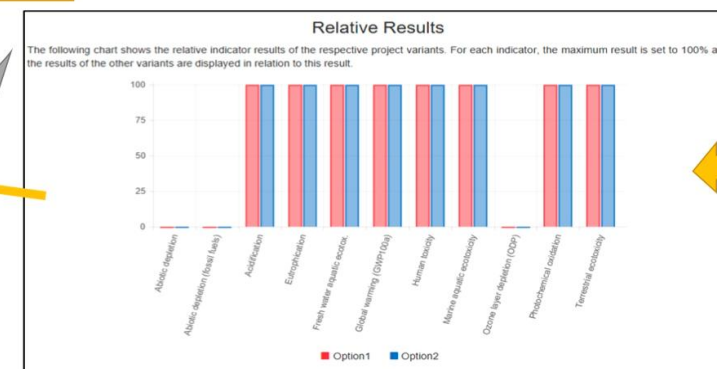
Graphical Abstract

Selected LCIA Categories

The table below shows the LCIA categories of the selected LCIA method of the project. Only the LCIA categories that are selected to be displayed are shown in the report. Additionally, a user friendly name and a description for the report can be provided.

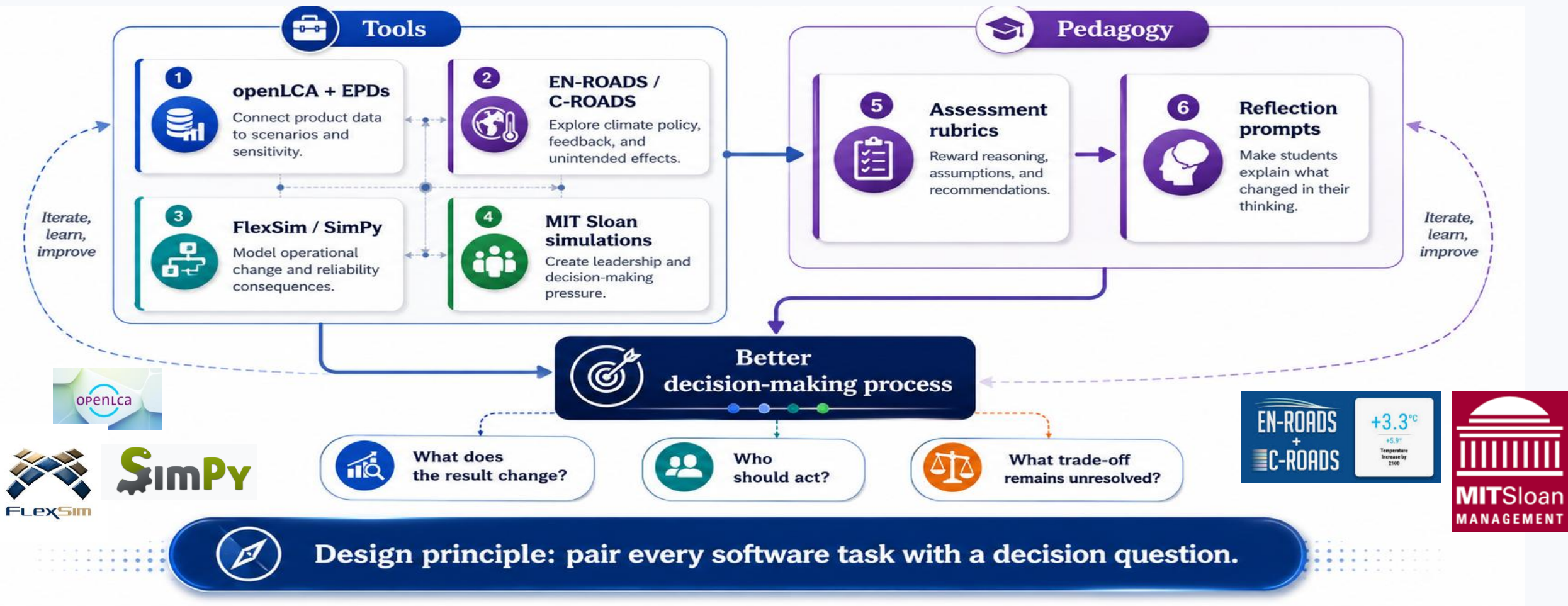
Impact category	Unit
Abiotic depletion	kg Sb eq
Abiotic depletion (fossil fuels)	MJ
Acidification	kg SO ₂ eq
Eutrophication	kg PO ₄ — eq
Fresh water aquatic ecotox	kg 1.4-DB eq
Global warming (GWP100a)	kg CO ₂ eq
Human toxicity	kg 1.4-DB eq
Marine aquatic ecotoxicity	kg 1.4-DB eq
Ozone layer depletion (ODP)	kg CFC-11 eq
Photochemical oxidation	kg C ₂ H ₄ eq
Terrestrial ecotoxicity	kg 1.4-DB eq

Generated in
openLCA programme



Tools help students see systems — but the pedagogy makes them learn

The tool is not the learning outcome; the learning outcome is a better decision-making process.



Learning from dissemination: conferences, seminars, and public scholarship

Sharing teaching practice helps refine the way we teach sustainability capabilities.



Research in Engineering Education Symposium (REES) 2025, Universiti Teknologi Malaysia (UTM)

Innovative pedagogy for industry alignment through project-based learning and simulation.

NTU Engineering Research Seminar

Communicating applied engineering research and making complex evidence accessible.

Climate simulation public scholarship, i.e. LSE Impact Blog

Use of solution-orientated simulations to connect learning with real climate action.

Teaching feedback

Student response has supported the value of simulation, authentic cases, and practical sustainability learning.

Core lesson: evidence-based sustainability education becomes stronger when it is taught, tested, shared, and revised.

LSE Impact Blog – “Solution orientated simulations can drive real action on the climate crisis”



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Sharizal Ahmad Sobri

Krishna Chandrajeet Vishwakarma

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Abbas Almas Parvin

Siddhant Prashant Remje

Manan Sunil Pandier

June 25th, 2025

Solution-orientated simulations can drive real action on the climate crisis

1 comment | 6 shares

Estimated reading time: 10 minutes



As the world confronts the catastrophic risks of surpassing 2°C of warming, tools like En-ROADS—a global climate simulator that lets users test the impact of climate policies in real time—offer a powerful way to turn data into practical policy decisions. Researchers from Nottingham Trent University’s Department of Engineering demonstrate how such tools can guide more informed, collaborative and effective climate action.

If **global temperatures rise beyond 2°C**, the consequences for ecosystems and human societies will be catastrophic. We could witness **severe disruptions** including increased frequency and intensity of extreme weather events such as hurricanes, droughts, floods and heatwaves, leading to significant loss of life and economic devastation. Rising sea levels could displace millions of people living in coastal areas, creating unprecedented humanitarian crises and increased migration pressures. **Ecosystems** could suffer irreversible damage, with biodiversity loss accelerating as many species struggle to adapt to rapidly changing climates. Agricultural

Driving real action on the climate crisis

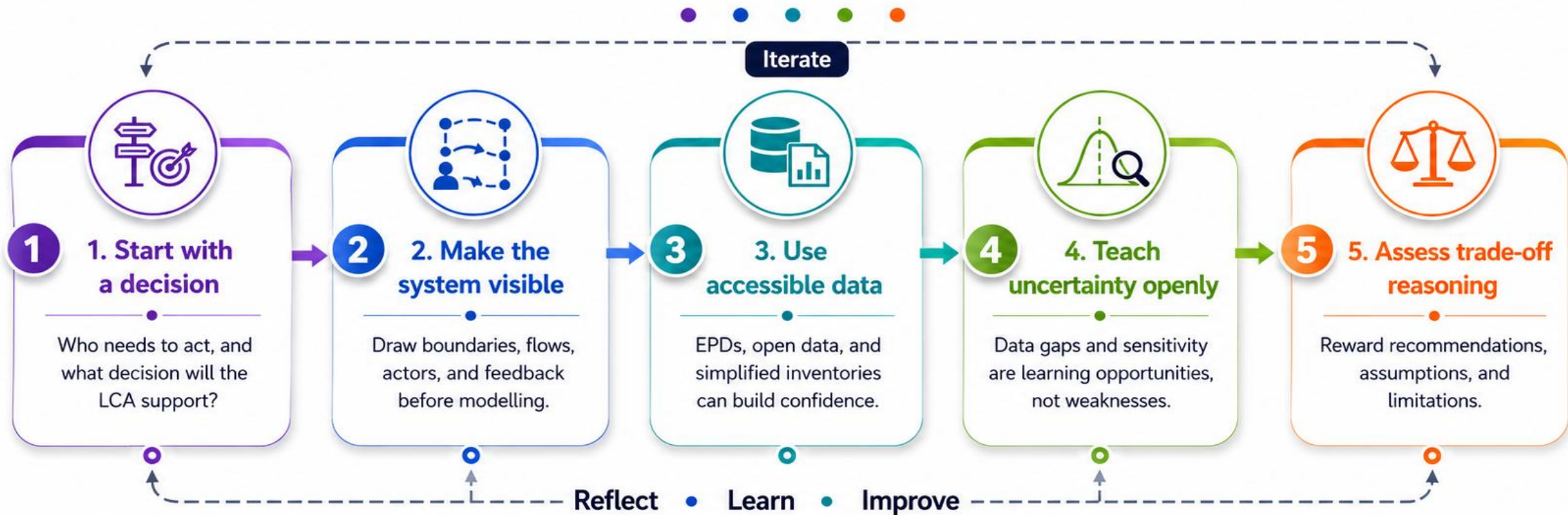
Several of our MSc Engineering Management students and Dr Sharizal Ahmad Sobri published a blog post in the *LSE Impact Blog*, which is hosted by the London School of Economics and Political Science, one of the leading institutions in the field. The piece, developed from a group project in the module: Global Business Management, showcases how the EN-ROADS climate simulator can be used to support solution-oriented learning about climate policy and sustainable business. Traditional academic models are often static and complex, and there is a need for more dynamic, intuitive and accessible ways of understanding the adverse impacts of global warming. En-ROADS changes this narrative by making climate solutions tangible and actionable. It allows users to simulate real-world policies in a virtual environment, offering immediate feedback on their potential impacts.



NTU Department of Engineering – Winter Newsletter

A transferable framework for LCA teaching

Useful across modules, short courses, dissertation supervision, and professional upskilling.



Final message: LCA education is not only about measuring impacts — it is about learning how to make better choices in complex systems.



Thank you

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<https://www.ntu.ac.uk/staff-profiles/science-technology/sharizal-ahmad-sobri>



Discussion welcome after the keynote session



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