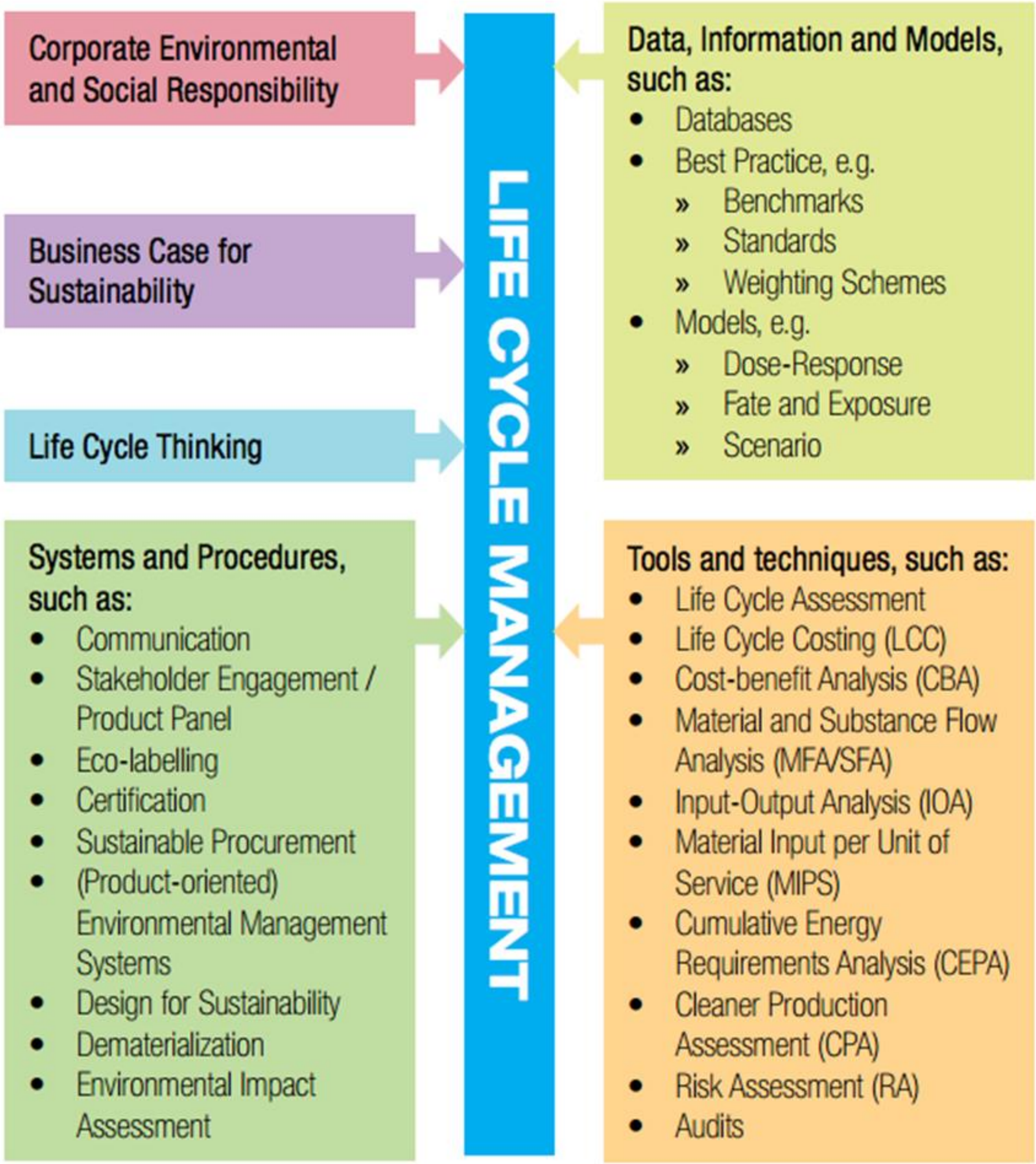
Dr. Asela Kulatunga is a senior lecturer at the Faculty of Engineering, University of Peradeniya. He earned Bachelors in Production Engineering from University of Peradeniya and PhD in Industrial Engineering from University of Technology, Sydney, Australia and gLink Erasmus Mundus Research Fellow at University of Bremen Germany. He is an expert of LCA, Eco Design and Sustainable Manufacturing with more than 12 years of experience. He has involved in several projects funded by UNEP, UNIDO and UNEP-SETAC initiative. He is a Senior Member of institute of Industrial & Systems Engineers -USA, Chartered Member of Institute of Logistics & Transport (UK), Member of European Roundtable on Sustainable Consumption & Production. He is an Accredited Professional of Green Building council of Sri Lanka and currently serves GBCSL as a Green label consultant and a member of expert panel developing Green Label guidelines Version 2.0..

LCA Experiences in Sri Lankan Context; Potential Business and Economic Sectors for LCA Application

Dr. Asela K. Kulatunga
Head
Department of Manufacturing & Industrial Engineering
Faculty of Engineering
University of Peradeniya
Sri Lanka

- Life Cycle Thinking (LCT) is adopting a **holistic approach in sustainability** related decision making(UNEP, 2007).
- LCT identifies both **opportunities and risks** of a product or technology, all the way from raw material extraction to the final disposal of a used product and can range from a **qualitative life cycle thinking** to a **comprehensive life cycle assessment**, where overall environmental impact of a product or service is quantified.
- This approach **prevents sub optimization** and **shifting of environmental burdens** from one environmental medium to another and/or from one life cycle stage to another.
- The LCT supports **life cycle management (LCM),** which aims at **minimizing environmental and socioeconomic burdens associated with an organization's product or product portfolio during their entire life cycle and value chain**.
- LCT is an **important component in achieving the real objectives of sustainable development goals (SDGs)** such as **SDG 9 – Industry, Innovation, and Infrastructure, SDG11 – Sustainable Cities and Communities, and SDG12 – Sustainable Consumption and Production** since LCT facilitates identifying priorities of interventions based on the areas for highest opportunities and managing potential trade-offs.



Source: UNEP/SETAC. Life Cycle Management: A Business Guide to Sustainability. Paris, 2007.

Contents

Overview of LCA in Sri Lanka

- Evolution
  - 2005 to present
- Level of penetration
  - Awareness to policy intervention
- Areas of Penetration
  - Agriculture to manufacture to waste to Product Design DSS's
- Educational Programmes
  - Awareness workshops to degree programmes
- Resource Pool

Timeline of LCA adaptation in SL context

2005 National level Capacity building

UNIDO-NCPC

2012 National Level Capacity Building

UNEP-NCPC

2015 National Level Capacity building LCAdeSNET

2016 Training Programme on LCP based on ISO 14001-2015

NCPC-SL

2017-2019

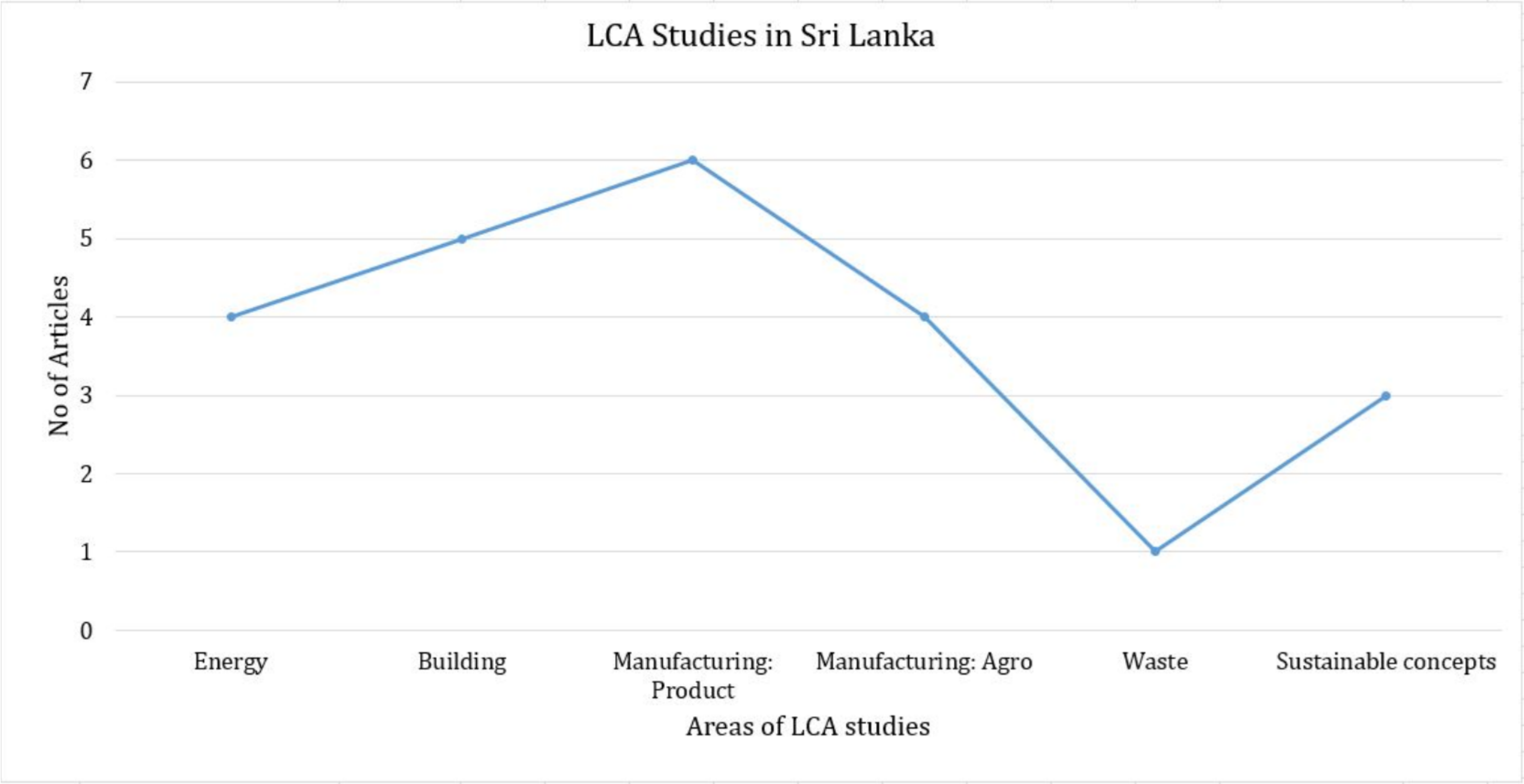
10YP

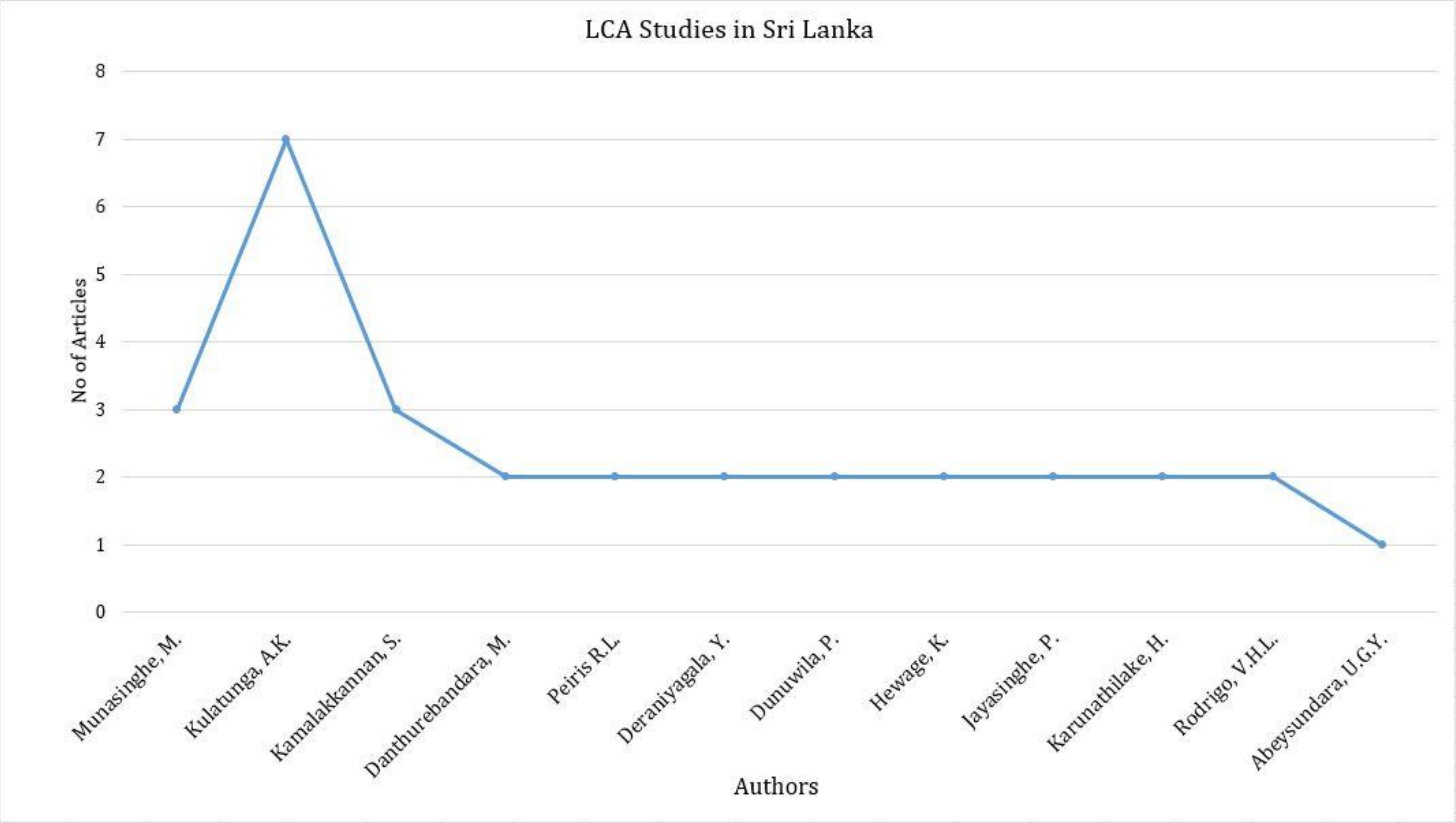
CI-SCP Programme

UNEP & NCPC

Conduct Detail LCA for agro Food industry & Development of LCI2016 Training Programme on LCP based on ISO 14001-2015

NCPC-SL


LCA Studies in Sri Lanka
No of Articles
0
1
2
3
4
5
6
7
Energy
Building
Manufacturing: Product
Manufacturing: Agro
Waste
Sustainable concepts
Areas of LCA studies


LCA Studies in Sri Lanka
8
7
6
5
4
3
2
1
0
No of Articles
Munasinghe, M.
Kulatunga, A.K.
Kamalakkannan, S.
Danthurebandara, M.
Peiris R.L.
Deraniyagala, Y.
Dunuwila, P.
Hewage, K.
Jayasinghe, P.
Karunathilake, H.
Rodrigo, V.H.L.
Abeysundara, U.G.Y.
Authors

Scopus

Search Sources Lists SciVal Create account Sign in

76 document results

(TITLE-ABS-KEY ("life cycle assessment*" OR "life cycle management*" OR "LCA" OR "life cycle analysis*" OR "life cycle thinking*" OR "environmental impact assessment*") AND TITLE-ABS-KEY ("Sri Lanka*" OR "srilanka*"))

Edit Save Set alert Set feed

Search within results...

Refine results

Limit to Exclude

Access type

- Open Access (6)
- Other (70)

Year

- 2020 (1)
- 2019 (8)
- 2018 (8)
- 2017 (5)
- 2016 (10)

View more

Author name

- Kulatunga, A.K. (5)
- Kamalakkannan, S. (3)
- Munasinghe, M. (3)
- Babel, S. (2)

Documents Secondary documents Patents

Analyze search results Show all abstracts Sort on: Date (newest)

All Export Download View citation overview View cited by Add to List

	Document title	Authors	Year	Source	Cited by
1	A conceptual methodology for estimating embodied carbon emissions of buildings in Sri Lanka	Nawarathna, A., Alwan, Z., Gledson, B., Fernando, N.	2020	Smart Innovation, Systems and Technologies 163, pp. 83-95	0
2	Assessment of Pollution Sources, Fate of Pollutants, and Potential Instream Interventions to Mitigate Pollution of Earthen Canals of Urban to Rural-Urban Fringe	Gomes, P.I.A., Fernando, B.A.V.W., Dehini, G.K.	2019	Water, Air, and Soil Pollution 230(11),262	0
3	Assessment of groundwater quality in CKDu Affected areas of Sri Lanka: Implications for drinking water treatment Open Access	Cooray, T., Wei, Y., Zhong, H., (...), Weragoda, S.K., Weerasooriya, R.	2019	International Journal of Environmental Research and Public Health 16(10),1698	2
4	Performance of water efficiency measures in commercial buildings	Sousa, V., Silva, C.M., Meireles, I.	2019	Resources, Conservation and Recycling 143, pp. 251-259	1

View abstract Find Full Text View at Publisher Related documents

Activate Windows
Go to Settings to activate Windows.

LCA expert	Affiliation	Area of focus
Dr. Erandi Lokupitiya	University of Colombo	Agriculture & Livestock, forestry
Dr. Janaka Gamage	University of Moratuwa	Machining Processes
Dr. Maheshi Senanayake	University of Moratuwa	Chemical processes
Prof. Parakrama Karunaratne	University of Peradeniya	Chemical processes
Dr. Asela K. Kulatunga	University of Peradeniya	Manufacturing, Agriculture, Construction industry
Dr. Maheshi Danturebandara	University of Peradeniya	Waste, Energy
Dr. Sampath Wahala	University of Sabaragamuwa	Forestry
Dr. Y. Abeysundara	Ministry of Education	Buildings
Prof. M. Munasinghe		Agriculture, Energy

LCA Type	Definition	Example
Contribution Analysis	Comparing impact contribution from different sources of process or product	• Comparison of process stages in manufacturing phase (ex: Withering, Rolling, Drying) • Comparing main 4 phases of product life cycle (Pre-Manufacturing, manufacturing, Use, Disposal) • Comparing different product specifications (600x600 floor tile with 300x600 floor tile)
Scenario Analysis	Comparing different impact levels in different scenarios of life cycle	• Comparing different practices of the manufacturing product of a process (ex: Semi-Conventional practice vs Modern Practice) • Comparing different technologies (Hot air generation by boiler with furnace)
Uncertainty Analysis	Identifying variation and plotting the distribution of impact for different exchanges	• Fitting the biomass firing impact to a normal distribution and identifying the effectiveness
Sensitivity Analysis	Identifying the sensitivity (tendency to change impact) of exchanges	• Identifying the expected data quality of exchanges during data collection • Declaring LCA cut-off values for a new product
Parametric Analysis	Optimizing environmental impacts based on parameters of a product or process	• Optimization of GWP of a product by changing thickness (t) and water absorption (WA) from tiles

General LCA	Standard LCA	Advantages of Standard LCA
Conduct according to the common sense of developer	Conduct according to ISO14040-14044 standard framework	Can be compared due to common structure
Data is collected by plant data recording system	Data is collected by a specifically designed data collection inventory booklet	Comfortable for calculations
Only scope is defined based on phase check points (Ex: Cradle to Grave, Cradle to Gate, Gate to Gate)	System boundary is defined based on 4 aspects • Aggregation Boundary • Geographical Boundary • Scope Boundary • Life Cycle Level Boundary	Easy to determine all relevant life cycles
Only consumption and production data is collected (process data)	Uncertainty data is collected in addition to process data	Data quality can be estimated
Only primary data is collected by plant	Secondary data is collected from other sources in addition to primary data	Country specific assessment and more accurate
Inventory results is interpreted by exchange data	Detailed inventory results are interpreted as exchange summary report, balance sheets and data quality matrices	High data reliability
Commonly carbon foot is calculated	Detailed calculations are done by impact assessment methods (IPCC GWP100a, ReCiPe)	Useful to initialize eco-designs
Environment Impact Assessment (EIA) is conducted manually	Life Cycle Impact Assessment (LCIA) is conducted by advanced LCA software (Ex: SimaPro)	More accurate calculations and ability to link with international databases

Business Opportunities through LCA

- Branding and Marketing purposes
- Penetrate into different markets (international)
- Optimize the Processes & Supply chains
- Reduce Resource Consumption in Manufacturing processes
- Decide the appropriate technologies / methods for economical and low carbon scenarios

Sectors which have economic & Business potential for LCA

- Constriction industry
  - Buildings
  - Constriction Materials
- Agro food industry
  - Tea
  - Cinnamon
  - Coconut Products
- Apparel. Garments & Textiles
- Export oriented other products
  - Natural & Synthetic Rubber products

Ex: Building LCA : LEED Requirements

- Worth of **3 points** of LEED green building rating program
- Need to conduct a **Cradle to Grave** study
- Required to compare LCA's of two building designs- (**Reference &** Proposed)
- Need the results of both buildings in six LCA metrics
    - Global Warming Potential (kg CO_2 eq.)
    - Acidification (kg SO_2 eq.)
    - Eutrophication (kg N eq.)
    - Ozone depletion (kg CFC-11 eq.)
    - Smog (kg O_3 eq.)
    - Non Renewable Primary Energy (MJ)

Building LCA according to LEED

- Minimum 10% reduction in **Proposed Building** for at least three impact indicators,
- One of them must be GWP
- Maximum 5% increase for any impact indicator
- Minimum life span of 60 years to be considered

GCSM

16th Global Conference on Sustainable Manufacturing

Sustainable Manufacturing for Global Circular Economy

University of PERADENIYA Sri Lanka

Life Cycle Assessment based tool for Eco-Design in manufacturing sector




R. L. Peiris*, A. K. Kulatunga, K.B.S.N Jinadasa

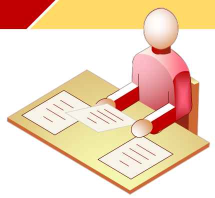
Department of Manufacturing & Industrial Engineering
Faculty of Engineering
University of Peradeniya
Peradeniya

Introduction

Key Elements

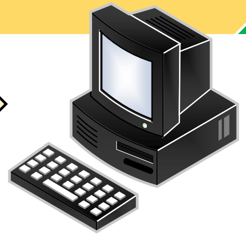
- Life Cycle Assessment (LCA) - Scientific methodology for environment performance analysis
- Eco Design (ED) - Product or process design to reduce environment impacts in industries
- Decision Support System (DSS) - Supporting framework to get eco friendly decisions for industries

Data Collection → LCA with Contribution Analysis → Hot Spot Identification → Redesign Scenario Analysis → **Eco Design**

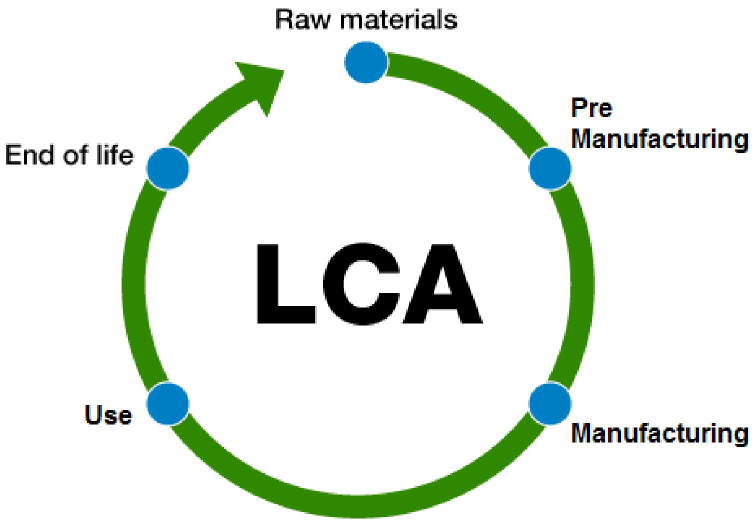


LCA based computer tool

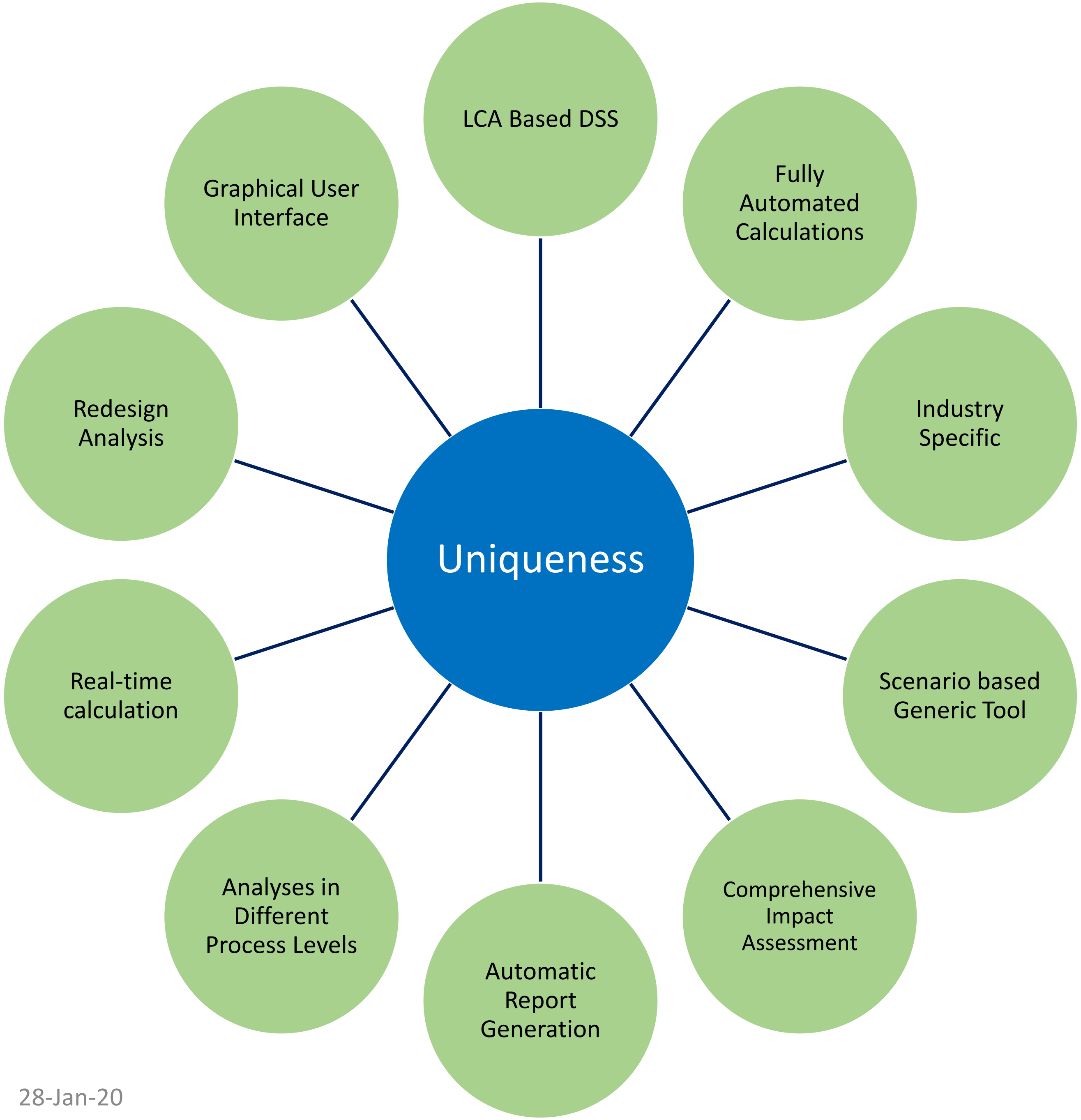
Proposed Solution



- Area focused : Manufacturing Industry
- Aim of research : Facilitate eco-designs in manufacturing industry
- Problem addressed : Barriers in LCA based eco design
- Outcome of Research : DSS tool (Linked LCA & Eco Design)
- Completed level : Conceptual model
- Version : Basic version on macro based excel framework
- Customization : Clay roof tile manufacturing industry



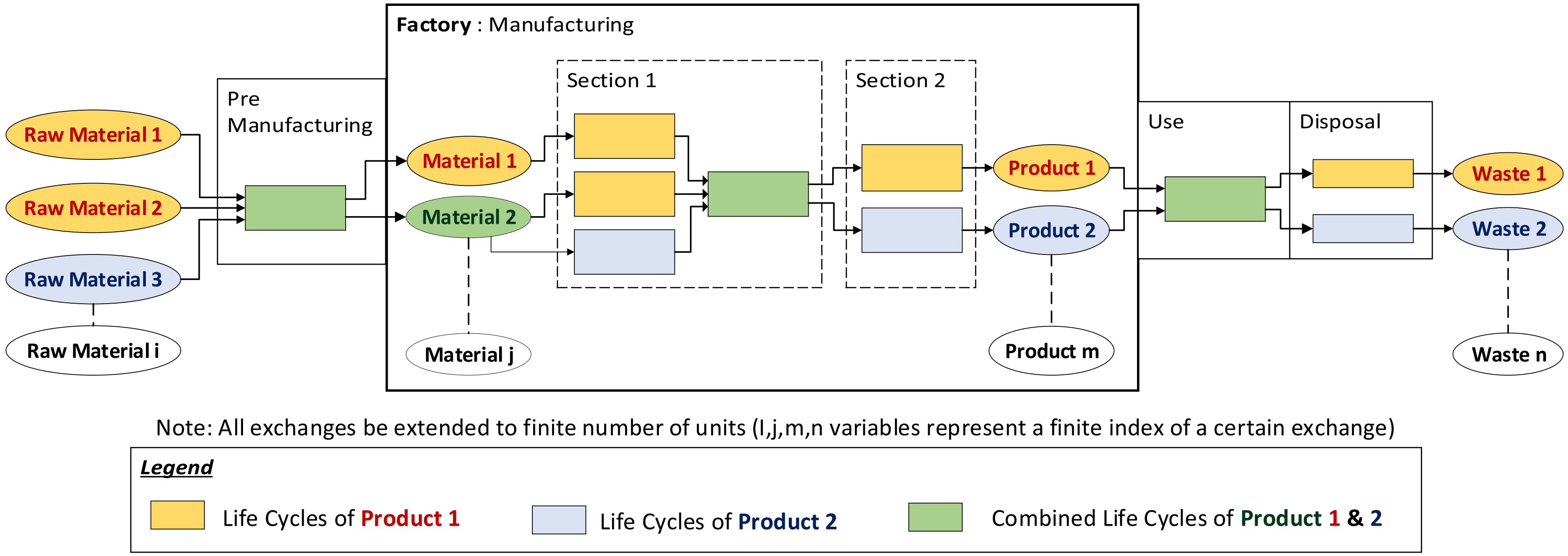
Uniqueness of the model



<u>Benefits of proposed model</u>

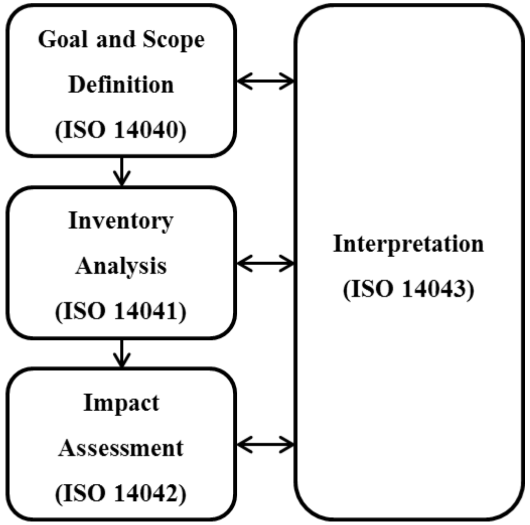
- Less human interaction
- Time saving
- Ease of use
- Professional results interpretation
- No need of research background
- Finally, enhance sustainability

Architecture of DSS



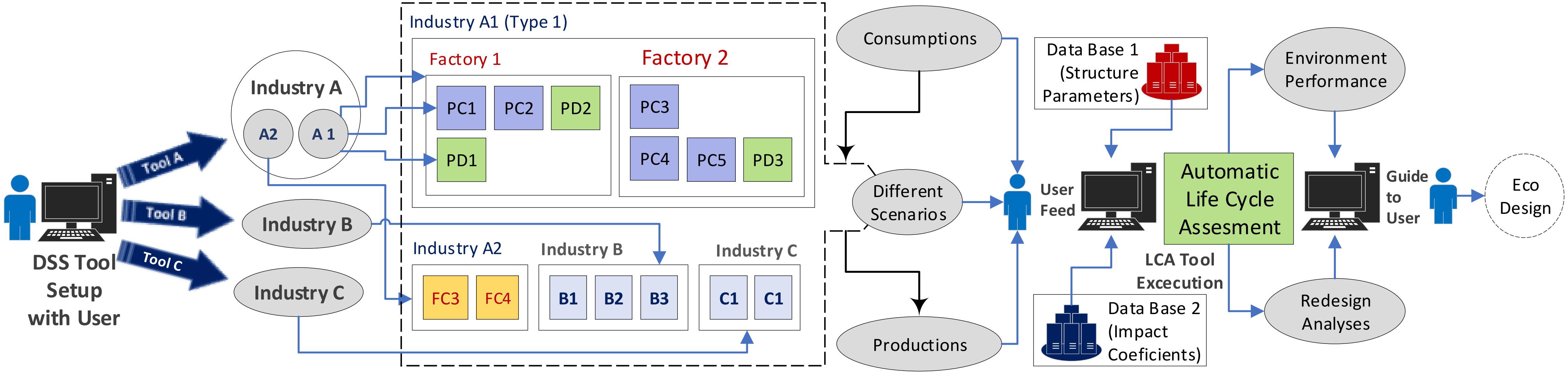
Life cycle levels contained in the model

- Industry level – a group of factories (affecting factors ex: product type, geography, technology level)
- Factory level – a group of products as a bulk production
- Product-level – a group of processes (affecting factors ex: product type, specification)
- Process level – a group of processes (affecting factors ex: department, section)



ISO Framework for LCA

Overview of the DSS model



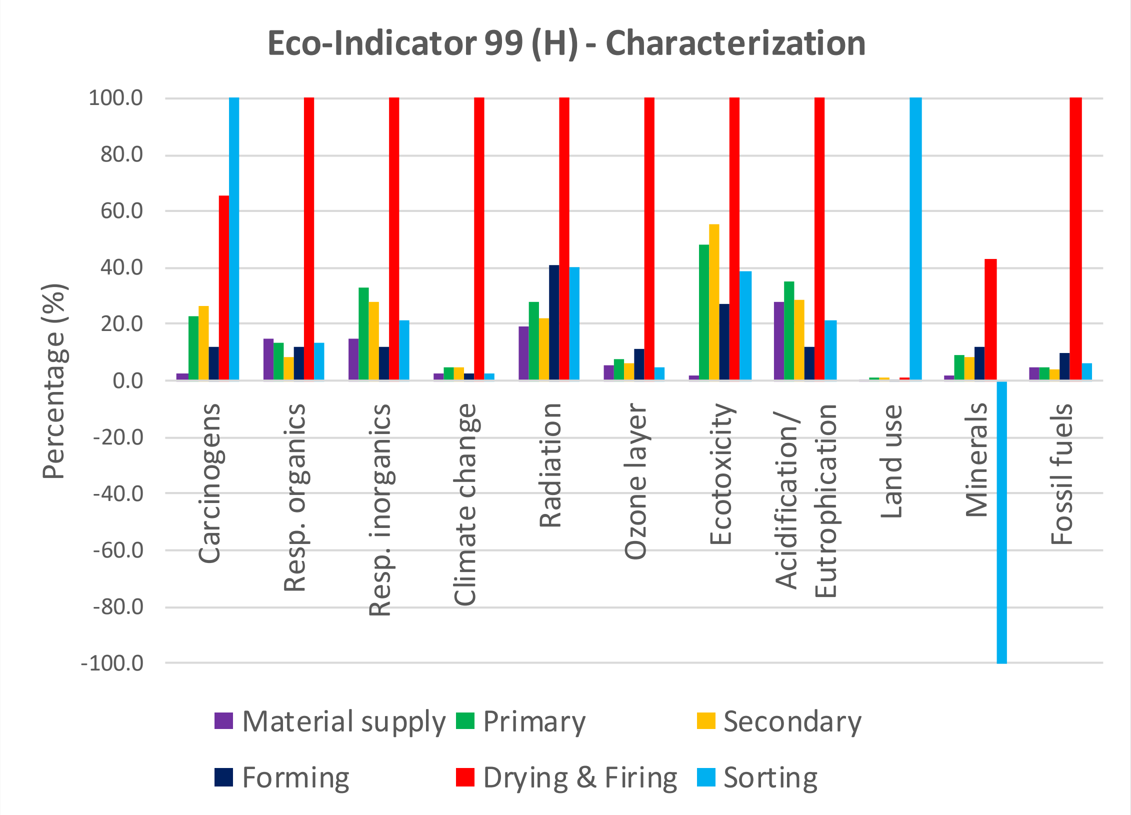
Executional flow of the DSS model

➢ Selection of tool	- Selection of relevant tool which was specially designed by developer for particular industry
➢ Setup of DSS model	- Configuration of the system for each resource/process/product scenario for particular setup
➢ Development of LCI	- Record of consumptions and productions of system within system boundary
➢ Development of LCIA	- Calculation of environment performances based on LCI and pre-defined Impact Coefficient Database
➢ Interpretation	- Automatic report generation to identify environment hotspots
➢ Redesign scenario analysis	- Scenario analysis to estimate environment performance gain of redesign

Validation with Case Study and Discussion

a

Life Cycle Impact Assesment (LCIA)



Plot Graph (Eco-Indicator)

Characterization

Report on Environment Performance Analysis

b

Eco-design checker

Scenario Analysis - Rejection rate

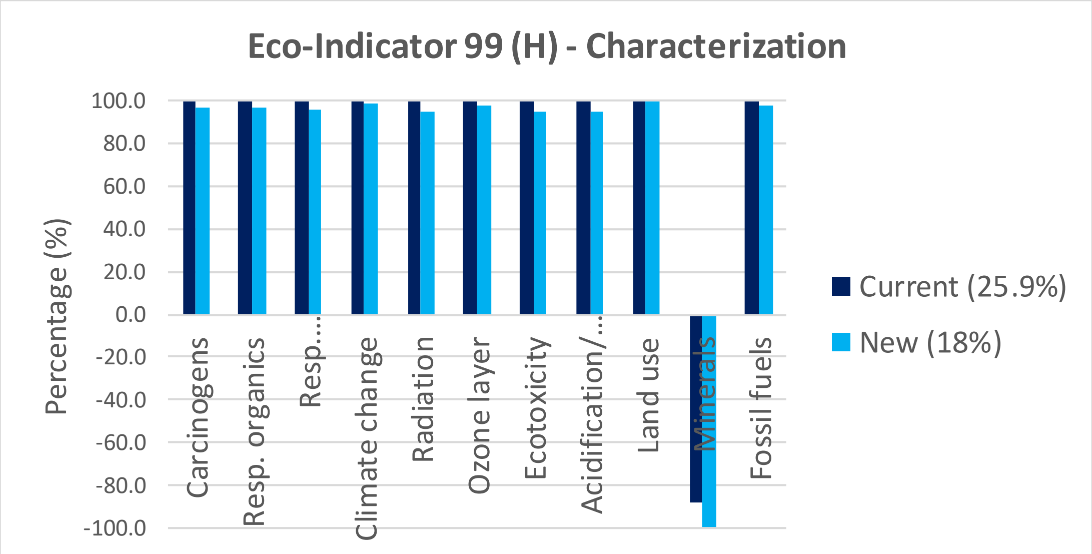
Forming Rejects

Current Rejection Level: 25.9%

Rejection level after modification: 18%

Slow   Medium   Fast

Generate Graphs

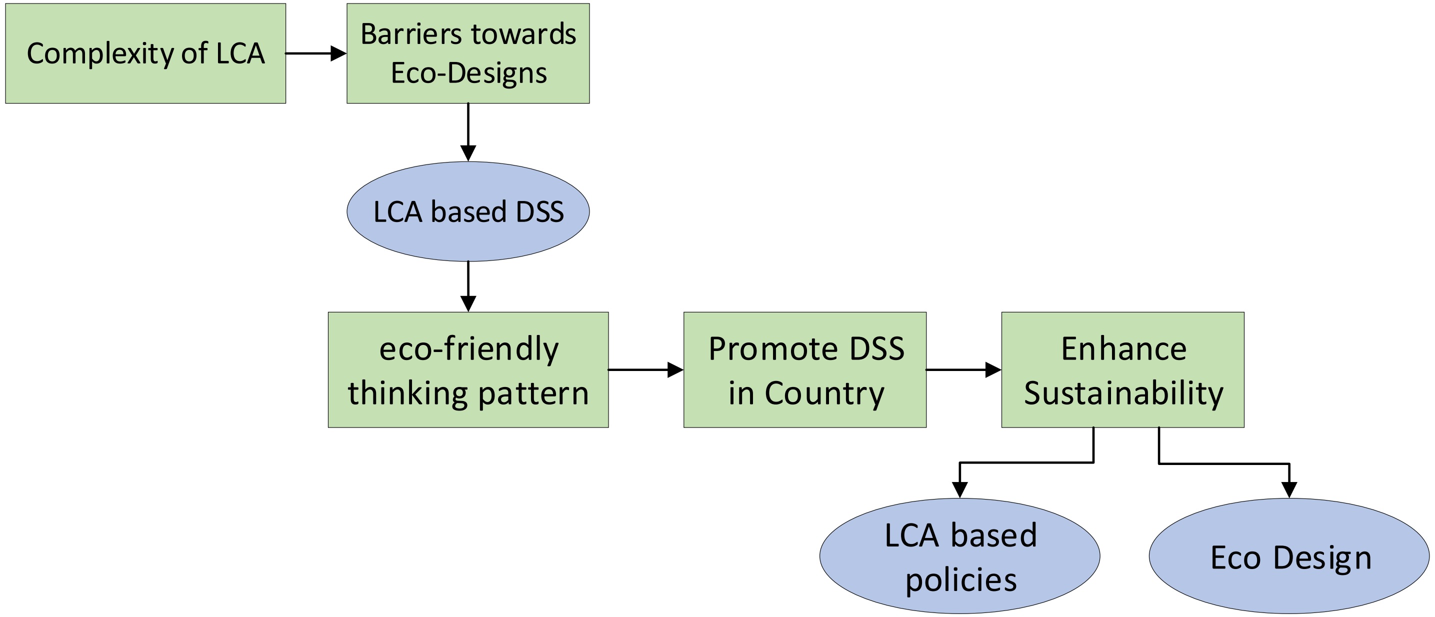


EI99(H) - Characterization											
Impact Category	Carcin.	Res. Org.	Res. Ino.	CC	Radiation	Ozone	Ecotox.	Acid.	Land	Mineral	Fossil
Reduction %	2.8	3.4	4.4	1.4	4.6	2.4	4.8	5.0	0.3	11.4	2.0

Report on Environment Performance Gain of Redesign

Outcome

How DSS drives system towards sustainability . . .

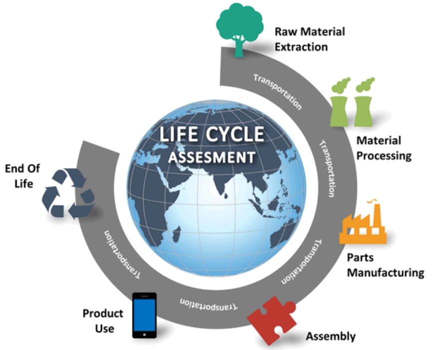


On going research. . .

- Realize the conceptual model to a software available in cloud based environment
- Integration of automatic data feeding by Industry 4.0 based IoT techniques

GCSM
17th Global Conference on Sustainable Manufacturing

The conceptual framework of IoT based decision support system for life cycle management

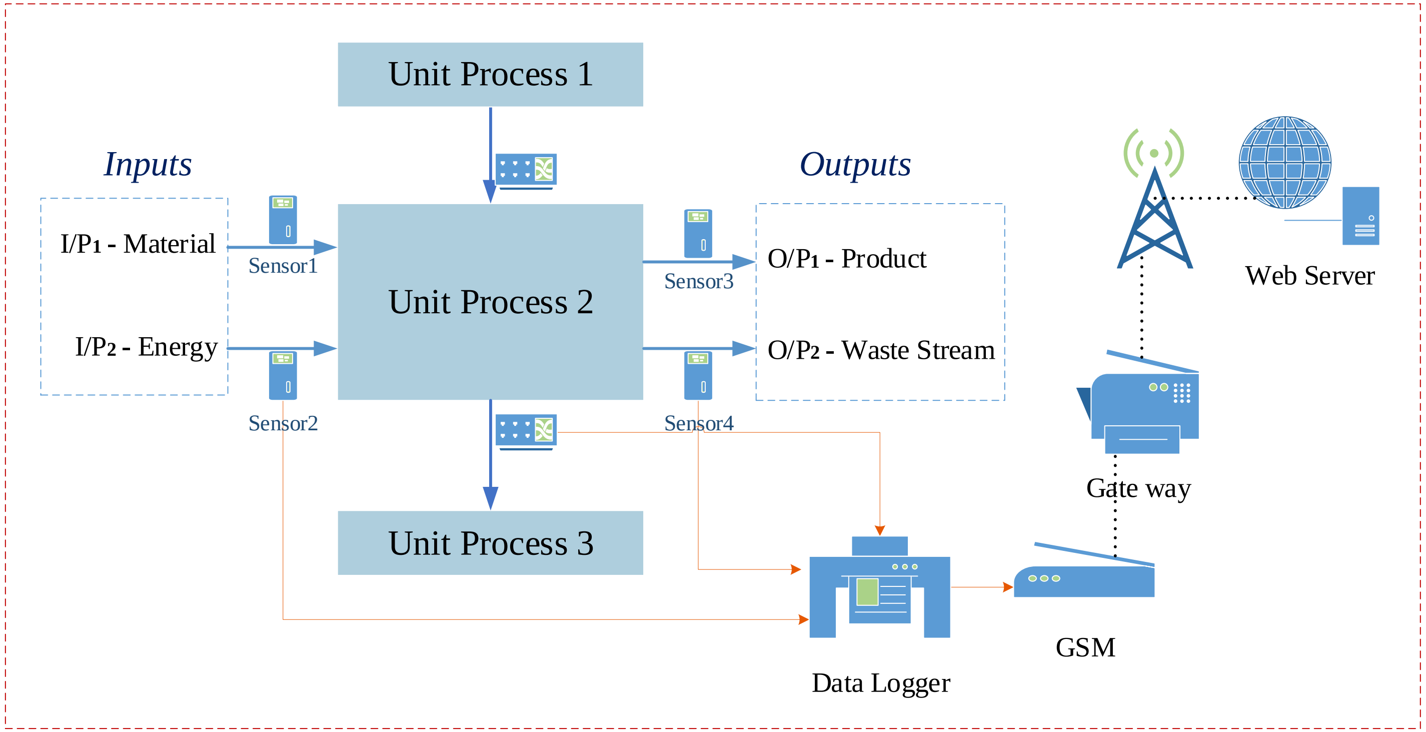


S. Kamalakkannan*, A. K. Kulatunga, L.A.D.A.D. Bandara

Department of Manufacturing & Industrial Engineering
University of Peradeniya, Sri Lanka

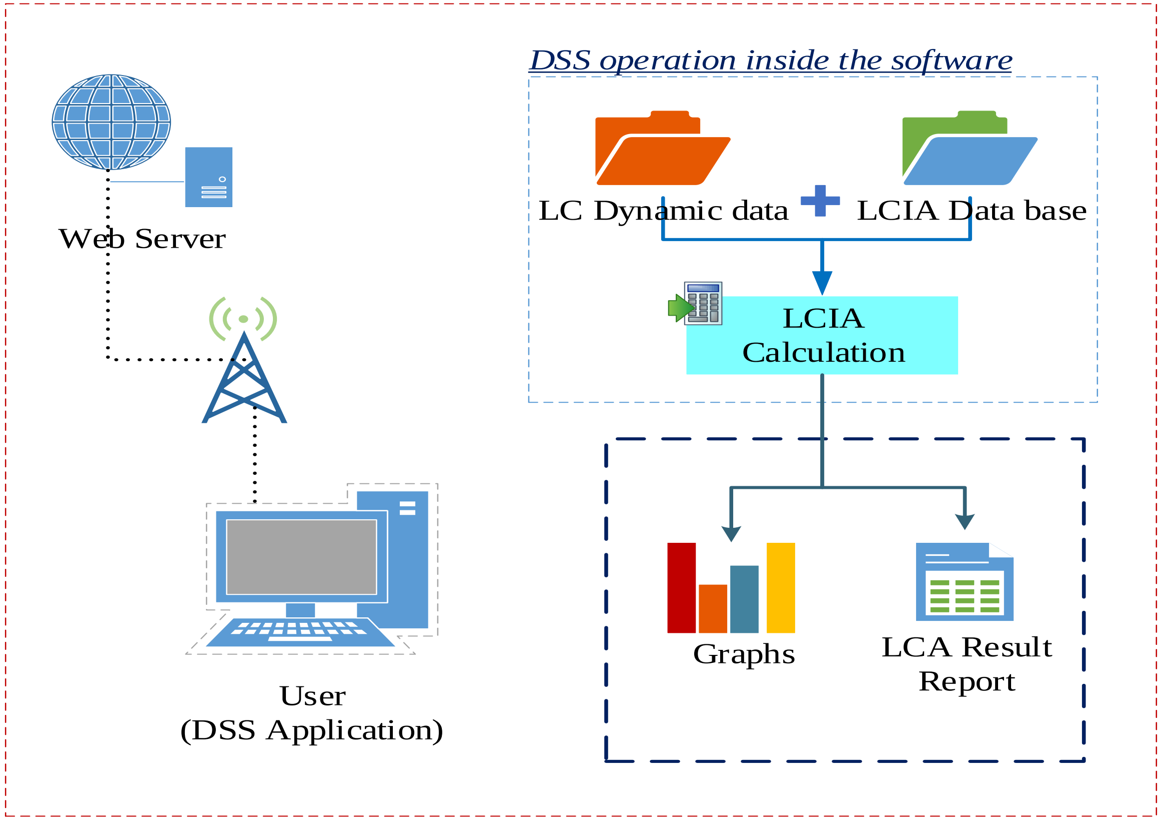
IoT based Dynamic Data Collection

- Input & Output parameters of unit processors are monitored using appropriate seniors
- Sensor network is connected to a cloud environment via data logger and GSM network

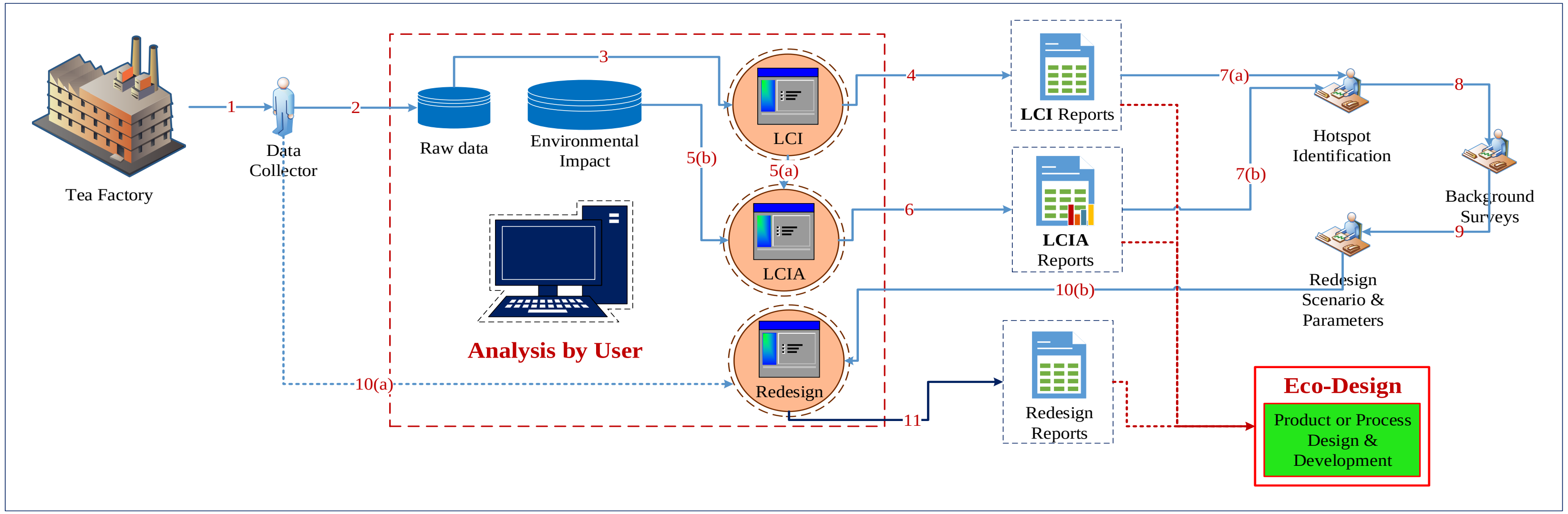


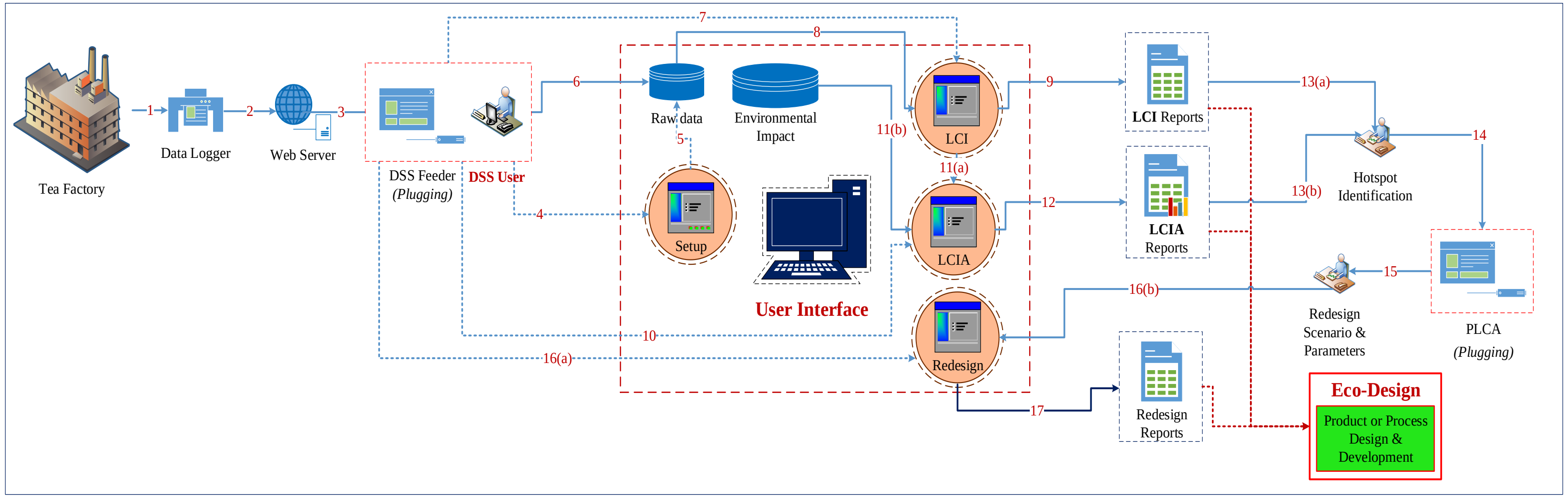
Decision Support System

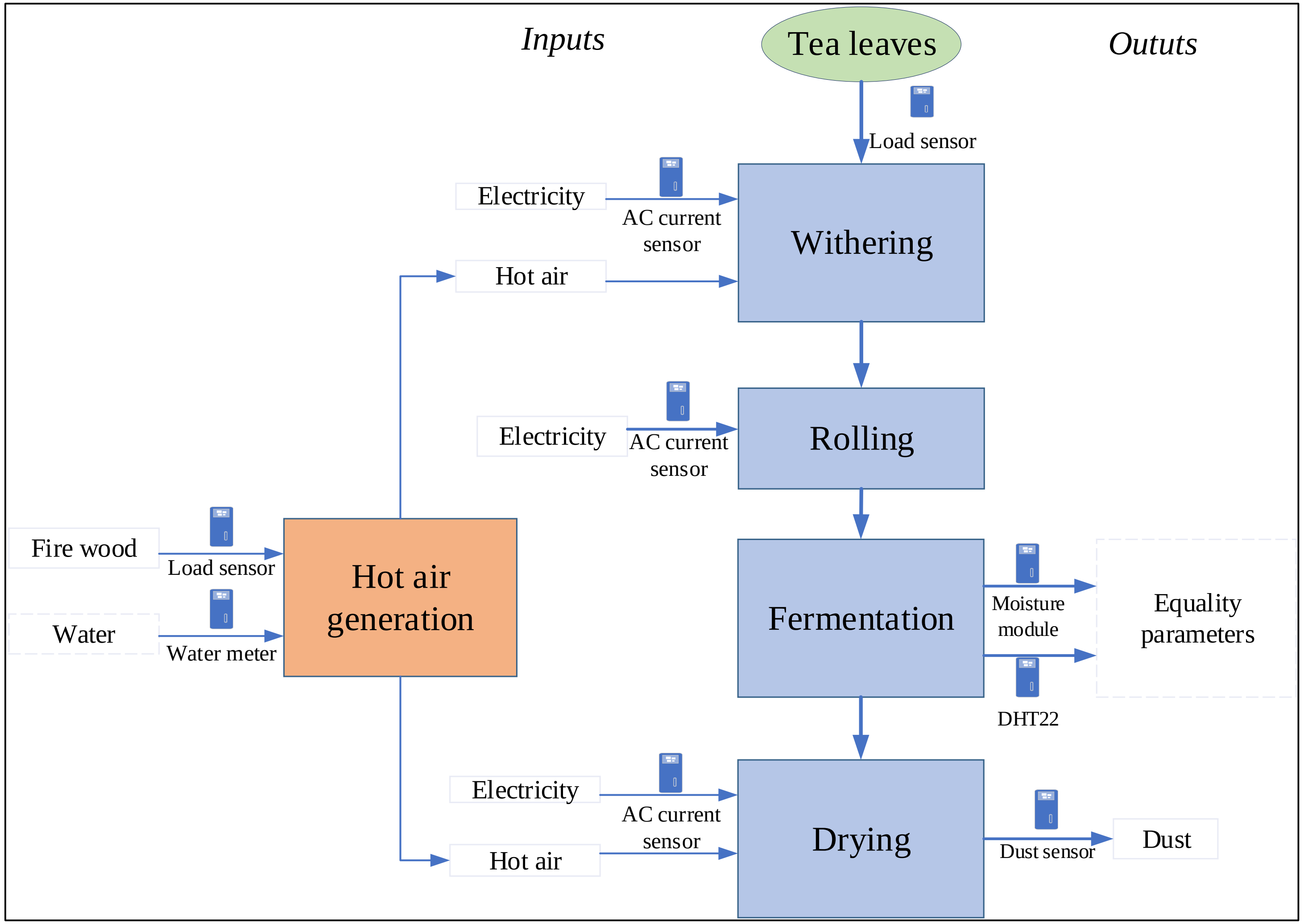
- Cloud base DSS web application tool provides instructions and guidance to facilitate the Eco-designs.
- DSS tool is capable to generate LCA reports
- Through the user interface, user is able to calculate and generate the LCA report to identify the hotspot and Eco-design possibilities



Existing and proposed framework for LCM

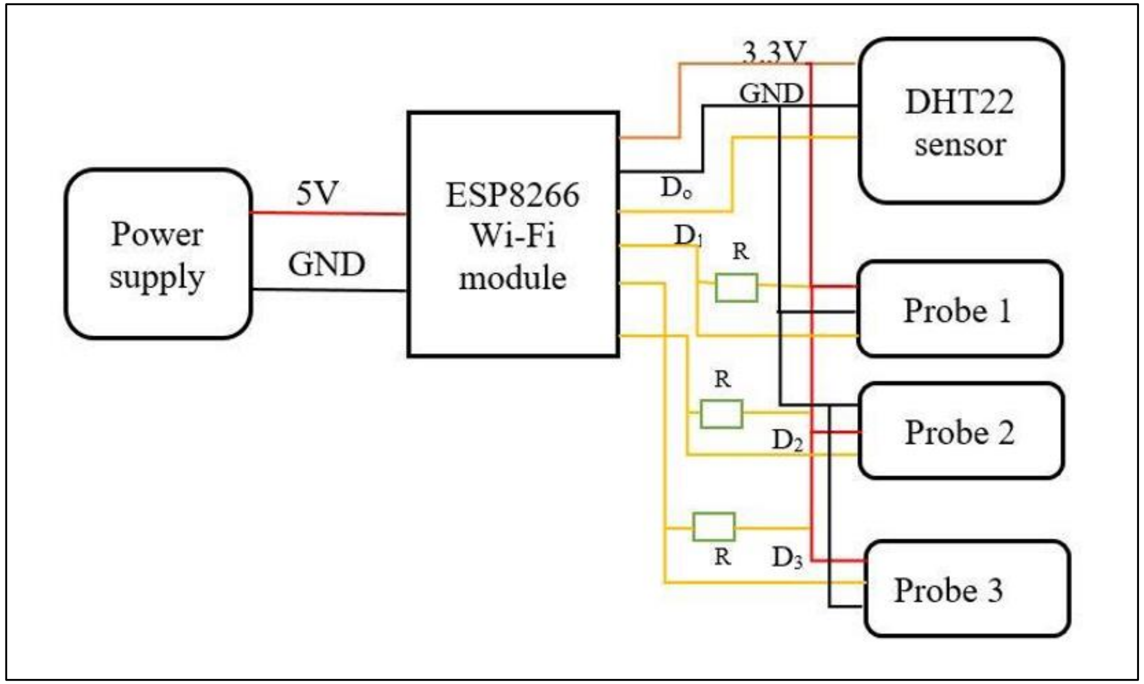


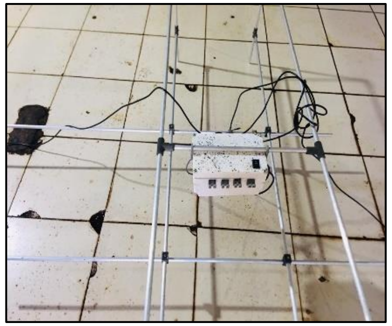




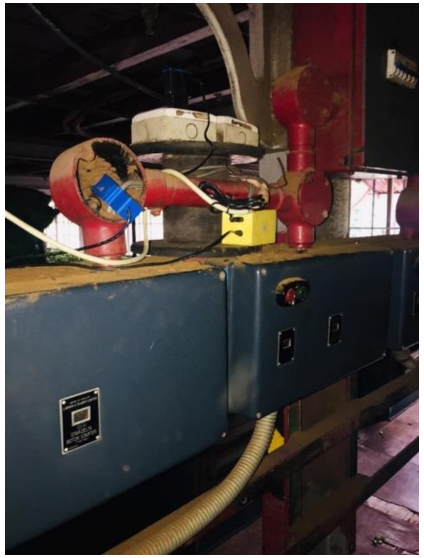
Inputs
Tea leaves
Oututs
Load sensor
Electricity
AC current sensor
Withering
Hot air
Electricity
AC current sensor
Rolling
Fire wood
Load sensor
Hot air generation
Water
Water meter
Fermentation
Moisture module
Equality parameters
DHT22
Electricity
AC current sensor
Drying
Hot air
Dust sensor
Dust

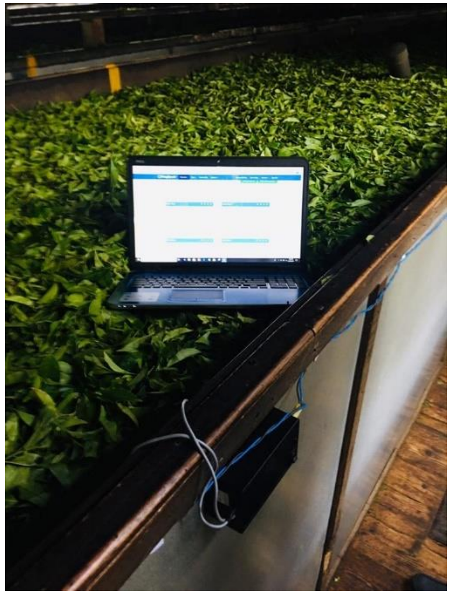
IoT installation in the factory region…






CE
SCT013
30A / 1V
www.yhdc.com





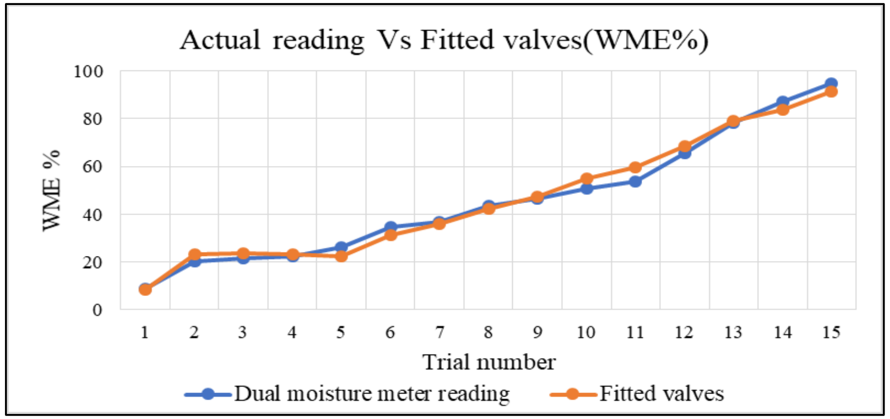
- Primarily the applied sensors were properly calibrated and the mathematical equations were formulated using the analytical software “Minitab”.

➤ Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
3.43118	98.62%	98.25%	85.24%

Coefficients

Term	Coef	SE Coef	T-Value	P-Value	VIF
Constant	461.9	31.7	14.58	0.000	
S1	-21.24	1.88	-11.29	0.000	1371.10
S1^2	0.3399	0.0350	9.70	0.000	5630.60
S1^3	-0.001799	0.000207	-8.70	0.000	1522.51



Dual moisture meter reading (WME%)	Fitted valves
9	8.167268
20.23	23.08089
21.34	23.62228
22.34	23.33433
26.38	22.40029
34.58	31.16022
36.74	36.07516
43.43	42.06942
46.66	47.29927
50.64	55.17077
53.8	59.47664
65.58	68.33189
78.22	78.95373
87.3	83.88034
94.8	91.24877

Sensor calibration and data analysis

4. Developed Local LCI Dataset for Construction Industry

Clay Roof Tiles – Semi Conventional Practice

<u>System Boundaries</u>

- ❖ Scope Boundary : Cradle to Gate
- ❖ Geographical Boundary : Single Plant, Kurunegala District, North Western province, Sri Lanka
- ❖ Aggregation Boundary : Considered the only one production specification of roof tiles
- ❖ Life Cycle Level Boundary:
  - ➢ Life cycles of infrastructure and capitals were neglected.
  - ➢ Small contributions of waste streams were neglected lower than 5%
  - ➢ Non-material emissions (Ex: Noise) were neglected.

Table 01: Exchange Summary Report – Semi-Conventional type manufacturing

(Functional Unit: Coverage of 1m2 effective area of roof)

Exchange Summary Table (per m²) – Semi-Conventional type clay roof tile manufacturing										
Exchange Type	**Resource**	**per m²**		**Section wise allocation (%)**					**Pedigree matrix**
		Unit	**Amount**	**MN**	**M/F**	**ND**	**F/S**	**WS**	
Raw Material	Main clay materials	kg/m^2	51.79	100					[3,4,3,1,1]
	Water	kg/m^2	13.22		100				[2,2,3,1,1]
Energy	Biomass-Wood logs	m^3/m^2	0.028				100		[3,4,3,1,1]
	Biomass-Wood powder	kg/m^2	4.680				100		[3,4,3,1,1]
	Electricity	kWh/m^2	1.872		100				[2,2,3,1,1]
Disposing & Emissions	Dried scrap rejects (Recycling)	kg/m^2	9.330			100			[5,4,3,1,1]
	Fired rejects (Landfill)	kg/m^2	0.320					100	[5,4,3,1,1]
	Evaporated water	kg/m^2	14.77			66.4	33.6		[4,4,3,1,1]
Overall Transport	Road transport	tkm/m^2	4.297						[3,4,3,1,1]
	Diesel – Internal transport	kg/m^2	0.034		100				[3,4,3,1,1]

[MN-Main material flow, M/F-Milling & Forming, ND-Natural Drying, F/S-Firing & Sorting, WS-Waste Scenarios]

Clay Roof Tiles – Modern Practice

<u>System Boundaries</u>

- ❖ Scope Boundary : Cradle to Gate
- ❖ Geographical Boundary : Single Plant, Anuradhapura District, North Central Province, Sri Lanka
- ❖ Aggregation Boundary : Aggregated all specifications of clay roof tiles
- ❖ Life Cycle Level Boundary:
  - ➢ Life cycles of infrastructure and capitals were neglected.
  - ➢ Small contributions of waste streams were neglected lower than 5%
  - ➢ Non-material emissions (Ex: Noise) were neglected.

Table 02: Exchange Summary Report – Modern type manufacturing

(Functional Unit: Coverage of 1m2 effective area of roof)

Exchange Summary Table (per m^2) – Modern type clay roof tile manufacturing											
Exchange Type	Resource	per m^2		Section wise allocation (%)							Pedigree matrix
		Unit	Amount	M	PR	SC	FM	D/F	ST	DP	
Main Material Flow	Main clay material	kg/m^2	51.7	100							[3,4,3,1,1]
	Waste body material (Reused)	kg/m^2	2.9	100							[5,4,3,1,1]
	Crushed roof tile powder	kg/m^2	2.9	100							[5,4,3,1,1]
	Water	kg/m^2	21.0		92.1	6.6	1.3				[4,4,3,1,1]
Auxiliary Materials	BaCO3	kg/m^2	0.0		100						[3,2,3,1,1]
	Coconut Oil	kg/m^2	0.0				100				[5,5,3,1,1]
Energy	LP Gas	kg/m^2	4.2					100			[1,2,3,1,1]
	Diesel	kg/m^2	0.0	20.2	19.5	9.0	40.1		11.2		[1,2,3,1,1]
	Electricity	kWh/m^2	3.6		24.2	29.4	11.7	34.7			[2,2,3,1,1]
Packaging Materials	Shrink wrapping	kg/m^2	0.1				77.6		22.4		[1,1,3,1,1]
	Wood pallets	kg/m^2	1.7						100		[1,1,3,1,1]
	Strapping	kg/m^2	0.0						100		[1,1,3,1,1]
	Black polythene	kg/m^2	0.0						100		[1,1,3,1,1]
Disposing & Emissions	Body mix rejects (Recycling)	kg/m^2	34.5				100				[4, 4,3,1,1]
	Dried scrap rejects (Recycling)	kg/m^2	24.2					100			[4,4,3,1,1]
	Fired rejects (Recycling + Landfill)	kg/m^2	9.2						31.3	31.3	[4,4,3,1,1]
	Dusty water	kg/m^2	2.1							100	[4,4,3,1,1]
	Coconut Oil	kg/m^2	0.0							100	[5,4,3,1,1]
	Diesel	kg/m^2	0.0							100	[4,4,3,1,1]
	Evaporated water	kg/m^2	16.8							100	[3,4,3,1,1]
	Thermoplastic wastage	kg/m^2	0.1							100	[2,4,3,1,1]
Overall Transport	Road transport	tkm/m^2	1.9								[2,2,3,1,1]
	Transoceanic transport	tkm/m^2	391.2								[2,2,3,1,1]

[M-Main material flow, PR-primary section, SC-Secondary section, FM-Forming section, D/F-Drying/Firing, ST-Sorting, DP-Disposal]

Roofing Scenario Comparison

System Boundaries

- Scope Boundary : Cradle to Grave
- Geographical Boundary : Three districts in Sri Lanka: Kurunegala District, Anuradhapura District and Colombo District; Global data: Eco-invent database
- Aggregation Boundary : Aggregated all roofing materials as an assembled product called roof
- Life Cycle Level Boundary:
  - Life cycles of infrastructure and capitals were neglected.
  - Small contributions of waste streams were neglected lower than 5%
  - Non-material emissions (Ex: Noise) were neglected.

Table 03: Exchange summary report for benchmarking LCA of clay cladded roof

(Functional Unit: Coverage of 400 ft^2 effective floor area of a single storey building)

Phase	**Exchange**	**Unit**	**Roof Scenario / Cladding Type**							
			Clay Tile - Semi		**Clay Tile - Modern**		**PVC Sheet**		**Asbestos Sheet**	
			Case 1	**Case 2**	**Case 1**	**Case 2**	**Case 1**	**Case 2**	**Case 1**	**Case 2**
Pre manufacturing	Cladding material	kg	3852.8	3852.8	4045.4	4045.4	500.8	500.8	884	884
	Ridge tiles	kg	88.10	88.10	88.10	88.10	18.3	18.3	88.1	88.1
	Rafters	kg	208.5	128.3	208.5	128.3	156.5	293.4	205.4	176
	Battens	kg	123.9	185.8	123.9	185.8	75.2	150.3	64.4	120.8
	Ridge	kg	63.0	63.0	63.0	63.0	63.0	63.0	63.0	63.0
	Steel brackets	kg	68.8	42.3	68.8	42.3	42.3	42.3	74	47.6
	Steel fasteners	kg	1.10	0.70	1.10	0.70	1.10	1.10	0.7	0.7
Manufacturing (Construction)	Transport (Road)	tkm	433.6	431.8	452.9	451.1	81.4	102.6	130.5	133.2
	Transport (Ocean)	tkm	206.1	206.1	206.1	206.1	206.1	206.1	206.1	206.1
Use	Electricity	kWh	126534				123625		126970	
Disposal	Incineration-wooden	Kg	395.3	377.1	395.3	377.1	294.7	506.7	332.8	359.8
	Landfill-Ceramic	kg	3940.9	3940.9	4133.6	4133.6	N/A	N/A	88.1	88.1
	Landfill-Plastic	kg	N/A	N/A	N/A	N/A	519.1	519.1	N/A	N/A
	Landfill-Steel	kg	69.9	43	69.9	43	43.3	43.3	74.7	48.3
	Landfill-Asbestos	kg	N/A	N/A	N/A	N/A	N/A	N/A	884	884

Ceramic Floor Tiles

System Boundaries

- ❖ Scope Boundary : Cradle to Gate
- ❖ Geographical Boundary : Single Plant, Colombo District, Western Province, Sri Lanka
- ❖ Aggregation Boundary : Aggregated all sizes and designs of floor tiles
- ❖ Life Cycle Level Boundary:
  - ➢ Life cycles of infrastructure and capitals were neglected.
  - ➢ Small contributions of waste streams were neglected lower than 5%.
  - ➢ Non-material emissions (Ex: Noise) were neglected.

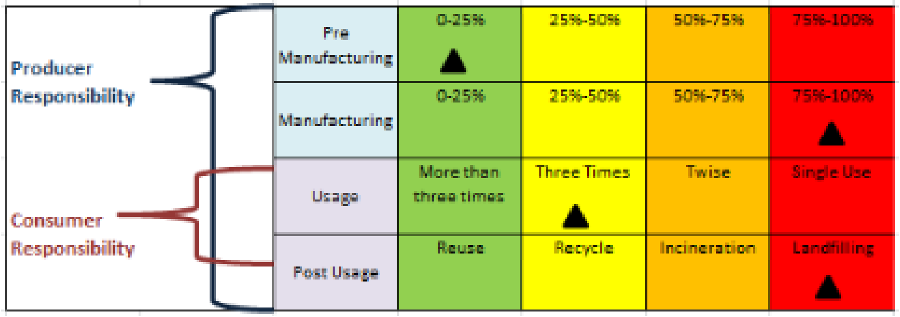
Table 04: Interpretation of Exchange Summary Report (ESR) – Ceramic floor tile

(Functional Unit: Coverage of 1m2 area of floor)

Exchange Summary Table – Production of floor tile to cover 1 m² floor area												
Exchange Type	Resource	per m²		Section wise allocation (%)								Pedigree matrix
		Unit	Amount	MF	PP	ML	SD	P&D	G&P	FR	S&P	
Main material flow	Ball day	kg/m^2	6.710	100								[1,2,2,1,1]
	Silica sand	kg/m^2	3.580	100								[1,2,2,1,1]
	Dolomite	kg/m^2	0.890	100								[1,2,2,1,1]
	Feldspar	kg/m^2	11.18	100								[1,2,2,1,1]
	Water	kg/m^2	7.910			77	23					[2,2,2,1,1]
Auxiliary materials	Glaze mixture	kg/m^2	6.800						100			[1,1,2,1,1]
	Printing ink	g/FU	11.71						100			[1,1,2,1,1]
Energy	LP Gas	kg/m^2	2.750				33	15	52.3			[3,1,2,1,1]
	Electricity	kWh/m^2	4.880		0.2	19.7	2.9	27.5	10.2	26.4	13.1	[2,1,2,1,1]
Packaging Materials	Cardboard	g/m^2	129.5								100	[1,1,2,1,1]
	Polythene	g/m^2	15.30								100	[1,1,2,1,1]
Disposed material	Landfilled rejects	kg/m^2	1.310						51.2	48.8		[4,4,2,1,1]
	Evaporated water	kg/m^2	5.990									[3,4,2,1,1]
Overall Transport energy	Transport-Road	tkm/m^2	2.478									[2,2,2,1,1]
	Transport-Transoceanic	tkm/m^2	7.053									[2,2,2,1,1]
	Transport-Air	tkm/m^2	0.033									[2,2,2,1,1]
	Transport-Internal transport	g/m^2	9.250									[2,2,2,1,1]

MF – Main Flow, PP – Primary Process, ML – Milling, SD – Spray Drying, P&D – Pressing & Drying,
G&P – Glazing & Printing, FR – Firing, S&P – Sorting & Packaging

LCA based Green Labels



The Environmental Label Based On the Case Study Done in House Hold Glove Manufacturing in Sri Lanka Based On Life Cycle Assessment

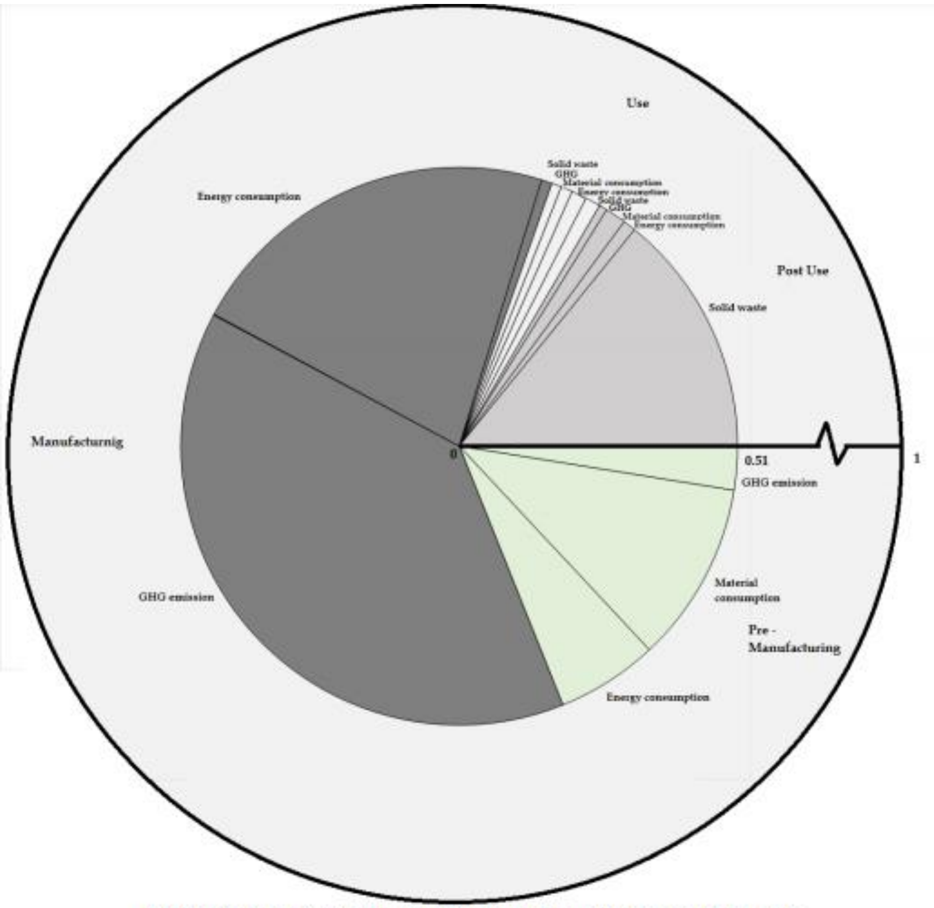


Figure 4: Graphical representation of environmental impact

Conclusion

- LCT is one of the holistic approach to promote sustainability
- It has evolved in Sri Lankan context for last 25 years
- Reached to several sectors over the period of time
- Availability of LCA experts to handle industry /country needs
- Policy interventions have been initiated
- Advanced research and LCA based analytical tools have been developed
- LCA based Green Labels have been evolved in Sri Lankan context
- ***Its right time for corporate sector to harness the benefits if LCT and LCM to be competitive in Global Markets***

International Conference on Resource Efficiency and Circular Economy

Thank You...!