Evaluation for branding of Environment-conscious Products and Enterprises in Kyoto Project

Koji Okuhara
Osaka University, Japan

Hiroshi Tsuda
Doshisha University

Kazuhiko Shibuya
The Institute of Statistical Mathematics, Japan

Hiroe Tsubaki
The Institute of Statistical Mathematics, Japan

Genshiro Kitagawa
Research Organization of Information and Systems, Japan

Kyoto project has proceeded by Kyoto city, the institute of statistical mathematics, Doshisya university and Osaka university. We developed Web based LCA system which executes environmental impact evaluation with lower burden on introduction and operational management. It can contribute significantly to the environmental load curtailment, because it satisfies the transparency by the use of provided common inventory data and the standardization of estimation procedure.
Furthermore it is important to give incentive to environment-conscious product and enterprise by branding. In order to evaluate each product and enterprise, to set up nondiscriminatory and transparent evaluation method is desired. For such purpose, our Web based LCA is very suitable and works well.
We derive algorithm to formulate consensus of participants who join our framework in Kyoto project. Then we create and estimate value of brand of environment-conscious products and enterprises.

Evaluation for branding of Environment-conscious Products and Enterprises in Kyoto Project

Koji Okuhara
Osaka University, Japan

Hiroshi Tsuda
Doshisha University

Kazuhiko Shibuya
The Institute of Statistical Mathematics, Japan

Hiroe Tsubaki
The Institute of Statistical Mathematics, Japan

Genshiro Kitagawa
Research Organization of Information and Systems, Japan

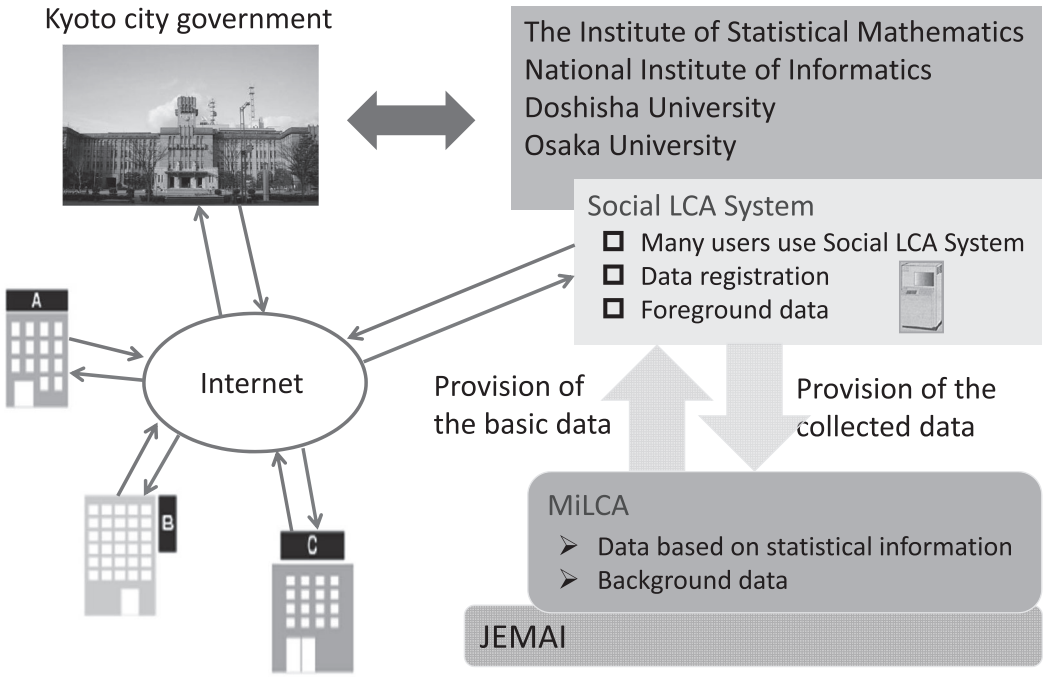
Agenda

Kyoto project has proceeded by Kyoto city, the institute of statistical mathematics, Doshisya university and Osaka university. We developed Web based LCA system which executes environmental impact evaluation with lower burden on introduction and operational management. It can contribute significantly to the environmental load curtailment, because it satisfies the transparency by the use of provided common inventory data and the standardization of estimation procedure.

Furthermore it is important to give incentive to environment-conscious product and enterprise by branding. In order to evaluate each product and enterprise, to set up nondiscriminatory and transparent evaluation method is desired. For such purpose, our Web based LCA is very suitable and works well.

We derive algorithm to formulate consensus of participants who join our framework in Kyoto project. Then we create and estimate value of brand of environment-conscious products and enterprises.

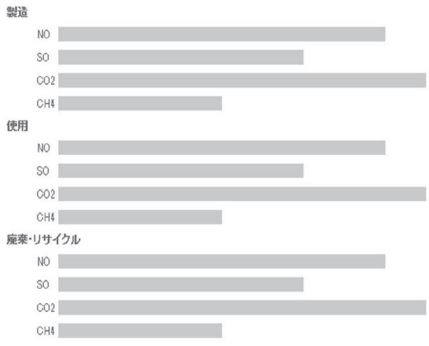
Cooperative Structure of Kyoto Project



Visualization Tool of Environmental Value

https://133.1.173.208/

- It shows the load on each stage of the product in life cycle by using graph to understand easily.
- It can display graphs for comparison of some products.

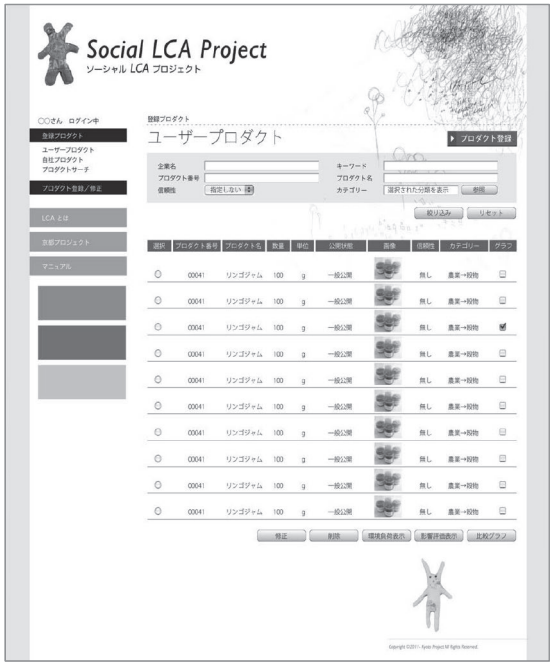


Visualization → Leading the recognition of the bottleneck and the awareness for the improvement.

Features of Data Format in Social LCA

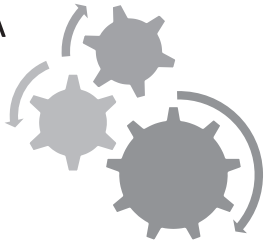
- I follow ISO 14048 for data item.
- Simplification and cache design about the background data.
- Only values of results can register for each product.

  *Evidence of data is required.
- Preservation of all the data of the child process.
- Recalculate and cache for updated parts of product.



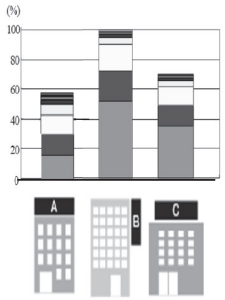
Shift to eco-co-exist industry by LCA

- why use our Social LCA System
  - strong public demands for eco-products
  - shift to eco/benefit from costs/benefit
  - objective reliable/transparent cheep LCA
  - governments' backup by certification
  - industry's incentives to get certificates
  - industry's initiatives to increase sales



Formulation of evaluation indicators concerning branding of environment-conscious products by governments' certification is very important for incentives of companies.

Outline of Evaluation Indicators



CO_2 reductions

	Output y
Company	CO_2 (GtC/year)
A	18,00
B	20,00
C	14,00

- ✓ It is necessary to consider various factors for an evaluation.
- ✓ Our system manages the information of environmental value and company information collectively.


Company A


Company B


Company C

	Input x	Output y
Company	Capital (million yen)	CO_2 reductions (GtC/year)
A	300	18,00
B	400	20,00
C	200	14,00

Concept of Efficiency by DEA

	Input x			Output y		
Company	Capital (million yen)	.....	waste production	CO_2 reductions (GtC/year)	.....	Employee
A	300	.....	43	18,00	.....	700
B	400	.....	57	20,00	.....	1,100
C	200	.....	39	14,00	.....	500

Data	x_{k1}	.....	x_{kN}	y_{k1}	.....	y_{kM}
Weight	w_{k1}	.....	w_{kN}	v_{k1}	.....	v_{kM}

$$Efficiency\ of\ Company\ k = \frac{Virtual\ Output\ of\ Company\ k}{Virtual\ Input\ of\ Company\ k} \rightarrow \theta_k = \frac{\sum_{j=1}^{M} v_{kj} y_{kj}}{\sum_{i=1}^{N} w_{ki} x_{ki}}$$

Maximize $\theta_d = \dfrac{\sum_{j=1}^{M} v_{dj} y_{dj}}{\sum_{i=1}^{N} w_{di} x_{di}}$

Subject to $\dfrac{\sum_{j=1}^{M} v_{dj} y_{kj}}{\sum_{i=1}^{N} w_{di} x_{ki}} \le 1 \qquad (k = 1,2,3,\cdots,K)$

$w_{di} \ge 0, \quad v_{dj} \ge 0$

Example of Efficiencies

$\theta_1 = 0.6$

$\theta_2 = 1.0$

$\theta_3 = 0.7$

Proposal of Evaluation Indicators

Select Input factors from $(x_{k1}, x_{k2}, x_{k3}, \cdots, x_{kN})$

Select output factors from $(y_{k1}, y_{k2}, y_{k3}, \cdots, y_{kM})$

$$\theta_k = \frac{\sum_{j=1}^{M} v_{kj} p_{kj} y_{kj}}{\sum_{i=1}^{N} w_{ki} q_{ki} x_{ki}} \qquad p_{kj}, q_{ki} = 0 \text{ or } 1$$

The most advantageous value of evaluation indicators for DMU k can be derived by solving for possible combination of $p_{kj}, q_{ki} = 0 \text{ or } 1$.

Maximize $$\theta_d = \frac{\sum_{j=1}^{M} v_{dj} p_{dj} y_{dj}}{\sum_{i=1}^{N} w_{di} q_{di} x_{di}}$$

Subject to $$\frac{\sum_{j=1}^{M} v_{dj} p_{kj} y_{kj}}{\sum_{i=1}^{N} w_{di} q_{ki} x_{ki}} \le 1 \qquad (k = 1,2,3,\cdots,K)$$

$$p_{kj}, q_{ki} = 0 \text{ or } 1 \qquad w_{di} \ge 0, \quad v_{dj} \ge 0$$

Case 1: Ranking based on p_{kj}, q_{ki} requested by governments' certification.

Case 2: Evaluation by applying consensus-based common values p_{kj}, q_{ki} .

Case 3: The most advantageous value of evaluation indicators for DMU k.

Conclusions

- We introduced our Social LCA System:
  - transparency : common inventory data
  - low costs : research institute initiatives
  - web-client/host server system
  - easy to operate: web-based user interfaces
  - governmental certifications

  Incentives as the driving force for widespread use

- We discussed evaluation for branding:
  - Management of both environmental value information and company information
  - Necessity for governments' certification
  - industry's incentives to increase sales based on advantage