NOTE

Introduction of LCA (Life Cycle Assessment)

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1 Introduction

With recent close attention to global environmental issues, disclosure of LCA (Life Cycle Assessment) data as the product environmental information to society has become a trend among companies.

Behind the trend, those companies are willing to disclose their efforts toward "Eco-design" at the design stage that has a great influence on the product life cycle.

LCA is the method defined in ISO14040 for quantifying the environmental impacts through a product life cycle (materials, design, manufacturing, logistics, use and disposal) in terms of carbon dioxide (CO_2).

FUJITSU TEN has implemented LCA for some specific models since FY 2004 responding to the requests from car manufacturers. However, we did not establish the system for calculating CO_2 emissions based on FUJITSU TEN rules. Ahead of competitors in the calculation and its disclosure, FUJITSU TEN implemented LCA, as a trial, for the main models of our AE (Automotive Electronics) and CI (Car infotainment) products in FY 2007, and established the framework of its approach.

In FY 2008, we will implement LCA for the main products in all our product categories and promote its standardization. This paper elaborates the trial results and our future efforts.

2 Our Eco-design

2.1 Efforts until Today

As shown in **Fig. 1**, we have placed top priority on legal compliance in eco-design.

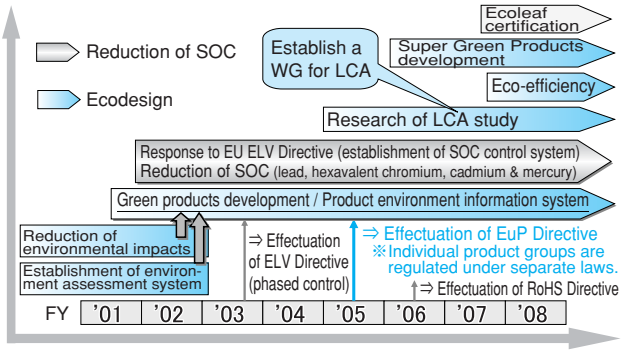

Fig.1 Our Efforts in Responding to Eco-design

Since ELV (End of Life Vehicle) Directive took effect in EU, we have focused on reduction of SOC (Substances Of Concern). But, we launched a working group for the introduction of LCA from FY 2007 and decided to establish its standardized procedure in our company.

2.2 Product Environment Assessment

We established the system for product environment assessment in 1995 and have promoted the reduction of environmental impacts of our products at the design / development stage.

Our product environment assessment comprises three categories: "energy saving / resource saving," "recycling," and "non-use of SOC." And each category has questions about green achievements. According to the achievements of each category, green evaluation (overall evaluation score) is calculated out of 100 points. When the green evaluation does not reach a certain point, or when a product does not comply with laws / regulations, such as the case where a product contains a prohibited substance, the product "fails" the green evaluation and its mass production is not allowed. The green evaluation target is set as one of our mid-term targets and we have improved the score year after year.

However, the green evaluation score does not represent environmental impacts quantitatively and could not be used as a green indicator for disclosure to society.

2.3 Environmental Action Plan

In the Environmental Action Plan that FUJITSU TEN group created based on the mid-term plan, we set a goal of expanding LCA in compliance with the standard of the car industry to all our new products by the end of FY 2009 and to improve our system to disclose LCA data.

In addition, in FY 2008, we will calculate eco-efficiency (discussed later) for which LCA value is used as a part of the indicators and we will double the efficiency by the end of FY 2012. Moreover, we aim to materialize Super Green Products (discussed later), which have excellent environmental performance, in our four product categories by the end of FY 2009.

Hereinafter, the details will be described.

3 What is LCA?

3.1 Definition of LCA

LCA is the method for understanding environmental impacts of a product quantitatively through its life cycle. Therefore, the environmental impacts need to be calculated in each of the following stages. (Refer to **Fig. 2**.)

①Materials: mining of resources, manufacturing of materials / parts
②Design: office, evaluation equipment
③Manufacturing: production lines
④Logistics: transport of parts and products
⑤Use: in vehicles
⑥Disposal: shredded, for landfill sites, etc.

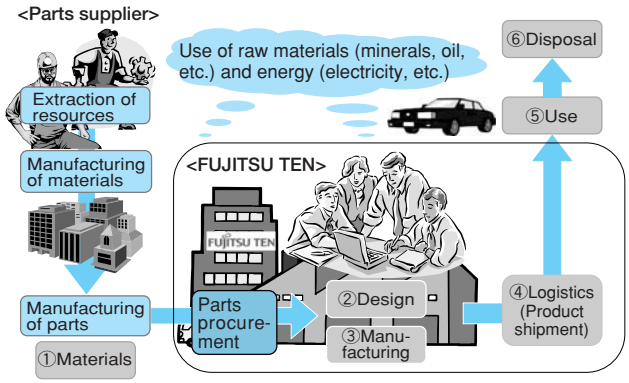

Fig.2 Product Life Cycle

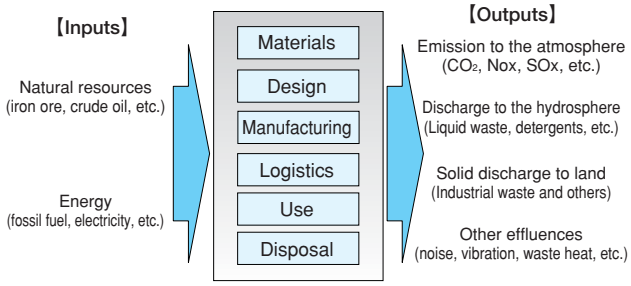

Fig.3 Inputs and Outputs in Product Life Cycle

In order to implement LCA, the purpose and survey range of LCA are defined, and resource consumption and amount of emission in the life cycle of an applicable product are calculated. Here, environmental impacts include not only emission to the atmosphere but also discharge to the hydrosphere and solid discharge to the land. And greenhouse gases other than CO_2 are also included as the emission to the atmosphere in some cases. (Refer to **Fig. 3**.)

However, in many cases, "CO_2 emission to the atmosphere" is defined as "the survey range" mentioned above.

FUJITSU TEN also decided to calculate easily visualizable CO_2 in consideration of the balance among development of global warming, the significance of CO_2 impact, and its influence on the product life.

3.2 Why Does LCA Need to be Introduced?

FUJITSU TEN introduced LCA from the following viewpoint.

①Customer requests

We have been requested by our customers to submit LCA data of our products that are car parts for them.

The procurement guidelines of some customers refer to LCA data submission.

②Information disclosure

Since the LCA data is calculated based on the international standard (ISO14040), it is so objective and reliable that it is suitable to be disclosed as quantified values of our environmental activities.

Recently, many manufactures post the LCA data on their website.

③Regulatory compliance

The conventional laws targeted only a certain period of a life cycle such as "use stage." However, it is expected that a law targeting the entire life cycle will be established.

The EuP (Energy-using Products) Directive, an EU directive regarding eco-design, is the framework for mandatory requirements of environmental performance through the entire life cycle of products as a part of measures against global warming. It demands assessment of environmental impacts through the product life cycle and storage of the assessment data. In the EuP Directive, rules of procedure are to be established for each product group, but our products are not included as the applicable products. Nevertheless, FUJITSU TEN decided to introduce LCA partly because of complying with the EuP Directive.

Table 1 History of Laws Related to Products

Chronological order	Past	Today	Future
Typical laws	Product Liability Law	ELV/RoHS/WEEE Directives	EuP Directive (framework)
Stage	Use	Designing/disposal/recycling	Entire life cycle

3.3 Trend of Other Companies

The car industry and consumer-electronic industry are leading the way in the LCA data. Companies in those industries disclose the data to users in their catalogue or through other media showing environmental impacts at all stages such as manufacturing, using, disposal, etc. of a product.

Recently, many companies are using "eco-efficiency" (discussed later) with which CO_2 emission (LCA value) can be assessed to the product value and disclosing an eco-efficiency factor that shows the improvement level of the value. We too will promote the eco-efficiency calculation at the same time as the LCA calculation.

4 LCA Trial and Its Results

4.1 Model Selection

We decided to implement LCA for one model each of AE products and CI products, as our main products, in FY 2007 and to expand the range of subject products to our all product categories in FY 2008. We decided to assess airbag ECU (Electronic Control Unit) as a main AE product and AVN as a main CI product, and we selected specific models on such conditions as manufactured volume.

4.2 Calculation Method of LCA Value at Each Stage

We established a working group at each life cycle stage and the bureau in Environment Protection Dept. for the trial. We now explain a part of implementing method for each stage.

4.2.1 Materials

We calculated CO_2 emission by adding the four items below.

- **Electronic parts→ CO_2 emission coefficient/part × q'ty of used units**
- **PCB→ CO_2 emission coefficient/mm² × area of PCB**
- **Display→ CO_2 emission coefficient/inch × screen size**
- **Mechanical parts→ CO_2 emission coefficient/g of each material × weight × q'ty of the parts**

4.2.2 Design

We calculated the following three items using CO_2 emission coefficient, and allocate them according to production volume.

- **Electricity consumed in design**
- **Electricity consumed in reliability test evaluation**
- **Fuel consumed during test driving**

4.2.3 Manufacturing

We calculated CO_2 emission by measuring electricity consumed on the manufacturing floor, heavy oil, etc. and allocated it according to production volume.

4.2.4 Logistics

We calculated the CO_2 emission by summing up the values from the following three logistics groups.

- **CO_2 emission during distribution of the products (land)**
- **CO_2 emission during distribution of procured parts for the products (land and sea)**
- **CO_2 emission during distribution between our factories or between our factory and headquarters (land and sea).**

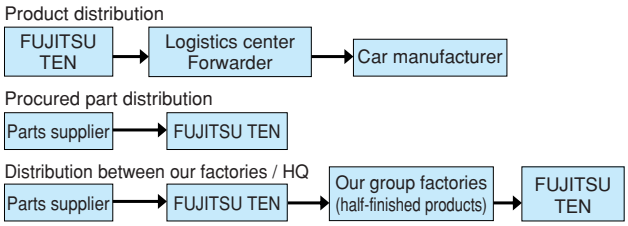

Fig.4 Distribution Groups where CO_2 Emission is Calculated at Logistics Stage

4.2.5 Use

On the assumption that the products are used in vehicle, we calculated the LCA value at the use stage from the following formula and allocated it based on the average weight of vehicles and the weight of the product.

- **CO_2 emission/km × driving distance/year × years of use**

We calculated the CO_2 emission per km and the weight from the average of vehicles among the most sold vehicle and the others accounting for half of the total sales.

4.2.6 Disposal

On the assumption that the products are disposed as parts of a vehicle, we summed the CO_2 emission of the following two items and allocated it based on the average weight of vehicles and the weight of the product.

- **CO_2 emission when the car is shredded**
- **CO_2 emission when the automobile shredder residue is disposed of in a landfill site**

4.3 Results and Observations

Fig. 5 shows the results of the LCA trial.

The adequacy of the values gained from the trial were verified at each stage.

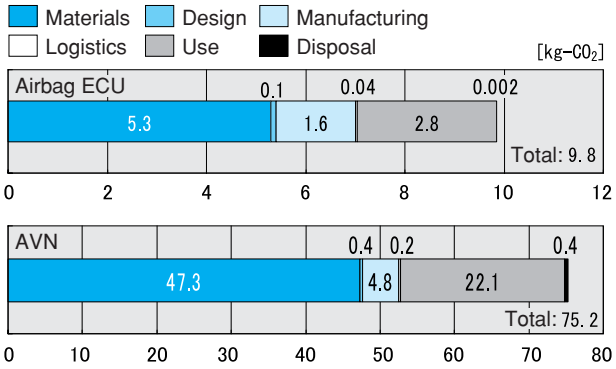

Fig.5 Trial Results of LCA in FY 2007

As shown in **Fig. 5**, the material stage and the use stage account for the majority of CO_2 emission in the life cycle of those products.

Therefore, it would be said that the effective measures to cut CO_2 emission through life cycle are reducing their weight (saving weight and fewer parts) that is the base of the calculations at these stages. However, we need to find comprehensive measures to reduce CO_2 emission because reducing CO_2 at one stage may lead to an increase at another stage.

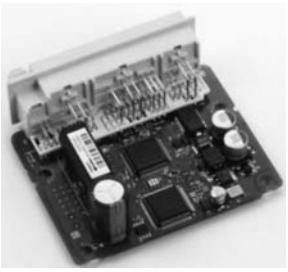

Fig.6 Airbag ECU

Fig.7 AVN

5 Future Action

5.1 LCA Disclosure

We think disclosure of the LCA trial results encour-

ages our engineers to recognize again that CO_2 emission is effectively reduced by miniaturizing our products, saving their weight and selecting optimal parts.

In the future, we will disclose LCA values to society in our after market product catalogues and on our website. Also, we will promote the disclosure in compliance with the Ecoleaf.

5.2 Eco-efficiency Factor

These days, companies make public eco-efficiency, an indicator that can show environmental impacts along with product value, on their sustainability report and/or website.

The indicator is expressed as a fraction with environmental impacts as denominator and with product value as numerator. That means eco-efficiency will double if the environmental impacts are halved and the product value is the same.

The eco-efficiency ratio of a new product to the baseline product is referred to as "eco-efficiency factor." We will establish the baseline value in FY 2008 and endeavor to achieve the eco-efficiency factor of 2.0 in FY 2012. (Refer to **Fig. 8**.)

$$\text{Environmental efficiency} = \frac{\text{Product value}}{\text{Environmental impacts}}$$

$$\text{Environmental efficiency factor} = \frac{\text{Environmental efficiency of a new product}}{\text{Environmental efficiency of the baseline product}}$$

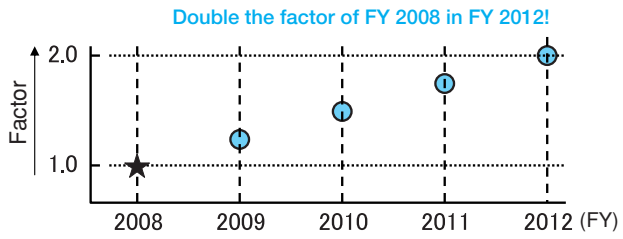

Fig.8 Eco-Efficiency and Eco-Efficiency Factor

5.3 Super Green Products

FUJITSU TEN has certified its products that meet certain environment assessment criteria and are significantly improved to be eco-friendly as Green Productproduct with enhanced environmental consideration).

In addition, it has introduced Super Green Products (product with superior environmental consideration) to the market in FY 2007 based on the FUJITSU Group standard.

Candidate products to be certified as Super Green Products are Green Products of which environmental performance is at the industry-leading level in one of the following points.

- **Energy saving**
- **3R (Reduce, Reuse, Recycle) design / technology**
- **Reduction in substances of concern etc.**

Since the FUJITSU group standard is not designed for in-vehicle products, we will establish our own standard applicable to in-vehicle products and introduce a Super Green Product from each of our production categories into the market in accordance with the standard in FY 2008. **Fig. 9** shows the position image of Super Green Products.

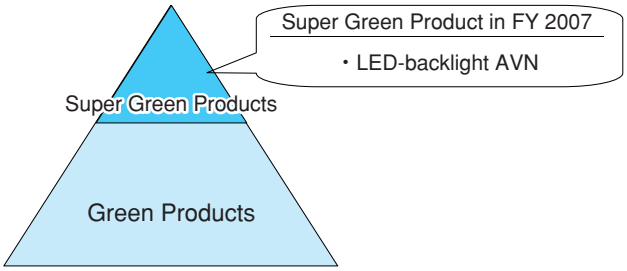

Fig.9 Position Image of Super Green Products

6 Conclusion

We have just launched LCA as a company-wide project in FY 2007. We organized working group activities in which representatives from each department participated, but we experienced difficulties. We had to exclude some areas from the LCA calculation because their detailed information was insufficient. On the contrary, we calculated other areas in too detail because we did not know the degree of their influence on the entire LCA.

We will review the range of the calculations and improve its accuracy in FY 2008 while simplifying the calculation in the areas that have little influence on the entire LCA.

We will develop an automatic calculation tool at the same time.

We hope all of our engineers will be able to use the LCA for design and believe that FUJITSU TEN has a mission to contribute to environmental protection by introducing eco-design products designed by them in the near future.

Profiles of Writers

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Entered the company in 1991. Since then, has engaged in promotion of green product development by way of CI product development, on-vehicle LAN control and E-iSERV operation. Currently in Environmental Protection Department.

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