Method for Approving ICT Solutions as Environmentally Conscious

● Takafumi Hashitani ● Shigeharu Suzuki ● Yuzo Horikoshi

(Manuscript received February 17, 2005)

Fujitsu Laboratories has developed an environmental burden assessment method for approving information and communication technology (ICT) solutions as environmentally conscious solutions. By separating environmental burdens into eight root factors (e.g., resource consumption, human transportation, and waste generation), this method estimates environmental burdens before and after an ICT solution is introduced. One particular characteristic of this method is that changes in operating efficiency, documentation space, and equipment floor space due to ICT introductions are collectively represented as changes in office space. We used this method to evaluate how various ICT solutions have reduced environmental burdens. We found that, of the eight factors, the biggest reductions in environmental burden in most cases were due to office-space reductions, which reduced working person-hours and therefore energy consumption.

1. Introduction

When the Kyoto Protocol enters into effect on 16th February 2005, the countries of the world will become more actively engaged in efforts to prevent global warming. Although Japan is committed to a 6% decrease in greenhouse-gas emissions between 2008 and 2012 compared to the 1990 level, Japan actually increased its emissions by about 8% in 2002. Clearly, the goal is not easy to meet.

Through information and communication technology (ICT) products and solutions, Fujitsu is adopting an environmental policy that will help its customers reduce their environmental burdens and improve their environmental efficiency. Aiming at concrete measures, we have established a system for approving environmentally-conscious solutions that effectively reduce environmental burdens.[1] This paper explains our environmental burden assessment method, which is the cornerstone of this approval system.

To examine the possibility of reducing environmental burdens by introducing ICT, we developed the assessment method mentioned above.[2)-6)] This method estimates environmental burdens before and after the introduction of a solution based on eight factors (e.g., resource consumption, human transportation, and waste generation). One particular characteristic of this method is that it collectively represents changes in operating efficiency, paperwork, and equipment floor-space in terms of changes in office space.

This paper describes the concept behind the assessment method and describes its use in two case studies: one for a materials-procurement service and another for an electronic administration service for local authorities. It then describes a trend analysis of reductions in environmental burdens that are achieved by implementing various solutions.

2. Environmental burden assessment method for software and services

This method evaluates how the software and services of ICT solutions affect environmental burdens in terms of CO_2 emissions and quantifies how changes made by solutions to eight selected factors affect environmental burdens. The first factors that are considered are the changes in paper consumption, human transportation, goods transportation, storage space (in terms of materials flow and stock storage), and the introduction of ICT equipment. Then, changes in consumption of other resources, for example, compact disks (CDs), and the improvement of services using the Internet are forecast. In particular, the improvement in operating efficiency, which is the main goal when introducing an ICT solution, can be assessed in terms of environmental burden.

The first seven of the factors in this method are as follows: resource consumption, human transportation, goods transportation, office space, warehouse space, electrical power consumption of ICT and network equipment, and network data communication volume (**Figure 1**). Each of these factors is converted into an equivalent unit weight of CO_2 emission.

Then, the eighth factor — waste generation — is converted into a total weight, and the total environmental burden is estimated. **Table 1** lists definitions of the eight environmental burden factors, and **Table 2** lists the estimated CO_2 emission unit weight for each factor.

The estimation of environmental burdens before and after the introduction of solutions is done by accumulating data about each investigated factor and then calculating the environmental burden for each factor in standard units.

The targets for each of the investigated factors are as follows:

1) Resource consumption: Increases and decreases in CD media, documentation, paper, and other factors accompanying the introduction of a solution.
2) Transportation of people and goods: Total amount of transportation of people and goods by cars, trains, planes, and other means.
3) Office space: Total amount of workspace area, documentation storage, and server equipment floor space.
4) Warehouse space: Area for shipping storage.
5) Power consumption of ICT and network equipment: Electricity consumption of the equipment.
6) Network data communication volume: Data volume transmitted over a network.

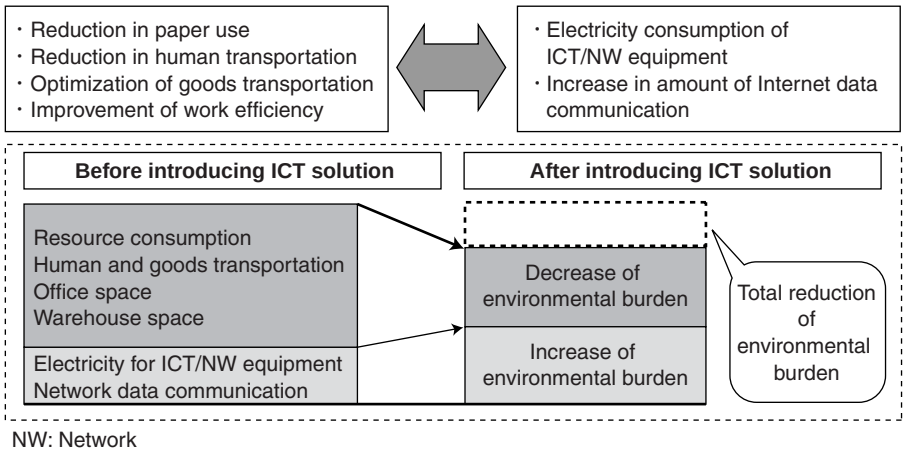


Figure 1
Environmental effects of introducing ICT.

Table 1
Eight environmental burden factors of ICT solutions.

(1) Resource consumption	CO_2 emissions of product manufacturing stage
(2) Human transportation	CO_2 emissions of transportation (cars, trains, planes, etc)
(3) Goods transportation	CO_2 emissions of transportation (trucks, trains, planes, etc)
(4) Office space	CO_2 emissions from energy consumption of air conditioning and other electrical devices, and CO_2 from gas and gasoline used in offices as a power source
(5) Warehouse space	CO_2 emissions from energy consumption of air conditioning and other electrical devices
(6) Electricity for ICT/NW equipment	CO_2 emissions of ICT/NW equipment electricity consumption
(7) Network data communication	CO_2 emissions relating to data communication
(8) Waste generation	Waste generation during manufacturing and final disposal

Table 2
Methods of calculating CO_2 emissions for factors listed in Table 1.

(1) Resource consumption	Paper use (A4 sheets/year) × paper weight (kg/sheet) × paper unit (kg-CO_2/kg)
(2) Human transportation	Car transportation (person·km/year) × car unit (kg-CO_2/person·km)
(3) Goods transportation	Truck transportation (t·km/year) × truck unit (kg-CO_2/t·km)
(4) Office space	Person-hours (persons) × office space (m^2/person) × office space unit (kg-CO_2/m^2·year)
(5) Warehouse space	Warehouse space (m^2) × warehouse unit (kg-CO_2/m^2·year)
(6) Electricity for ICT/NW equipment	Electricity (kW) × operation time (hour/year) × electricity unit (kg-CO_2/kWh)
(7) Network data communication	Data communication (Mbyte/year) × data communication unit (kg-CO_2/Mbyte)

In particular, as for office space, because operating efficiency can be improved by introducing solutions, it is thought that person-hours will fall and the occupied floor-space for related services (office space) will be reduced.

The environmental burden is estimated from the following two values:

Environmental burden due to energy consumed by an office building per year:

$$87.7 \text{ kg-}CO_2/m^2 \cdot \text{ year}^{7)} \quad (1)$$

$$\text{Workspace per person: } 13.1 \text{ } m^2/\text{person}^{8)} \quad (2)$$

Accordingly, the CO_2 emission unit weight per person for an office building is calculated on the basis of (1) × (2) as 1149 kg-CO_2/person · year.

3. Case studies

We now describe two examples of environmentally-conscious solutions: one for a materials-procurement service and another for an electronic administration service. By digitizing, standardizing, and commoditizing information, both of these solutions realize quick and efficient business transactions within company departments and between different companies.

It is anticipated that the introduction of these solutions will have the following effects:

1) Communication and information sharing will become instantaneous, so environmental burdens due to resource consumption and transportation will be reduced.
2) Communication and information sharing will improve, so environmental burdens due to person-hours will be reduced.

Example 1: Materials-procurement service

The materials-procurement service uses an application service provider (ASP) to support transactions in product parts, from the approval, ordering, and receiving stages, between supplier and buyer companies (**Figure 2**).

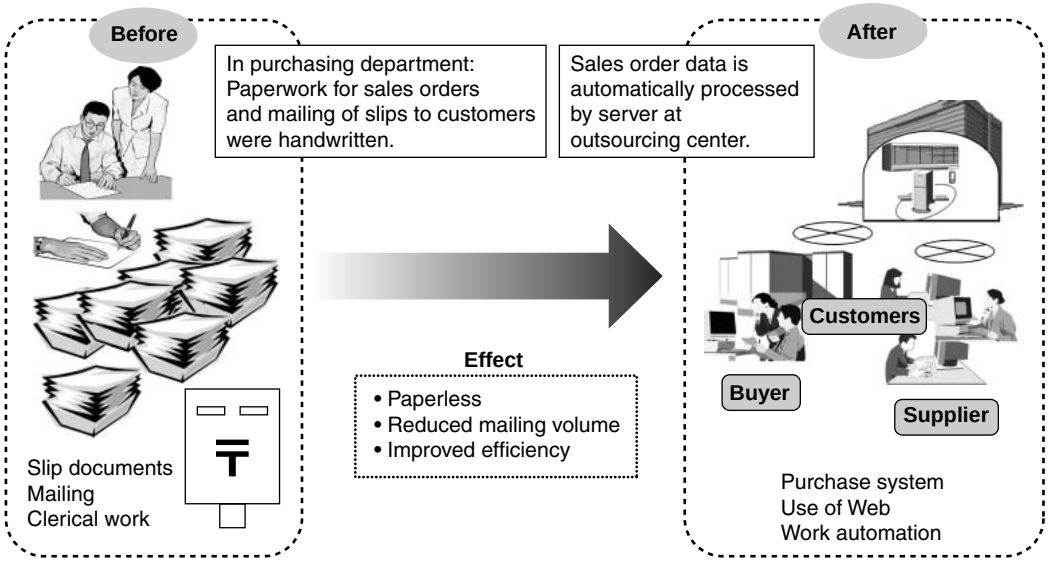


Figure 2
Before and after introducing materials procurement service.

The results of introducing this service are shown in **Figure 3**. As the figure shows, introducing the service decreased the CO_2 emission volume by 97%. In particular, the main factor contributing to the overall reduction is a 52% reduction in the amount of human transportation. Also, the increase in CO_2 emission volume based on the electricity consumption and network data communication volume accompanying the introduction is insignificant.

Example 2: Electronic administration service

The electronic administration service enables electronic approval of forms and documents used by local governments for accounting, salaries, general affairs, and other purposes (**Figure 4**).

The results of introducing this service are shown in **Figure 5**. As the figure shows, the service reduced the CO_2 emission volume by 44%. Particularly, the main factor contributing to the overall reduction is a 39% reduction in the office space used for handwritten approval. Also, as in Example 1 above, the increase in CO_2 emission volume based on the electricity consumption and network data communication volume accompanying the introduction is insignificant.

4. Trend analysis

Figure 6 shows a bar chart of the increases and decreases in CO_2 emissions due to the introduction of various ICT solutions.

The 23 solutions in the figure include the two examples described above. As can be seen, in most cases (14 solutions), the biggest reductions in CO_2 emissions are due to reductions in office space. The next CO_2-reducing factors, in decreasing importance, were transportation of people and goods (four solutions), electricity for ICT equipment (two solutions), resource consumption (two solutions), and warehouse space (one solution).

Although person-hours, documentation space, and ICT space are all factors reflected in office space, among them, the decrease in person-hours makes the biggest contribution to reducing CO_2 emissions. Therefore, when customers introduce a solution, we advise them to focus on promoting efficiency, which in turn will have the effect of reducing the environmental burden.

Although the electricity consumption of ICT equipment increases the environmental burden in many cases, when clients' legacy systems (e.g., mainframes) are replaced with new client/server systems and Web systems, power savings

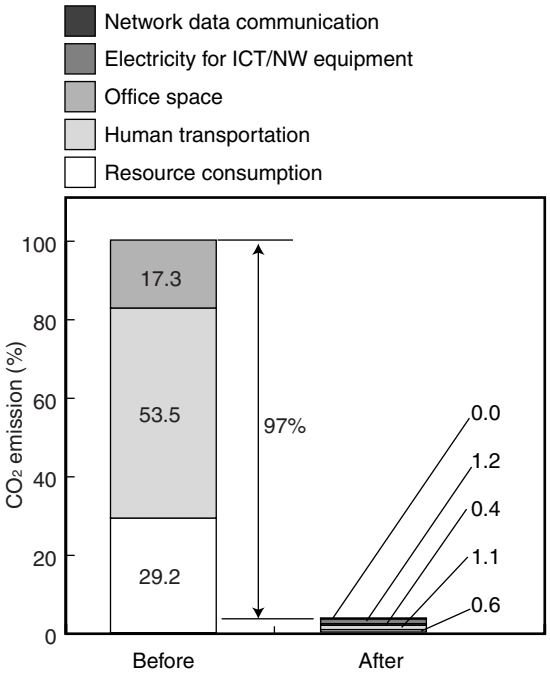


Figure 3
Environmental burdens before and after introducing materials procurement service.

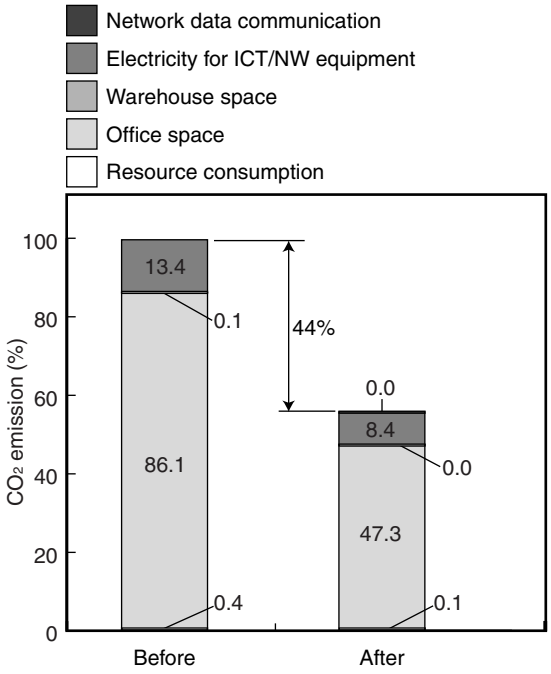


Figure 5
Environmental burdens before and after introducing electronic administration service.

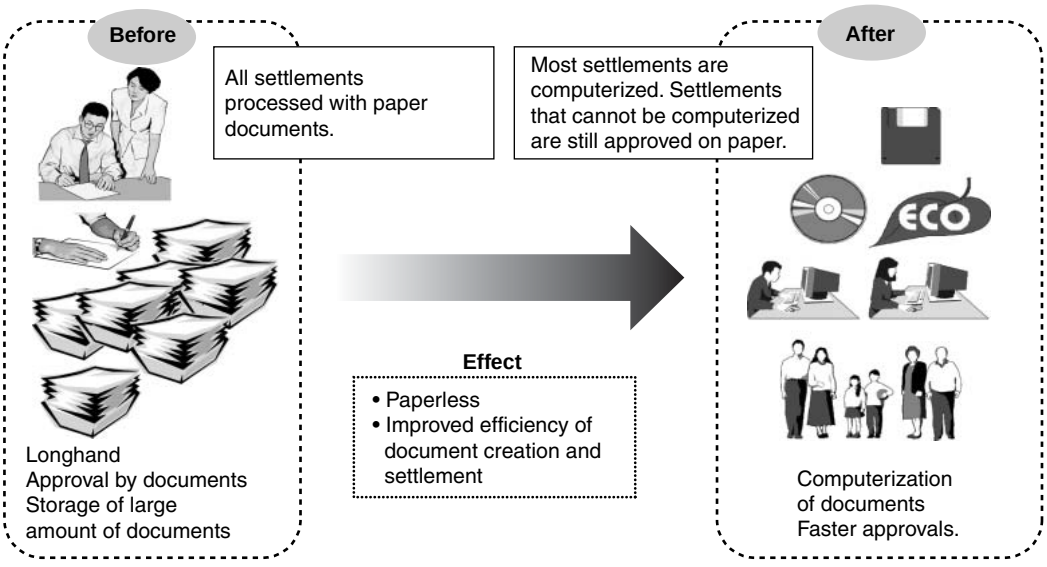
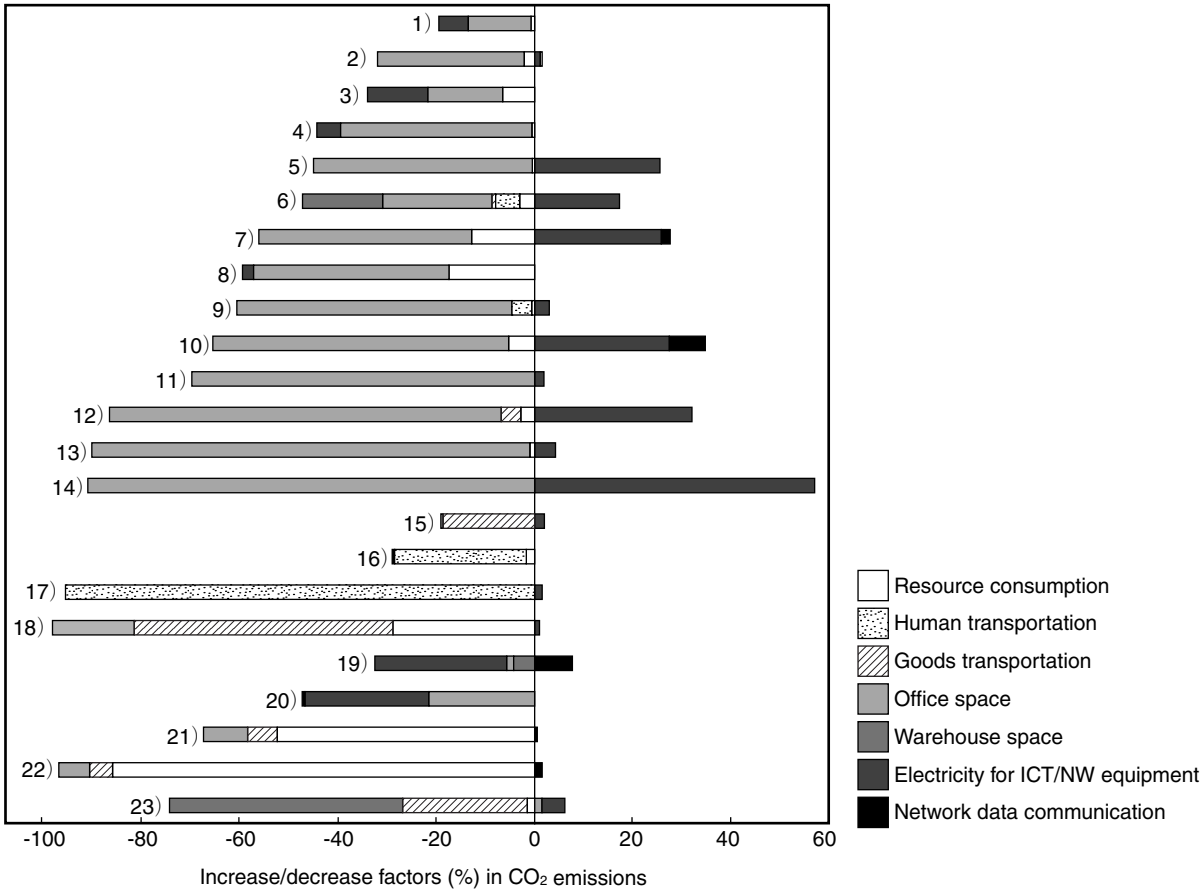


Figure 4
Before and after introducing electronic administration service.



1) Install service
2) Consulting service
3) Personnel administration and payroll service
4) Electronic administration service
5) Financial data warehouse service
6) Management service of automatic teller machines
7) Electronic administration of application and approval service
8) Computerization service of office work for a financial organization
9) Electronic data capture solution
10) Electronic medical data solution
11) Application management outsourcing service
12) Computerization service of office work for a university
13) Environmental product information service
14) Environmental database service
15) Driving information service
16) Virtual product simulator service
17) e-learning service
18) Materials procurement service
19) Dam management service
20) Facilities management service
21) Document computerization solution
22) PC lifecycle management service
23) Electronic document management solution

Figure 6
Analysis of CO_2 emissions for ICT solutions.

related to hardware will be gained, and these savings will be the main factor in reducing the environmental burden.

Moreover, other than solutions such as the computerization of manuals, very little of the CO_2 emission reductions achieved by these solutions is due to reductions in resource consumption.

5. Conclusion

We have devised a method for examining how ICT solutions reduce environmental burdens based on eight factors and evaluating how they improve business operations. We used this method to evaluate how introducing various Fujitsu ICT solutions have affected environmental burdens. We found that, of the eight factors, the biggest reductions in environmental burden in most cases were achieved through reductions in office space, which reduced working person-hours and therefore reduced energy consumption.

In the future, to improve reliability when evaluating environmental burden changes due to an ICT solution, it will be necessary to promote the use of standard units for indicating environmental burdens. Furthermore, by evaluating the ICT introductions mentioned above, we will reduce the environmental burdens of our products and services and link them together to reduce the overall environmental burden of human activity.

References

1) M. Nishikawa et al.: Reduction of Environmental Burden by Environmentally Conscious Solutions. *FUJITSU Sci. Tech. J.*, **41**, 2, p.147-152 (2005).
2) T. Hashitani et al.: IT and Environmental Burden Evaluation Technology. (in Japanese), *FUJITSU*, **54**, 6, p.524-529 (2003).
3) S. Suzuki et al.: Environmental Evaluation of Software Services (1) Development of New Evaluation Method. (in Japanese), 13th Symposium, The Japan Institute of Energy, 2004.
4) K. Nakazawa et al.: Environmental Evaluation of Software Services (2) Case Studies. (in Japanese), 13th Symposium, The Japan Institute of Energy, 2004.
5) T. Hashitani et al.: Methodology for Evaluating the Environmental Burden of ICT. 6th Ecobalance International Conference, 2004.
6) K. Nakazawa et al.: Assessment of Environmental Effects of Using IT Solutions. 6th Ecobalance International Conference, 2004.
7) Commercial and Residential Sector Energy Data Survey. The Institute of Energy Economics Japan, 2001-11. (in Japanese).
8) Building Owners and Managers Association, Japan. (in Japanese). *http://www.birukyo.or.jp*

Takafumi Hashitani received the B.E. and M.E. degrees in Science Education from Kanazawa University, Kanazawa, Japan in 1984 and 1986, respectively. He joined Fujitsu Laboratories Ltd., Atsugi, Japan in 1986, where he has been researching and developing biodegradable materials for electronic products. He is currently developing a methodology for LCA (Life Cycle Assessment). He is a member of the Institute of Life Cycle Assessment, Japan (ILCAJ).

Shigeharu Suzuki received the B.E. degree in Pure and Applied Chemistry from Tokyo University of Science, Noda, Japan in 1987. He joined Fujitsu Laboratories Ltd., Atsugi, Japan in 1987, where he has been researching and developing organic recordable materials for electronic devices.

Yuzo Horikoshi received the B.S. and M.S. degrees in Chemistry from Niigata University, Niigata, Japan in 1986 and 1988, respectively. He joined Fujitsu Laboratories Ltd., Atsugi, Japan in 1988, where he has been researching and developing organic materials. He is a member of the Institute of Life Cycle Assessment, Japan (ILCAJ).