지속가능경영을 위한 환경정보통합관리 사례

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Integration of environmental information for sustainability Management

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ABSTRACT

As sustainable management of companies becomes highly necessary, the need to manage various information within a company concerning environment using computerized system is also increasing. Computerized system for environmental information management or environmental regulation response which is gaining new attention lately under the name of "Green IT", can be seen as an extension as well. This paper examines recent corporate issues related to environment and then moves on to examine the necessity of systemizing environmental data. Furthermore, the functions and benefits of the system are assessed through case studies and the key factors that are to be considered in establishing the system are suggested. SMIS(Sustainable Management Information System) of Samsun SDI as means of sustainable management and Hazardous Substances Management System of Korea Electronics Association as means of environmental regulation response are introduced for case studies..

요약문

기업의 지속가능경영 필요성이 높아짐에 따라 환경과 관련된 기업 내의 다양한 정보도 전산화하여 관리할 필요가 높아지고 있다. 최근 "그린 IT"라는 명칭으로 새로이 주목 받고 있는 환경정보관리나 환경규제 대응을 위한 전산시스템도 그 연장선으로 볼 수 있다. 본 논문에서는 최근 기업의 환경관련 이슈를 살펴보고 환경관련 데이터의 시스템화 필요성에 대하여

살펴보았다. 또한 실 사례를 통하여 시스템의 기능과 효용성을 평가하였으며 시스템 구축 시 고려되어야 할 핵심사항이 제시되었다. 사례로서는 지속가능경영의 수단으로서 삼성SDI의 SMIS(Sustainable Management Information System)과 제품의 환경규제 대응 수단으로서 한국전자산업진흥회의 유해물질관리시스템이 소개되었다.

1. Environmental issues in industries

As the global awareness on the environment increases, industries are also facing more challenging and diversifying environmental issues than ever. Legal pressures not only affect production but also products. Stakeholders now range from local residents of a company to consumers, NGOs, and even investors. Therefore the environmental management of industries has to shift from end-of-pipe and cleaner technology to sustainable development.

For sustainable development, a holistic approach is needed to cover issues of so called triple bottom lines; environment, economy, and society. Moreover, the object of environmental control is not only limited to production process and is urged to expand to product-life cycle. According to the paradigm shift, technologies such as quantification of environmental impact and optimization among different values of different stages on product lifecycle are important.

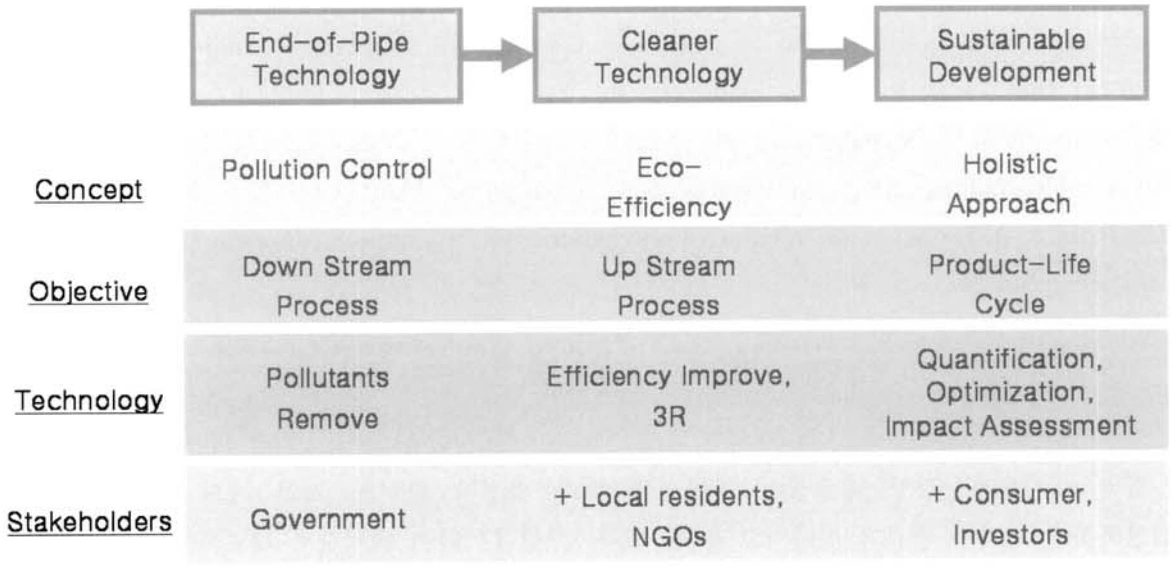

Figure 1. Paradigm shift of environmental management.

2. Reasons for integrating environmental data

2.1. To facilitate sharing environmental information

Increasing number of companies are adopting an Environmental Management System (EMS), to reduce environmental impact of their business. The EMS is a systematic tool to measure environmental impacts and manage its'risks of activities at all levels, from manufacturing to procurement, marketing, and product development. The selections of raw materials of the procurement section, for example, can affect the pollutants emissions from manufacturing shop. The marketing policy has to consider the eco-profile of the product. That means the environmental data should flow through the functional sections of a company for a successful operation of EMS. If we call it as the vertical integration of environmental data, other dimensions of integration are also necessary to consider a life-cycle of a product. To evaluate the environmental profile of a product, all stages ranging from raw material handling to manufacturing, usage, and final disposal areto be considered. It means the company should gather data from both internal and external of its own operational boundary. As Life Cycle Assessment (LCA) becomes a common practice in industries, LCA data communications between organizations in a same supply chain happens quite openly.

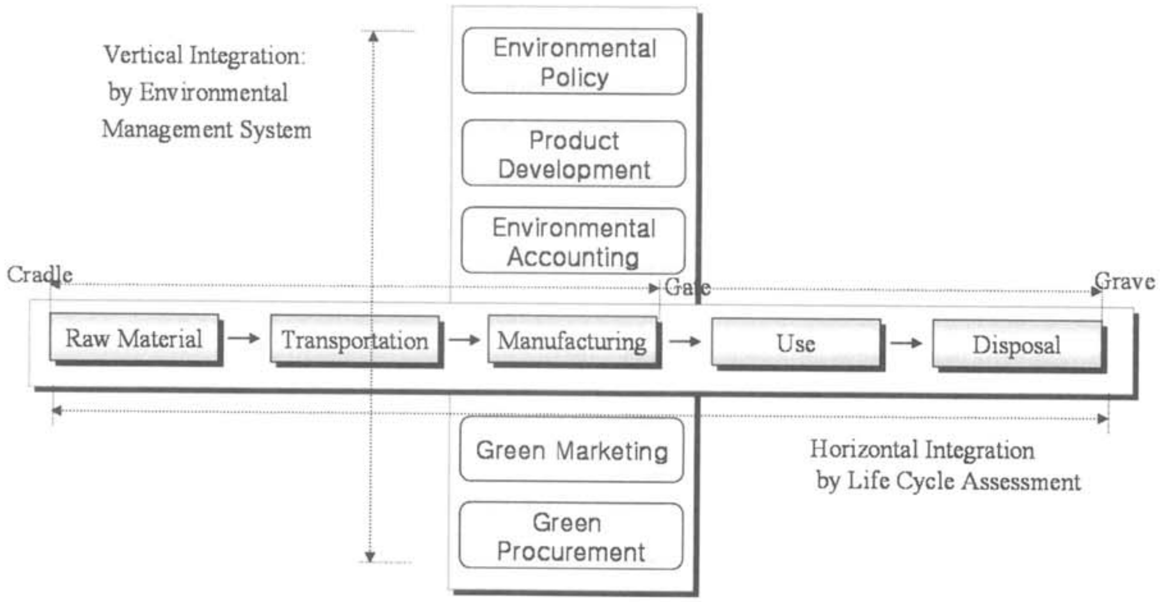

Figure 2. Vertical and horizontal integration of the environmental information.

2.2. To comply with regulation on product

The necessity of horizontal integration of environmental data is highlighted when it comes to the product-based regulation. In the case of RoHS,[1] the hottest issue in the electronics industry, the set-maker should keep certain hazardous substances under required level. To comply with RoHS, the company should know the concentration of those hazardous substances of the parts purchased from outside of the company. Gathering those data needs quite a lot of resources even for ordinary electronics products. When a company has some brand of electronics frequently changing its designs, an integrated computational system is needed to manage all the data. Many parts maker in the electronics industry are increasingly facing data enquiries from customer companies.

2.3. To quantify environmental performance

Communicating on environmental performance with stakeholders is becoming a common practice for organizations. The international standard for the Environmental Performance Evaluation, ISO 14031, recommends a company to assess broad range of indicators in the area of its operational and managerial environmental performance as well as the environmental condition. Because all the activities of an organization are related to environmental performances both directly and indirectly, gathering and calculating data are not a simple job. Considering that the EPE is one of the core parts of EMS, an integrated data system can facilitate the sustainability management of an organization.

Many organizations are publishing an Environmental Report since mid '90s. However, after 2001, it is required to mention not only environmental performance but also economic and social aspects of the organization. To respond to the requirement, some leading companies are now publishing Sustainability Reports which usually accompanies 3rd-party verification. The integrated data management system may improve the completeness and transparency of the report.

2.4. To evaluate indirect environmental performance

Cleaner production is a practice to reduce environmental impact by improving production process. Improvement of the process results in less consumption of resources such as energy, water and other raw materials along with reduction

1) RoHS (Reduction Of Hazardous Substances) European Union regulations enforceable on July 1, 2006 that set maximum concentration limits on hazardous materials used in electrical and electronic equipment. The substances are lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB) and polybrominated diphenyl ethers (PBDE)

of pollutants emission. In the perspective of supply chain, any reduction of resources can achieve reduction of pollutants emission, an indirect emission, in supplier's boundary. The indirect environmental performance is an important concept in an environmental profile of a product since every activity in a life-cycle of the product affects the profile. Indirect emission is also important regarding greenhouse gas (GHG) inventory. According to ISO 14064-1,[2] indirect GHG emission is classified as "energy indirect" and "other indirect" emission. Energy indirect emission is the emission from the generation of imported electricity, heat or steam consumed by the organization while other indirect emission is the emission due to a consequence of an organization's activities but arises from sources that are controlled by other organizations. Therefore, to implement GHG inventory, an organization should integrate data from both internal and external of its own operational boundary.

3. Samsung SDI case: Sustainability Management Information System

2) ISO 14064: International standard for the specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals

3.1. Background of the system

Samsung SDI Ltd. is the main producer of PDP, LCD and CRT of which annual sale is US$7.8 Billion in 2005. It has 17 global branches including 12 production's site and 2 R&D centre. As a display supplier to final set makers, Samsung SDI has been receiving many enquiries on environmental data of the products.If the company keeping all the data aligned to prepare those enquiries, the amount of data could amount to almost 10million; 2,400 models, average of 50 parts and 76 data per parts. The heavy load of data handling is one of the important reasons of introducing Sustainability Management Information System (SMIS).

Vertical integration of environmental information is another driving force of the system. Samsung SDI started company-wide campaign for sustainability management in 2004. Since then, the companyis leading the industry in sustainability management the company became a member of Dow-Jones Sustainability Indexes since 2004. As allthe functional units of the company are participating in the sustainability management, a core system is needed as a module of the Enterprise Resource Planning (ERP) for sharing environmental information within the company.

The system launched in Jan. 2006 and covers all sites and offices of the company in all around the world.

3.2. Modules and functions

The system is comprised of 6 modules;

- EMS module: It controls operational reports on environment facilities, toxic chemical data, and pollutants emission data, so on. All the data are managed real time, and used as basic data for LCA and Eco-Design (ED). EMS module cuts down manual input and improves data quality so that the EMS gets far more efficient.
- Environmental Accounting (EA) module: The module supports cost-benefit analysis of environmental investment and operation. It shares data with SAP, investment management system, and EMS. Samsung SDI has a plan to create environmental accounting guidelines and improve the level of environmental accounting methodology continuously.
- Green Procurement (GP)/ED module: GP/ED is composed of GP and ED. GP enables (subject) to cooperate with S-partners, the verified suppliers by Samsung Electronics Group, and assess environmental performance of their parts. Meanwhile, ED supports eco-design. Aligned with BOM data, the module enables to respond to customers' request on product environmental profile immediately. It makes recycling ratio analysis of all parts and products possible.
- LCA module: LCA quantifies material consumption and generation, energy

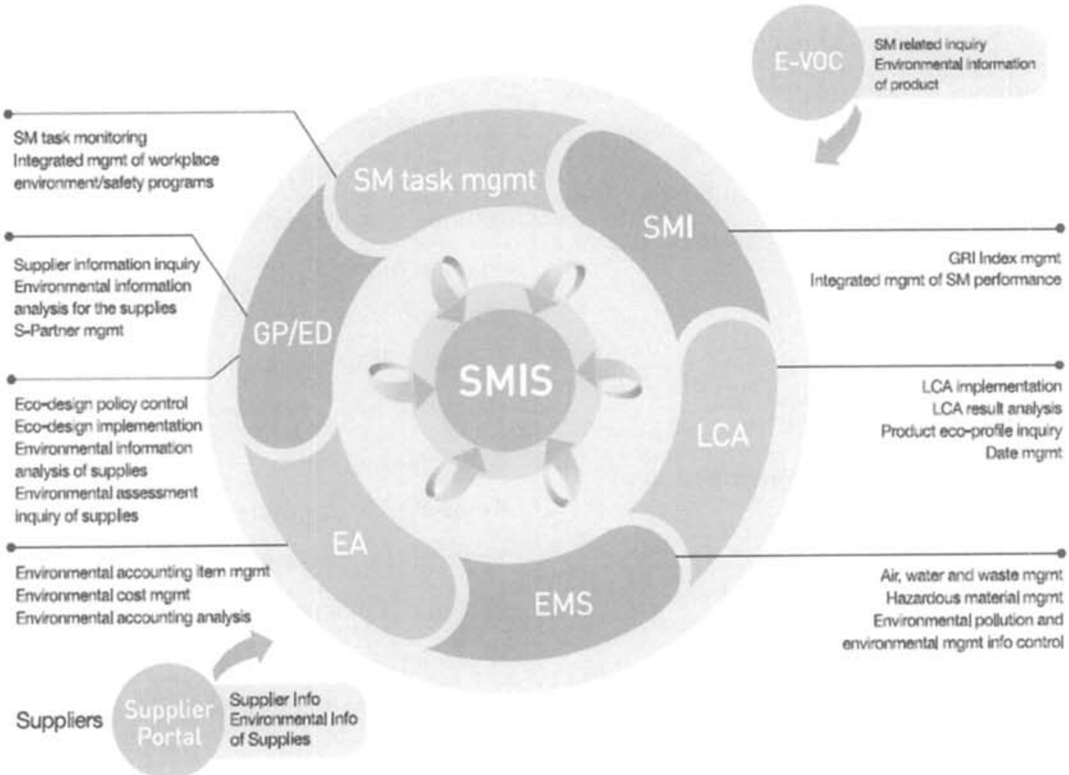

Figure 3. Modules and functions of SMIS.

use, and emission throughout the life cycle of a product and analyzes eco-friendliness of the product. It is linked to e-Energy system to allocate utility use by processes and collect basic LCA data of parts from suppliers. Linked to GP/ED module, time-series analysis for monthly recycling rate is made possible. It automatically generates LCA scores for all products developed in Samsung SDI.

- Sustainability Management Task management (SMT) module: Samsung SDI deploys many tasks to improve the sustainability of the company. The tasks, which are developed according to the company's SM strategies, are classified as the environmental and social area. SMT is a monitoring system for evaluation of SM task progress and status. All SM tasks have department/strategy codes to weigh up each department's efforts on SM.
- SMI (Sustainability Management Index management) module: SMI manages economic, environmental, and social indices to evaluate the sustainability of the company. Employees can access to indices selected according to the global standard. SMI provides a holistic view on SM progress and users can analyze in details status and situations by division and plant.

3.3. Business procedure with SMIS

- The SMIS is comprised of 4 functional modules (GP/ED, EMS, LCA, EA) and 2 SM modules and one integrated database. Legacysystems connected to the SMIS include GP and VOC (Voice Of Customer) modules and other ERP modules. All the modules exchanges relevant data through the integrated database.

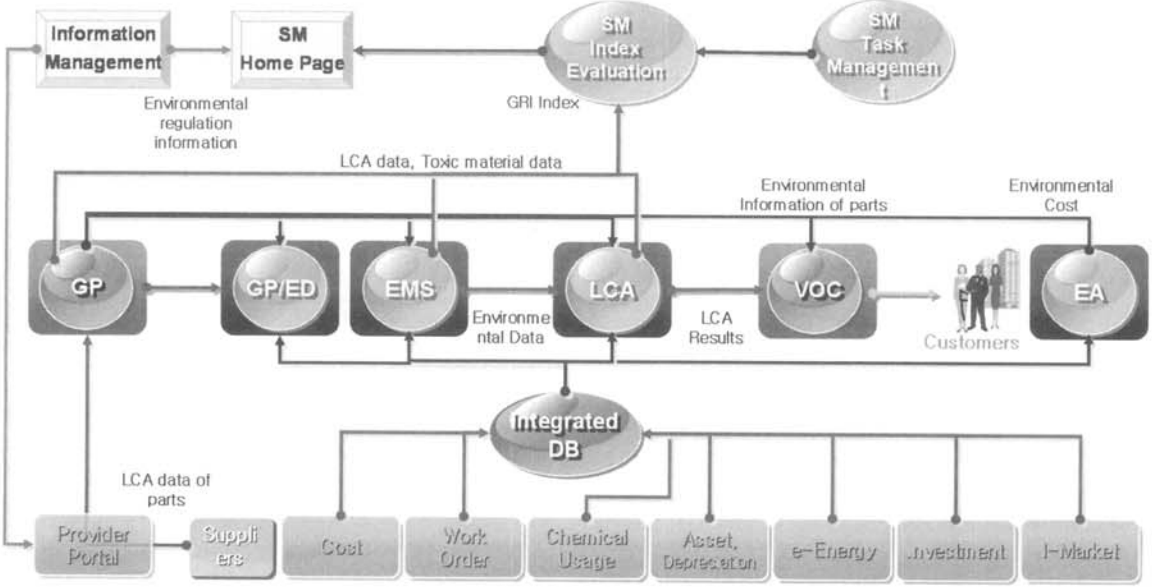

Figure 4. Data flows of SMIS.

Before SMIS was adopted, data communications with suppliers were done manually. Every time when Samsung SDI received a data enquiry from customer, they had to reply it manually. For this purpose, the company had to carry out LCA studiesor gather instant data from suppliers. This was tedious and time-consuming. After launching SMIS, VOCs are uploaded to the system and relevant data are prepared by computational process by the system. Human resources on this task have reduced dramatically. LCA study, for example, reduced from annual of 300man-day to 1.

The value of modules differs. Figure 6 shows the using frequency and effectiveness of each module. The using frequency was measured by click count of the system and effectiveness was measured according to the responses of questionnaires asked to staffs. GP/ED and EMS were used the most while the least were the LCA and EA. The result explains the difference of work load of employees on the issues. Work loads on GP/ED and EMS are heavier than LCA and EA. Even though LCA and EA are less used in frequency, their effectiveness still remains high since they support core data to the system.

3.4. Critical success factors and risk factors

SMIS is not simple. The system needs lots of resources and easily fails to keep the reliability of the functions. From the experience of Samsung SDI, following key success factors can be suggested.

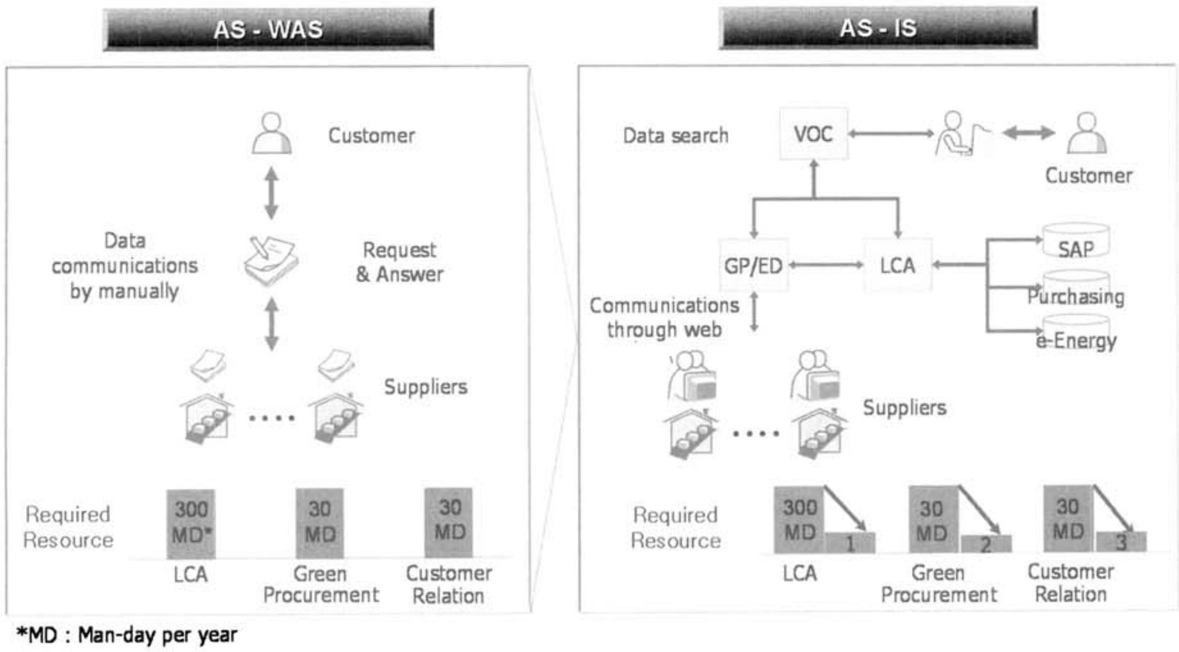

Figure 5. Business proc edure of GP/ED/LCA.

Modules	Managerial parts	Using frequency	Effectiveness
GP/ED	Procurement, Environmental, Product development. Quality control, Marketing	■■■■■	■■■■■
LCA	Environmental, Product development. Quality control, Marketing	■■	■■■■
EMS	Environmental	■■■■■	■■■■
EA	Environmental, Financial	■■	■■■■
SMTM	All staffs	■■■■	■■■■
SMIM	Sustainability manager	■■■	■■■■■

■■■■■ ↔ ■
High Low

Figure 6. Using frequency and effectiveness of SMIS.

- Strategy aspect
  - Internalize sustainability management of the organization: SMIS is a supporting tool for sustainability management. Therefore, the value of the system is not much if the company does not fully internalize it.
  - Cooperate with suppliers: The system integratesdata of product life-cycle. Cooperating with suppliers on data communication is one of the most important success factors.
- Process aspect
  - Standardize processes among plants: Manufacturing sites all around the world should use standardized processes and documents to share information and to integrate activities of all levels to the company wide sustainability management.
  - Replenish necessary hardware: Many data should be collected in the field. Prerequisite measuring equipments are properly installed and replenished.
- System aspect
  - Keep user-friendliness: The system must be easy to use. Any inconvenience of the system becomes a big barrier for system operation.
  - Minimize manual input: The system must be designed as minimized as the manual input can be. At least the "As-Is" process should be simpler than the "As-Was" process in the view point of operators.

To install the system successfully, risk factors should be managed properly. In the planning stage, the cost effectiveness should be carefully measured. Unit functions concerning sustainability management must be selected for systemization only when it is more efficient than manual process. In the installation stage, the conformity between SMIS and legacy system is carefully controlled. Any mismatch in data format and protocols of programming could cause fatal errors. In operation stage, data correction may be necessary for a while to improve system accuracy. It is relatively easy to find errors in separate data, whereas hidden errors are not discoveredin the case of integrated data. LCA module especially requires quite a long time correcting data to get reliable results.

4. KEA case: Toxic Substance Database System

4.1. Purpose of the system

Korean Electronics Industry Association (KEA) has 320 member companies. The organization launched toxic substance database system (TSDS) to support member companies to cope with RoHS related activities. Difference of big companies such as Samsung Electronics and LG Electronics is that they can build their own system to compliant to the regulation while small and medium size companies cannot. The TSDS is designed to supply proper information on environmental issue of Korean electronic industry especially for SMEs (Small and Medium size Enterprises). KEA hopes the system will become a platform which can be used as an international portal system for the promotion of environmentally friendly electronic products. The main purposes of TSDS are as follow.

- To supply environmental information
  - Toxic substances on raw materials
  - Toxic substances on parts and components
  - Information sharing between industries
- To promote the environmental conscious products
  - Data communication between member companies for their environmental record of product
  - Searching tool for a product of specific condition
- To supply information on environmental regulations
  - Environmental regulations and standards on electronic products
  - Technical information / product policies of each countries
  - Support member companies for their implementation to the environmental regulations

The key idea is the integration of data. Since RoHS requires producers to file the information on hazardous substances of a product, relevant data should be tracked down to raw material producers and parts producers. Therefore, if thedata for common raw material and parts can be shared, the work load will be reduced. Table 1 explains changes in business process depending on companies of different levels. The most beneficiaries are the parts producers who have to communicate with multiple buyers in downstream and multiple suppliers in upstream.

4.2. Modules and functions

- Figure 7 shows the modules and their functions of TSDS. The system uses standardized formats for toxic substance information as long as it can and facilitates data transformation between formats through name matching function of a band of raw materials and parts. In the point of users, the system is useful in searching necessary data on hazardous substance of raw materials and parts, and can easily fill-in customer enquiries. The web-based system also provides individual data storage space for every member company.

4.3. Critical success factor

The most important success factor is the stakeholder's participation. Active participation of companies in the supply chain of electronic productscan facilitate the uploading and downloading of information. Especially participations of the large set-makers who have bargaining power can induce parts makers to participate. To acquire information on raw materials, cooperation of other industries such as steel and chemical is also important.

Table 1: Business procedure change through with TSDS

	As - Was	As - is
Set Maker	• Individual information search for proper parts to implement obligation • Difficult to access company information of part producers for their product policy	• Searching parts and producers information from the database system • Inquire the analysis report of parts thru the system
Parts Producer	• Individual information search for proper raw materials to implement obligation • Face increasing inquiry from customers	• Searching parts and producers information from the database system • Uploading report for inquiry of customers
Raw material Producer	• Face increasing inquiry from customers • Need resources to answer the inquiry from customers	• Uploading report for inquiry of customers • Reduce burden to answer each inquiry from customers

Figure 7. Modules of TSDS.

5. Conclusions

Sustainability became an important factor for an industry's competency. It has multi-dimensional aspects covering environment, economy, and society issues. To cope with these issues, companies have to integrate information vertically through management flow and horizontally following product life-cycle. The electronics industry especially feels the necessity of information integration to comply with product-base regulations such as RoHS.

Two casesof information integration system are discussed. The SMIS of Samsung SDI is designed to support the company-wide sustainability management. The system has a series of modules to integrate data of organizational environmental activities and product life-cycle eco-profile. Since the system needs lots of resources, the goal and scope of the system should be carefully decided. Furthermore, in order to maintain the reliability of the system, the data flows are to be controlled carefully. The KEA case shows that industries can cooperate to share information to cope with a specific environmental issue. The system may be successful when the stakeholders in the product life-cycle participate and find values of the cooperation.