Eco Products Development

Yasuo Abe, Osamu Yamashita, Yasunori Yamada, Tomohide Yamazaki

[Summary] Development of environmentally conscious products is one effective way to create a sustainable society. Anritsu has been targeting energy saving, reduced use of resources, and elimination of hazardous substances from its products using an environmental management system composed of product assessment at each stage of design and development to help reduce environmental loads. This article describes the product assessment system and introduces some examples in designing products using environmentally conscious production systems.

1 Introduction

Rapid economic growth since the start of the Industrial Revolution in the late 18th century has been the primary cause of various environmental problems, including man-made global warming (climate change) and resource depletion. Finding solutions to these environmental problems has become one of the most important issues for the world today.

To respond to these environmental problems, Anritsu has promoted the global environmental management based on its management concept of "contribute to the creation of a society that is friendly to people and the Earth as a good corporate citizen" and its environmental principle of "Anritsu strives to give due consideration to the environment in both the development and manufacture of our products. Through sincerity, harmony and enthusiasm we will endeavor to foster a prosperous society at one with nature". This system is summarized in Figure 1. The product development aspects include reduction of energy usage and resources, and exclusion of hazardous substances, while the business aspects include further reduction of energy usage as well as strengthening environmental consciousness (the eco mind) and environmental communications supporting all these activities. Together, these form the four key aspects. Moreover, as part of our business activities, we are continuing to make improvements in promoting the 3R concept of Reduce, Reuse, Recycle, and in reducing the use and risks of chemical substances in our products. Using these activities, we are aiming to help stop climate change and habitat loss while supporting biological diversity.

As part of the above described efforts to reduce energy consumption and resource usage as well as eliminate hazardous substances from our products, during the research and development stage, we assess the product environmental load to assure that we only manufacture environmentally conscious products satisfying fixed standards.

This article explains the contents of our activities so far and introduces some concrete examples of our product designs aiming to result in creation of an environmentally conscious sustainable society.

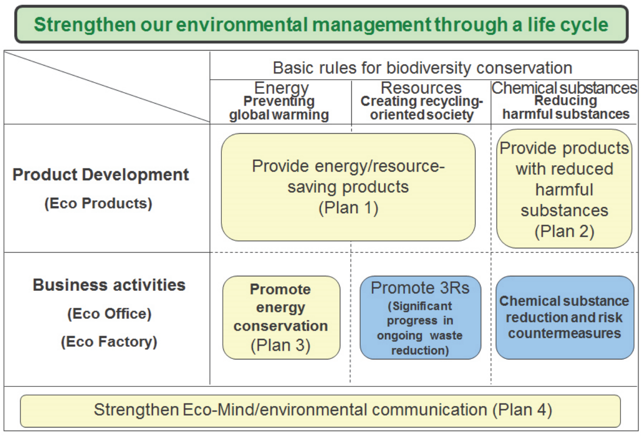

Figure 1 Environmental Management

2 Product Assessment

2.1 Introduction Process

In 1994, Anritsu established a product assessment working group which created the regulations for product assessment in the same year. These regulations clarified both technical and economic points as well as the importance of the environment.

In 2000, rules about environmentally conscious products and were added to the product checksheet followed by environmentally conscious standards in 2002. The product assessment evaluation points were used to evaluate the achieved level of environmentally consciousness.

2.2 Outline of Product Assessment

To regulate the environmental load of products, the product assessment looks at every process starting from procurement of parts and materials, manufacturing procedures, distribution, product usage, recycling, disposal, etc., by evaluating and checking (Figure 2) whether the product environmental load has been reduced. When developing environmentally conscious products using less energy and resources, etc., the product assessment is one of the most effective methods for achieving environmentally consciousness across the product life cycle.

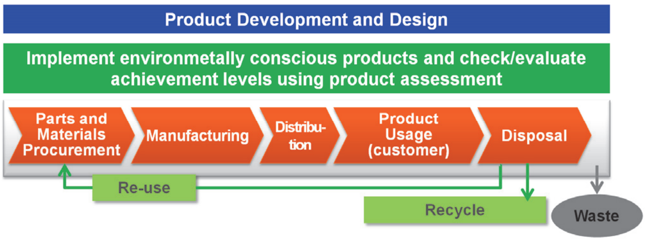

Figure 2 Outline of Product Assessment

2.3 Assessing Products

Product assessment is performed in three stages which must be completed before the product is launched commercially: stage I (setting targets) which clarifies the targets at the product development stage; stage II (examining design) which reviews the progress of the design in achieving the set targets; and stage III (new product evaluation stage) which assesses the final product. The Environment Division participates at stages I and II to help raise awareness about the importance of developing an environmentally conscious product; if the targets cannot be reached, the division also gives follow-up and advice. At stage III, evaluation is performed by a third-party such as the QC Division (Figure 3).

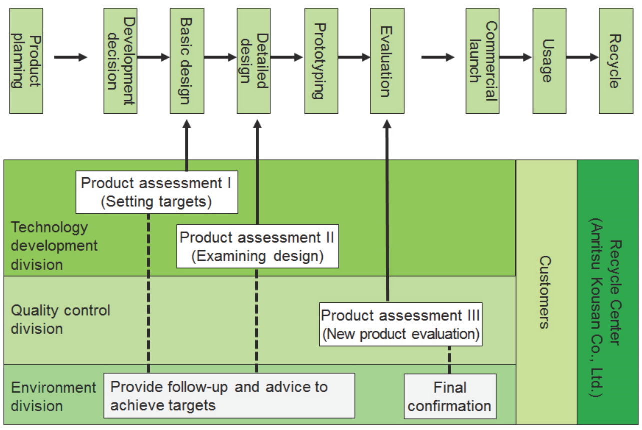

Figure 3 Execution Stages

2.4 Evaluation Items

The evaluations are performed with the key aims of meeting customers' needs and achieving a society with low environmental loads.

Every stage of reducing use of resources, eliminating hazardous substances, and cutting the environmental loads of manufacturing, transport, usage and disposal is evaluated. Table 1 lists the main evaluation items.

Table 1 Evaluation Items

Reducing resources/ Reducing manufacturing load	• Reduce volume and mass • Use reusable and recyclable parts and materials • Achieve expandability and long service life	• Use recycled paper for manuals • Reduce consumables • Reduce surface treatments • Reduce difficult-to-process materials
Reducing hazardous substances	• Eliminate hazardous substances from products • Reduce substances specified by RoHS	• Comply with RoHS • Reduce other hazardous materials
Reducing distribution load	• Reduce packaging materials • Use recycled paper for packaging	• Simplify transport at collection
Reducing usage load	• Reduce power consumption during the operation • Use standby mode	• Use low-power designs • Explain low power usage modes
Reducing disposal load	• Reduce number of parts • Eliminate hard to recycle materials • Design for easy separation of materials • Display material type on plastic	• Reduce material types and consolidate as one type • Indicate recyclable battery • WEEE compliance • Support Chinese RoHS

Among these items, one evaluation point is evaluation of the degree of improvement level by comparison with a reference product. This reference product is usually a conventional product with similar functions and performance as the new development. Table 2 shows the items.

Table 2 Evaluation Items for Degree of Improvement

Evaluation items	Evaluation purpose
Volume (size) reduction	Reduces raw materials usage and improves distribution efficiency
Mass reduction	Reduces raw materials usage and improves distribution efficiency
Disassembly time reduction (breakdown and separation total)	Reduces energy for disassembly
Power consumption reduction	Reduces energy consumption at usage and standby

2.5 Environmentally Conscious Production Systems

To clarify whether products are environmentally conscious, Anritsu has established three environmental classes (Figure 4). The conditions for each class are shown below.

- Excellent Eco Product

  A product that satisfies all the standards required for an excellent eco product in the evaluation results of the product assessment.
- Eco Product

  A product that satisfies all the standards required for an eco product in the evaluation results of the product assessment.
- Assessed Product

  A product that satisfies the requirements for the assessed product.

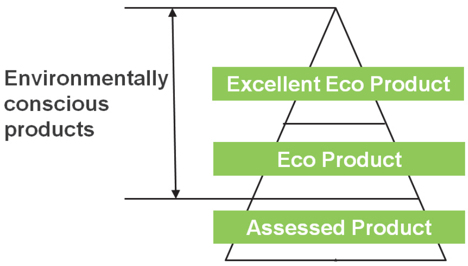

Figure 4 Outline of environmentally conscious Products

Excellent eco products are products with a high-level of environmentally consciousness. The key environmental items are listed below:

- Top industry ranking for environmentally conscious properties
- Indicates product-related environmental information
- Evaluates CO_2 emissions based on life cycle assessment (LCA)
- Product business and main production facilities use environmental management system

To promote the environmentally Consciousness of excellent eco products so that they are chosen by customers, the marks on the right are used in the catalog, etc., to describe environmental data related to the product.

These marks are classified into ISO and ISO 14021 type II.

3 Environmentally Conscious Product Development Results

3.1 Reducing Product Power Consumption and Resources Usage

Reducing power consumption by at least 30% is a key environmental target for products along with improving efficient usage of resources by at least 10% (average improvement rate of mass, volume, disassembly time, power consumption) and decides the development products aiming at these targets in the beginning of fiscal year. Sales ratio of environmentally conscious measuring products achieved 66% in FY2013.

Good examples of continuing reductions in energy consumption are the vector signal generator and digital modulation signal generator outputting various digital modulation signals. As shown in Figure 5, the power consumption and resources usage have both dropped continuously from 2000 through 2011 for the initial MG3681A model and its successor MG3700A and MG3710A by the comparison of taking into account the features and performance.

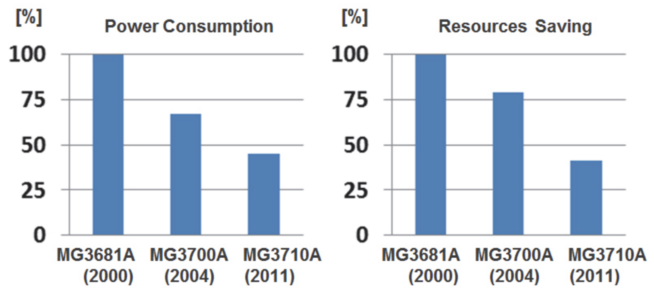

Figure 5 Trends in Product Power Consumption and Resource Saving

In addition, life cycle assessment (LCA) evaluations are also performed to clarify CO_2 emissions at every stage of a product's life cycle.

As shown in Figure 6, 71% of CO_2 emissions of the MP1800A Signal Quality Analyzer measuring instrument used for evaluating the performance of high-speed data transmission equipment occur during the use stage. However, the smaller and lighter ML8760A Handy Area Tester for field work produces 69% of its total CO_2 emissions at the manufacturing stage.

By understanding which stage has the largest emissions, it becomes possible to design products with lower total energy consumption and emissions by targeting the life-cycle stages where improvement is needed. Life cycle assessment evaluations have been implemented for the excellent eco product since 2000 and for all products in development since 2013.

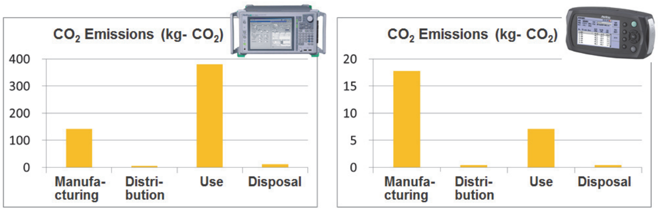

Figure 6 CO_2 Emissions (Left: MP1800A; Right: ML8760A)

3.2 Eliminating Hazardous Substances from Products

Hazardous substances leaching from electronic waste is a serious social problem threatening both the environment and people's health. Anritsu is working to reduce these impacts of its products by targeting hazardous substances as one item in its product assessment evaluations.

In 2006, the EU implemented the Restriction of the use of certain Hazardous Substances in electrical and electronic equipment (RoHS) Directive and measuring instruments are applied from 2017.

However, since measuring instruments have a much longer product life-cycle than domestic and household electronic equipment, Anritsu realized that early compliance was necessary and all new products designed since 2006 are in full compliance with RoHS. We have created an environmental database for all hazardous substances in each part to help the R&D sections only use parts that do not include hazardous substances, thereby promoting exclusion of hazardous substances from all our manufactured products. Currently, this database includes more than 70,000 items and is updated daily.

4 Examples of Environmentally Conscious Design

The following describes some examples of environmentally conscious design implemented for recently developed products.

Table 3 lists three actual instruments and sections 4.1 to 4.3 explain the main environmental contributions of these instruments.

Table 3 Key Environmental Contributions

Instrument	Environmental Contribution
MT1000A Network Master Pro	• Small size, light and easy to operate • Power saving battery operation
MT8870A Universal Wireless Test Set	• Space saving at adjustment inspections • Low power consumption at adjustment inspections
MS9740A Optical Spectrum Analyzer	• Low power consumption at measurement

4.1 MT1000A Network Master Pro

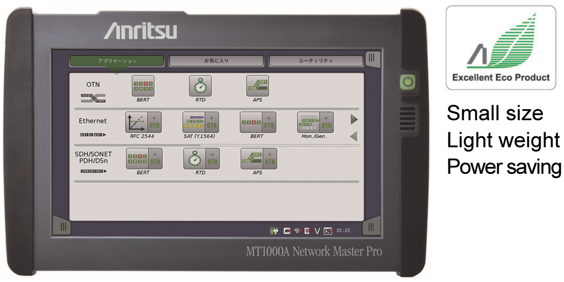

Figure 7 MT1000A Network Master Pro

The MT1000A Network Master Pro has been designed to facilitate efficient network installation and maintenance, optimization, and troubleshooting by network engineers; it supports a variety of communication protocols, such as Ethernet, Fibre Channel, OTN, and SDH/SONET, PDH/DSn (Figure 7). It was developed as the successor to the previous MP1590A Network Performance Tester and CMA3000 All-in-One Field Tester. Since the main target market is installation and maintenance, the design was required to support simple operation, along with small size, lightweight and power-saving battery operation. This new all-in-one tester meets these design points and has two ports supporting all the communications protocols of its predecessors.

4.1.1 Development Concept

The small size, lightweight power saving design was implemented using the following design concepts.

- Improve the ability to survive dropping, etc., by using a lightweight housing composed of molded resins.
- Use the latest Field Programmable Gate Array (FPGA) technology to achieve low-power operation of two independently controlled ports.

4.1.2 Environmentally Conscious Design and Results

(1) Small size, Lightweight and Strong Molded Housing Design

For the housing materials, this product uses a dual molded structure of PC/ABS composite plastics and elastomers. The internal structure uses a honeycomb form commonly used in commercially available notebook computers, etc., (Figure 8). The dual molded structure is formed as a soft resin part on the surface of the housing molded from hard plastics, helping to absorb mechanical shocks if dropped. Since handy measuring instruments must be easy to carry, they are often dropped by mistake, so the honeycomb form on the inside of the housing helps strengthen the housing itself while also reducing the need to strengthen other internal parts. As a result, internal space is saved, permitting efficient layout of printed circuit boards and other peripheral circuits. Consequently, the weight is less than 2.7 kg in the dimensions are only 163 × 257.6 × 77 mm, achieving a volume reduction of about 85% and a mass reduction of about 84% compared to previous equipment.

Figure 8 Honeycomb Internal Housing Wall

(2) Power-Saving Design

The MT1000A supports multiple communications protocols. It has two independent ports each of which can be switched to the target communications protocol for measurement. In conventional designs, a main FPGA part had to be provided for each port, but as the FPGA has become larger scale in recent years, it is becoming impossible to ignore power consumption by each FPGA, and space for arranging these parts has also been increasing. To solve these problems, we adopted use of a new FPGA technology called partial reconfiguration, allowing changes to parts of the internal circuits while other parts of the FPGA were still running, thereby permitting one FPGA to support the functions of two ports independently. To support this, the FPGA block design was divided between each measurement application so that even with one port in operation the other port application could be switched within the same FPGA. Reducing the number of FPGAs achieved a power consumption of less than 65 W, which is about 48% less than previous equipment. Eliminating the large space used by multiple FPGAs not only reduced power consumption but also reduced a size/quantity of the heatsink and its attachment for the FPGAs, which is linked with the volume reduction (Figure 9).

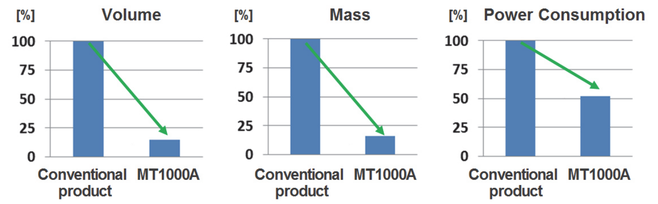

Figure 9 Trends in Reduced Volume, Mass and Power Consumption

4.2 MT8870A Universal Wireless Test Set

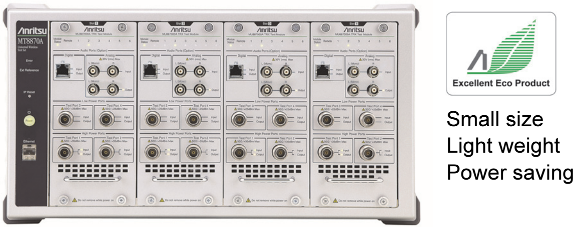

Figure 10 MT8870A Universal Wireless Test Set

The MT8870A Universal Wireless Test Set was designed for use on production lines for mobile telephones typified by smartphones (Figure 10). Up to four TRx test modules can be installed in it supporting simultaneous measurement of four mobiles instead of the two mobiles that could be measured simultaneously by previous testers, helping double production line efficiency. The MT8870A has about the same power consumption as its predecessors but since it can measure twice as many mobiles simultaneously, this is equivalent to halving power consumption, reducing the power requirements on customers' production lines. Additionally, since the test set is about the same size as its predecessors but supports twice as many simultaneous measurements, the number of units can be halved, saving space on the production line.

4.2.1 Development Concept

The small size, lightweight, power-saving design was based on the following concept.

- Prioritize basic performance required for mass production while eliminating unnecessary functions to save benchtop space, maximize measurement speed, and reduce cost.

4.2.2 Environmentally Conscious Design and Results

(1) Small Footprint and High-Speed Design

At adjustment and inspection of conventional mobile phones, the mobile is measured while being controlled using a connection from a base station simulator using call processing technology (call processing measurement). This method is simple because it does not require provision of a procedure for controlling the mobile but it requires a long time as well as operation of a base station simulator, which is an expensive measuring instrument due to the scale of the circuitry. However, since today's testing environment requires lower production costs, there is an increasing trend in measuring instrument design for mobile telephones to use sequence measurements shortening the adjustment and inspection time by using pre-settings to perform continuous measurement. To meet this market demand, the MT8870A was developed as a general-purpose instrument in which call processing measurements can be switched to sequence measurements.

Previous instruments used three separate printed circuit boards for each of the main, baseband, and measurement functions, but to achieve a compact size, this instrument aggregates these three functions on one board. The latest FPGA was integrated into the circuit design to achieve a high parts density while at the same time reducing the number of parts and power consumption.

Additionally, previous instruments performed processing using multiple CPUs but the MT8870A has aggregated these functions into one high-speed CPU, simplifying communications and hardware control procedures between CPUs for simpler faster measurement. Shortening the adjustment and inspection time of mobile phones, shortens the measuring instrument usage time, in turn cutting the customers' power consumption costs.

The following figure shows the reduction in volume (50% down), mass (50% down), and power consumption (60% down) compared to previous instruments by the taking into account the features and performance.

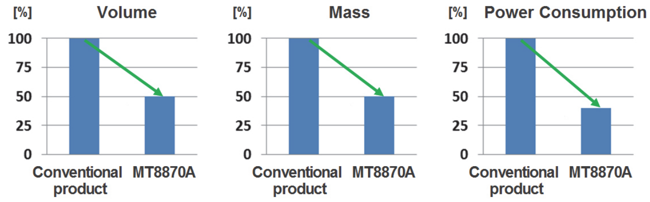

Figure 11 Trends in Reduced Volume, Mass and Power Consumption

(2) Long Life

Previous mobile phones were used mainly for telephone conversations and email but today they have many other communication functions built-in, such as WLAN, GPS, Bluetooth, and multimedia streaming. Consequently, mobile phone production lines require inspection procedures for these wireless interfaces and rising costs for adding and updating production line equipment have become a major issue. Since the MT8870A not only has general-purpose functions but also has excellent basic functions such as a maximum frequency of 6 GHz and a maximum bandwidth of 160 MHz, it supports next-generation communications standards simply by addition of new application software, helping assure a long service life without needing extra major investment, which not only reduces production line equipment costs but also reduces waste disposal.

4.3 MS9740A Optical Spectrum Analyzer

Figure 12 MS9740A Optical Spectrum Analyzer

The MS9740A Optical Spectrum Analyzer (Figure 12) measures the optical power (optical spectrum) as a function of wavelength of the optical device. The MS9740A released in December 2009 is used for the test of light sources, optical transceivers, and so on in R&D and manufacturing.

The basic block diagram of the MS9740A is shown in Figure 13. The optical signal input to the MS9740A is split into indivisual wavelengths through a tunable optical bandpass filter. The split optical signal is converted to the electrical signal in the optical receiver section. The electrical signal is digitized with the A/D converter before passing to the signal processing section, which displays the optical spectrum waveform on the screen.

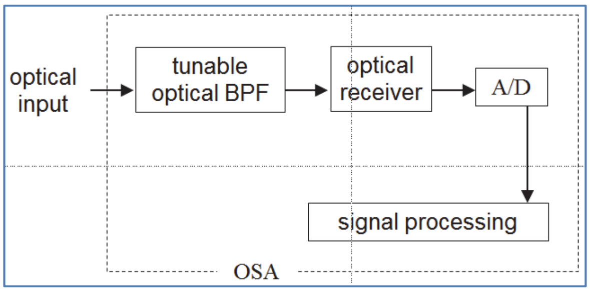

Figure 13 MS9740A basic block diagram

4.3.1 Development Concept

The lightweight, power-saving design was based on the following concept.

- Reduce power consumption by shortening measurement time, and lighten the weight.

4.3.2 Environmentally Conscious Design and Result

(1) Lightweight Power saving Design

To reduce power consumption, we adopted a low-power CPU board with high-reliability. Furthermore, in comparison with the circuits of the previous optical spectrum analyzer, we decrease the number of discrete parts in circuits of the MS9740A and integrated several functions into a large-scale logic IC. As a result, power consumption was almost halved compared to the previous MS9710 series (150 VA). Moreover, decreasing the number of mechanical and optical parts reduces the weight by 1.5 kg to 15 kg compared to the previous series (16.5 kg), making the MS9740A currently the world's lightest optical spectrum analyzer for benchtop applications.

(2) Shorter Measurement Time

As an environmentally conscious product in user's usage situation, we shortened measurement time due to the modification to waveform sweep processing, integration of display of DUT evaluation items and high-speed data transfer to external controllers. In particular, waveform sweep processing in conventional optical spectrum analyzer results in long measurement time because of the operating time required for tunable optical bandpass filter, opto-electric conversion in the optical receiver and waveform computation and drawing processing. To overcome these drawbacks, we used a faster CPU. In addition, to make best use of the CPU performance, we optimized the software, achieving an 80% shorter measurement time than previous instruments. As a result, measurement times have been reduced resulting in greatly reduced overall power consumption on customers' production lines.

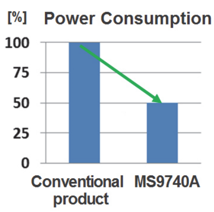

Figure 14 Trend in Power Consumption

5 Conclusions

We have used some examples to describe how development of environmentally conscious products has been achieved using product assessments, environmentally conscious production systems, and environmentally conscious design.

Following the introduction of the product assessment system in 1994, we have implemented R&D into new products not only considering customers' needs but also considering the importance of establishing an environmentally conscious society. The environment is considered right from the first product design stage. Environmental design has not been easy in the past but by promoting the importance of considering the environment at the earliest design stages it has been possible to develop environmentally conscious products. However, the ratio of environmentally conscious products in all sales of Anritsu products has yet to reach 100%; the above- described assessment system is being implemented increasingly in development of environmentally conscious products by group companies in Japan but has only just started at companies in the overseas group. Additionally, LCA evaluations are implemented at development of all new products to ensure environmentally consciousness across the full product life cycle but effective reduction countermeasures that determined improvement targets are not yet being implemented.

We are still progressing with work to deliver more environmentally conscious products in the future in the hope of creating a sustainable society.

References

1) "Development of Eco-Products", ANRITSU TECHNICAL No.80 2002

Authors


Yasuo Abe
Environment and Quality Promotion Dept.
Environment Promotion Team


Osamu Yamashita
R&D Division
Product Development Support Dept.


Yasunori Yamada
R&D Division
Product Development Division
3rd Product Development Dept.


Tomohide Yamazaki
R&D Division
Product Development Division
1st Product Development Dept.

Publicly available