SUSTAINABLE ECONOMY IV

5. THE FUNCTIONAL OR SERVICE ECONOMY[1]

Background – Links to Industrial Ecology

The concepts of product-life extension and the service economy go beyond all other industrial ecology approaches to closing the loop in industrial/consumer systems. They are an essential complement to the work of industrial metabolism, design for the environment, and other industrial ecology methods. Many of the ideas behind the concepts of product-life extension and the service economy are those of Walter Stahel, Director, Product-Life Institute, Geneva, Switzerland. Is Stahel's vision useful only in the long-term? His concepts could possibly be used by major entrepreneurs to enter markets now dominated by existing companies.

Stahel's basic message is: lower the demand for energy and materials by designing durable and upgradable products with a long-life span. He suggests that manufacturing companies remain profitable by refocusing their mission to delivering customer service (selling results, performance, and satisfaction rather than products) and owning the equipment themselves as the means of providing this service.

Summary of Stahel's Views and Concepts

Stahel defined the functional economy as follows:

> "*A functional economy, as defined in this paper, is one that optimizes the use (or function) of goods and services and thus the management of existing wealth (goods. knowledge, and nature). The economic objective of the functional economy is to create the highest possible use value for the longest possible time while consuming as few material resources and energy as possible. This functional economy is therefore considerably more sustainable, or dematerialized, than the present economy, which is focused on production and related material flows as its principal means to create wealth.*"[2]

One of Stahel's major concerns is to demonstrate the social, cultural, and organizational change which may arise in shifting from a production-oriented economy toward a functional or service-oriented economy.

Sustainability: Sustainability is dependent upon several inter-related systems (ecological services, ecological resilience, rate of flow of resources, and system of societal and economic structures). Each is essential for human survival, meaning that priorities cannot be argued over nor can there be speculation about which of these systems humans can afford to lose first.

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[1] Abridged from: Giarini, O. and W.R. Stahel. 1993. The limits to certainty: facing risks in the new service economy. Kluwer Academic Publishers, Boston, MASS.

[2] Stahel, W.R. 1986. The functional economy: cultural and organizational change. In: *The hidden wealth*, O. Giarini and W.R. Stahel (eds.). Special issue, Vol. 13, No. 4. Science & Public Policy, London, UK.

Traditional Linear Thought: Current economic systems are the result of linear thinking. The terms, *added value* (relating exclusively to production), and *waste* (at the end of, and probably only, use of resources), are notions of a linear industrial economy. Manufacturer's liability for quality and waste stops shortly after the point of sale – the buyer becomes responsible for the usage and disposal of goods without knowing what resources have been incorporated in the goods. Present provincial and national accounting systems and the usage of GNP as a measure of success are again a legacy of the linear industrial economy.

In contrast, cycles and loops have no beginning and no end – in a true economy of loops there is thus no waste in the linear sense. An economy in loops is similar to natural systems, but there is one major difference: the economy in loops has to search for the highest conservation of economic value.

Resource-Use Policies: Resource-use policies are industrial policies. The promotion of recycling strategies (i.e., closing the material loops) conserves the existing economic structures and is thus easy to implement. An increase in the amount of secondary resources can, unfortunately, cause an oversupply of materials and depress the prices of virgin and recycled resources alike, thus jeopardizing the economics of recycling. Increased recycling does not reduce the flow of material and energy through the economy but it does reduce resource depletion and waste volumes.

In contrast to recycling, strategies for higher resource efficiency reduce the volume and speed of resource flow through the economy. One of the keys to resource efficiency is the take-back strategy (product-life extension) is to close the product and material responsibility loops, a consequence of which is structural changes which makes the strategy more difficult to implement than recycling. However, because these strategies are to be based on innovative corporate approaches, they are expected to be highly competitive as well as sustainable. A higher resource efficiency through an optimization of the use of goods is measured as *resource-input-per-unit-of-use* over long periods of time. This will result in a substantial structural change with the economy. Among the strategies for higher resource efficiency are those for a longer and more intensive use of goods, those for dematerialized goods, and those for innovative systems solutions (Table 1).

RESOURCE EFFICEINCY STRATEGIES	**IMPLEMENTATION OF STRATEGIES**	
	CLOSING MATERIAL LOOPS (technical strategies)	**CLOSING LIABILITY LOOPS** (commercial/marketing strategies)
Reduce volume of resource flow	**Eco-products** • dematerialized goods • multi-functional goods	**Eco-marketing** • shared utilization of goods • selling utilization instead
Reduce speed of resource flow	**Remanufacturing** • long-life goods • product-life goals • cascading, cannibalizing	**Remarketing** • de-curement services • away-grading of goods and components • new products from waste
Reduce volume and speed of resource flow	**System solutions** • Krauss-Maffei plane transport system	**Systemic solutions** • lighthouses • selling results instead of goods • selling services instead of goods

Among the innovations to emerge from a promotion of higher resource efficiency are new technical and commercial strategies to improve usage. There have also been innovations in re-

designing components, goods, and systems which reduce material use in manufacturing and in reducing the costs of operating and maintaining he goods in use.

Problem of Over-Supply: The economies of industrialized countries are characterized by four key factors:

(1) their populations account for only 20% of the world's population, but consumes 80% of the world's resources;
(2) their markets for goods are saturated and the stocks of goods represent a huge store of resources; there is also an increasing financial burden because of use and deterioration of infrastructures;
(3) their economies suffer from over-supply; and
(4) incremental technical progress is faster than product development.

In many developing countries, the situation is substantially different. These countries will continue to have a strong demand for basic materials for the construction of their infrastructure and will continuously suffer from a shortage of affordable resources and goods, including food, shelter, and services for health and education. Resource efficiency in industrialized countries will ease market pressure on the resource consumption necessary for other countries to develop.

Product-Life Extension: Stahel proposed product-life extension as the necessary complement to recycling. He has developed and recommended business strategies (Table 1) for achieving it and the dimensions of a service-oriented economy. Product-life extension implies a fundamental shift from selling products themselves to selling the utilization of products, the customer value they yield. This change in the source of economic value to firms depends upon enhancing product life through several key design strategies. Designers would seek to optimize the following product qualities:

- durable and difficult to damage;
- modular;
- multi-functional;
- sub-components are standardized, self-repairing and easy to repair;
- easy to repair or upgrade;
- components can be reused in new systems; and
- units or systems can be easily reconditioned and re-manufactured.

These design strategies are already part of the design for environment toolkit. They would significantly help achieve central industrial metabolism objectives of cutting demand on material and energy resources and reducing pollution from manufacturing.

The Functional Economy (also known as, the Service Economy)

A key difference between the industrial economy and the service economy is that the first gives value to products that exist materially and are exchanged, whereas value in the functional economy is more closely attributed to the performance and real use of products integrated into a system. In our classical industrial economy, the value of products is essentially identified with the costs of producing them, whereas the notion of value in the service economy is shifted toward the evaluation of costs incurred to provide results in use. Economic well-being is no longer measured by exchange value (money cost) and GNP or GDP but by the use-value of a product and the wealth represented by the stock of existing goods.

The industrial economy approach, for example, considers the value of a personal computer with a printer. The functional economy, on the other hand, evaluates the actual performance of the, system, taking into consideration not only its cost of production but also all sorts of costs associated with successful use (such as the cost of learning to use it and the cost of repair and maintenance) as well as the quality of the result. In the service economy, what is purchased is the *functioning* of a tool; people buy "system functioning," or performance, not products.

Long-term ownership of goods becomes the key to the long-term (rental) income of successful companies, and with that ownership comes unlimited product responsibility. Strategies of selling the use of goods instead of the goods themselves and providing incentives to customers to return goods to manufacturers become keys to long-term corporate success. The adaptability of existing and future goods to changes in users' needs and to technological progress (to keep them current with technological progress) becomes the new challenge for designers and engineers. The economic structure must maximize the return from these new resources: a fleet of existing goods in a dispersed market. An adaptation of today's economic, legal, and tax structures to these new requirements may be a precondition for countries to attract and breed successful economic players for a sustainable functional society.

As a company moves from maximizing sales of material products to the delivery of customer satisfaction, its long-term source of competitive advantage will become the ability to provide the needed service. Revenues could come from: leasing of equipment with long life; continuing maintenance and service; major upgrading of systems; parts and supplies; and service provider training and licensing. Or the company might simplify the transaction by offering one use-based fee. Stahel argues that if the company is compensated on the basis of service provided, its employees will have strong incentives to minimize materials and energy used in the systems that deliver the service to the customer.

Boundaries: As with all systems work or analysis, definition of the systems boundaries is critical. This is the case both in ecology and in the analysis of engineering systems, such as computer networks, transportation systems, or chemical processing facilities. The same challenge exists in trying to understand industrial ecosystems. For example, an industrial ecosystem may be defined by a single product. Any product, at a certain time, has a unique ecosystem characterized by raw material suppliers or component manufacturers, delivery, maintenance and collection systems, waste handlers, recyclers, and consumers. The various actors in industrial systems — raw material supplier or component manufacturer, consumer, waste handler, or recycler — are analogous to biological organisms. In these complex spatial and temporal webs of human production and consumption activities, individual materials may be traced through several different industrial ecosystems, and each industrial sector (and even company) may be characterized as playing a role in several industrial ecosystems.

Alternatively, an industrial ecosystem may be bounded by geography (such as an urban area), an industry (such as agriculture), or a material (such as lead). Finally, just as from a global perspective, it is possible to think of the earth as made up of numerous interrelated natural eco-subsystems, so we may speak of the industrial ecosystem in terms of the whole network of industrial eco-subsystems. Industrial ecology recognizes the unique role of humans in creating complex artifacts and institutions that force changes in materials and energy flows in both industrial and natural systems. Natural ecosystems, which provide the raw materials for economic activity, also serve as sinks for wastes from producers and consumers in industrial activities. The interactions between industrial and natural ecosystems are full, intricate, and

complex. Thinking in this way—about industrial ecosystems—provides opportunities to examine and inform the ways in which producer and consumer practices in the economy may be altered to create environmentally compatible industrial ecosystems. Industrial ecology system boundaries may be drawn to include interacting industrial and natural processes.

Strategic and Organizational Changes: In contrast to the manufacturing economy, economic success in the sustainable functional economy does not arise from mass production but from good husbandry, caring attitudes and stewardship. Economic rewards come from minimizing tasks needed to transfer a product from one user to the next. Local reuse after a quality check or repair by the manager's representative is the smallest possible cycle and the most profitable strategy. A product that can no longer be commercialized (i.e., rented or used) will be remanufactured and upgraded or, in the worst case, be dismantled with the aim of reusing its components for new products. If there is no re-use possibility, the materials can be recycled and used to manufacture new components. To achieve the smallest cycles, a different economic and organizational mindset is necessary in several areas:

- The industrial structure for manufacturing and remanufacturing activities will have to be regionalized in order to be closer to the market assets. This proximity demands the capability to handle smaller (re-)manufacturing volumes more efficiently. Appropriate methods for such purposes will have to be developed and skilled labour trained. The cost for such a change is offset by dramatic reductions in the purchase of materials and the virtual elimination of disposal costs.
- Products will have to be designed as technical systems that are part of pre-designed modular master plans. Such plans will facilitate ease of maintenance and ease of out-of-sequence disassembly by workers or robots.
- Components will have to be designed for remanufacturing and technological upgrading according to the commonality principle. The commonality principle promotes standardized multi-product function-specific components that are interchangeable among different product lines. These standardized components are often maintenance free, self-protecting and fault-tolerant, which greatly reduces operating costs (such as service interventions, repairman training and spare-parts management).
- New technologies aimed at optimizing the resource efficiency and safety of products and components over long periods of time will have to be developed. These include spare-less repair methods, in situ quality of function monitoring systems, and memory chips to register life cycle data.
- New professions and job qualifications will emerge, such as operation and maintenance engineers. The salesperson of the past will have to become customer advisor able to optimize generic products for the needs of specific users, and to upgrade existing products according to the wishes of the user as technology advances.
- Users (ex-consumers) will have to learn to take care of the rented or leased products as if they owned them, and to enjoy the new flexibility in product-use offered by a use-focused service economy. Whereas in the industrial economy, misuse and abuse of products lead to a financial punishment in the form of increased maintenance cost for the owner-user, in the functional economy, they may lead to the exclusion of a user from the use-focused system.

Obstacles, Opportunities and Trends: Many obstacles will need to be overcome on the way to an economy optimizing multiple service-lives or use-cycles. Most of these obstacles are embodied in the logic of the present linear industrial economy. A supply definition of quality, for example, is based on warranties limited to 6 or 12 months for manufacturing defects only and on the newness of components in new goods. The logic framework of a functional economy requires

a demand-side definition of quality based on unlimited customer satisfaction and the guarantee of a system functioning over longer periods of time.

The signs on the horizon clearly point to a use-focused economy:[3]

- The European Community directives on product liability and more recently on product safety and the draft directive on service liability all stipulate a 10-year liability period, or impose a manufacturers disposal liability (end of life vehicles).
- Some car manufacturers offer a total cost guarantee over 3 or 5 years, which includes all costs except tire wear and fuel.
- Industry shows an increasing willingness to accept unlimited product responsibility and to use it aggressively in advertising, through money-back guarantees, exchange offers, and other forms of voluntary product take-back and is learning to make product retake and remarketing a viable business division.
- Out-sourcing has rapidly become a generally accepted form of selling results instead of (capital) goods or services.

Companies and regions that initiate the change toward a sustainable society rather than suffering the consequences of it through the actions of their competitors will have a head start and be able to position themselves strategically. An old, but in the age of market research somewhat forgotten, truth of economies will play its heavy hand again: Real innovation is always supply driven - the role of demand is one of selection.[3]

Challenges: This approach to sustainability requires long-range vision and major organizational and technological redesign on the part of corporations. Investment markets' present focus on short-term financial performance does not support such fundamental change. Product-life extension runs the risk of companies making major investments in technologies for service delivery that may become outmoded. To what extent can modular design for easy upgrading offset this risk?

Consumers have become addicted to inexpensive throw-away products that last as little as one to two years (cell phones) and are rapidly upgraded to new throwaway models. Even major appliances may last no more than three to five years before breaking down, without affordable repair available.

Summary and Conclusions

The shift in the economy towards a more sustainable society and functional economy began some time ago. However, most experts are unaware of the fundamental change, probably because they interpret the signs on the horizon in terms of the old industrial economic thinking. It is important to remember that a functional society will not solve all the problems of this world, and especially not the inherited problems from the past (e.g., pollution cleanup and unemployment of overspecialized production workers); nor will it make the manufacturing sector disappear. The manufacturing sector could well be transformed into a high-volume producer of global standardized components and regionalized assemblers (e.g. computer components) and remanufacturer or remarketer of products.

[3] Giarini, O. and W.R. Stahel. 1993. The limits to certainty: facing risks in the new service economy. Kluwer Academic Publishers, Boston, MASS.

A sustainable economy needs an appropriate structure. The characteristics include a regionalization of jobs and skills, such as mini-mills for material recycling, remanufacturing workshops for products, decentralized production of services (e.g. rental outlets), local upgrading and take-back, supplemented by centralized design, research, and management centres. Such an economy will consume fewer resources and have a higher resource efficiency, and its production will be characterized by smaller regionalized units with a higher and more skilled labour input. Transport volumes of material goods will diminish and be replaced by transports of immaterial goods such as recipes instead of food products, software instead of spare parts.

Quality will be redefined as a long-term optimization of system functioning. For the first time since the beginning of the Industrial Revolution, the economy will offer workplace mobility rather than rely on worker mobility. The more immaterial goods that are transported, the greater the feasibility of telecommuting. Flexible work periods and part-time work are compatible with, and even a necessity for, providing services and results around the clock.

Because services cannot be produced in advance and stored but have to be delivered at the location of the client when needed, the economic disadvantages of peripheral suburban zones will partly disappear, as will most of the environmental burden caused by transportation flows to centralized zones. Waste management could increasingly become a subject for historians rather than economists as large companies reach their goals of zero waste by 2000.[3]

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