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Sustainable Business Development

An attempt to get out of the environmental resource paradox

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Abstract

The sustainable business development takes an interest both in the avoidance of negative impact and in the promotion of activity with positive long-term effect. However, resource refinement for the future is hardly an explicit priority in today's environmental assessment methods. There is an apparent paradox in the resource concept as it's used in environmental assessments. Raw materials are conceptualised as given by nature, although we know that in fact much of the present resource values have evolved as a result of human activity. This paper uses a cleaner technology view on effectiveness in a system dynamics model which includes added resource values as an explicit link in the business development loop. A suggested model focuses on the quotient *customer utility per environmental load* and how this may improve when present activity generates additional system knowledge. This resource enhancement may evolve through learning about interrelations to surrounding systems that can be used in development of business relations and technical systems. The model emphasizes the importance of the business loop in the mobilization of resource development activities.

Key words

Effectiveness, Resources, Eco-efficiency, Business loop, Cleaner technology, Industrial ecology, LCA, EMS, Environmental Management

Introduction

Interest in avoidance of environmental loads triggers a lot of arguments against business activity. In a long-term perspective this may be crucial, because environmental concern may aggravate the short-term bias in business of today.

To take advantage of the environmental movement's pressure for change as a driving force for supply system development, it seems most effective to promote eco-efficient business activities. One aspect of the sustainability challenge, to enable ecological and economical development, is that "heightened consumer awareness of accumulated industrial wastes has led to heightened regulatory pressures designed to reduce waste. However, the subsequent increase in regulatory compliance costs tends to constrain profits which can potentially limit industry's investment in 'clean' technologies" (Schley and Laur J 1996). This system dynamics perspective indicates that promotion of the market development for 'clean' technologies may be preferable to regulations such as waste taxes.

System dynamics modeling has also been used to combine the perspectives of the technologist and the environmentalist on resource management (Saeed 1996) and to clarify the resource concept (Senge *et al.* 1994). The conceptual limitations of earlier models are clearly spelt out. The nature of the policy prescription of the World3 model used in Meadows *et al.* 1992 arises from the way the resource sectors have been modeled. The stocks of these resources only have outflows which makes the ultimate collapse inevitable (Acharya and Saeed 1996). There is an apparent paradox in the common understanding of the resource concept. We tend to conceptualize natural resources as something given by nature, although we know that they have been made valuable largely as a result of human activity. Consequently, there is a need for a change of perspective.

This paper begins with two distinct static views and continues with an attempt to develop a more coherent dynamic perspective. The aim is to provide a framework for interdisciplinary communication on relations between business activity and environmental concerns. The basic question is how to get business interests and environmental interests to reinforce each other.

Sustainable Development

Sustainable development involves a change from a traditional production oriented view and a balancing environmental concern into a combined evolutionary view, see Figure 1.

- The utility maximization paradigm illustrates the mainstream goal and worldview during industrialization and agricultural development. Two foci are growth of material consumption and redistribution of the most economical supply to the most beneficial use as described in neoclassical economics.
- The environmental view focuses on avoidance of negative impacts on ecological systems. From a more general perspective this is one form of a modern focus on different kinds of risk minimization.

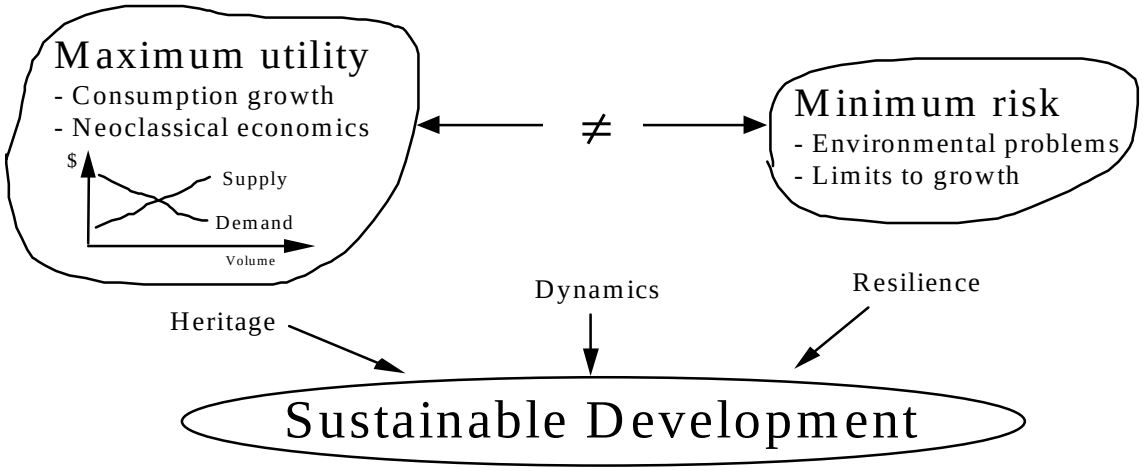

Figure 1 *An evolving sustainable development perspective in relation to earlier development and environmental adaptation interests.*

Environmental concerns have arisen from worries about observed health problems and ecological disturbances found to be caused by environmental pollution. This work began as clean-up activities and efforts to avoid emissions. Long-term sustainability is also dependent on sustainable supply of raw material. From an environmental point of view the sustainable development concept is often described by the following quote from the Brundtland report:

> ***Sustainable development... meets the needs of the present without compromising the ability of future generations to meet their own needs.*** (WCED 1987)

From this starting point it is natural to focus the thinking about resources on distribution of given resources, e.g. between different countries and between present and future generations. The UN sustainable development concept gives equal priority to environmental adaptation, economic and social development. It has been interpreted as an argument for redistribution of resources. The Brundtland report focuses on development dynamics.

> ***Sustainable development is a process of change in which the exploitation of resources, the direction of investments, the orientation of technical development, and institutional change are all in harmony and enhance both current and future potential to meet human needs and aspirations...*** (WCED 1987).

The environmental development focus is changing from ‘end of pipe’ pollution control towards holistic effectiveness. One basic aspect in further development of industrial activity is to “do the right thing from the outset“. Efforts are directed towards more integrative

resource management, goals and visions like the Ecocyclic Society (*The Ecocycle- the new view of the environment*, a summary of the Swedish Government's Ecocycle Bill. 1994)

The main *"World Business Council for Sustainable Development"* concept describing how business can contribute to sustainable development is Eco-efficiency. The WBCSD input to the 1992 Earth Summit in Rio, in its report '*Changing Course'*, defined eco-efficient companies as "those which produce ever more useful goods and services - in other words, add value - while continuously reducing their consumption of resources and pollution"(WBCSD 1996)

In our understanding the main novelty of the evolving sustainable development paradigm is that it introduces a dynamic view, with the main focus on development of resources, rather than distribution of resources. In addition to the previous paradigms, the new paradigm also give priority to new aspects of economics and new environmental considerations, such as production of a heritage for future generations and the importance of experience of building up a resilient capacity to cope.

The sustainable development paradigm aims to combine both the previous paradigms into an integrated and dynamic perspective on the human situation. The term 'Sustainable Development' is commonly used as a general goal and superior level ambition. However, the sustainability concept is not yet described as an explicit scientific foundation and is hardly included in operational methodology. In media and public discussions, the sustainable development ambition tends to be interpreted in relation to one of the established paradigms, i.e. as a one-sided view, most commonly, either from a third world perspective focusing on welfare development, or alternatively from a welfare state perspective focusing on environmental load reduction. Consequently, it is difficult to conceptualize what the sustainable development paradigm actually means

Modeling of Traditional Views

Sustainability and environmental issues such as the green house effects and bio-diversity are examples of global concerns. The pressure of exploding consumerism of a growing human population poses a threat to all life on earth. Consequently the following models relate to global parameters. However, many of the same relations also apply to phenomena on sub system levels, and the presented models may be easier to understand if viewed from a firm's business perspective. This indicates that each business system is dependent on its interrelationships with surrounding systems.

Traditionally societal systems have been viewed from two distinct perspectives. We now use causal loop diagrams to describe the traditional views and the interaction between different system parameters. The production and consumption interest has been dominant in societies with a focus on economic growth, commercial activity and profitability of business enterprises. On the other hand the environmental concern tends to be self-contained in a focus on the negative impacts of human activity.

The Business Perspective

The main coordinating system in modern society is that of the business and market systems. Commercial interests are traditionally important driving forces in society. The societal engine has been fuelled by the demand for new goods and services, and new innovations which have enabled new human possibilities. As illustrated in figure 2, the activities in the economy produce utility, which in turn provide consumer satisfaction and the basis for additional demand. This reinforces the business cycle and drives the loop towards still more activity and growth.

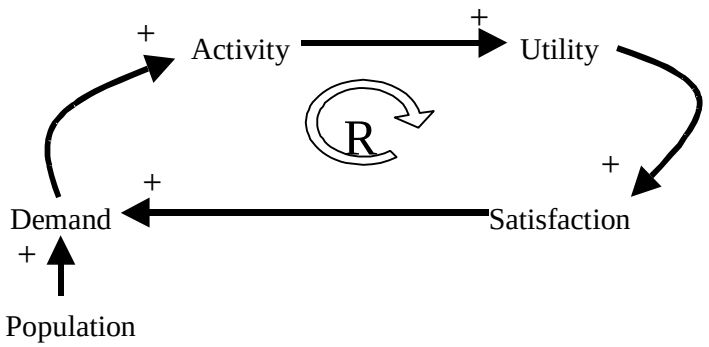

Figure 2 *Basic Business Growth Loop*

The Environmental Perspective.

Human life support and quality of life are dependent on an appropriate environment, for example clean air and fresh water, and those characteristics are dependent on the operation of geo-physical and ecological systems. The term environmental load includes both emissions and raw material depletion.

Environmental concern stresses that activity has a negative impact on the ecological environment. For a given technology, increased utility causes increased environmental loads and pollution. This increase in pollution levels increases the environmental concern in society and raises arguments to reduce consumption, which tends to reduce activity. This balancing feedback loop shows the possible effect of environmental awareness on economic demand.

The environmental concern also influences the activity through e.g. pollution control legislation and environmental taxes. This normally causes an increase in costs that affect demand. A reduction in volume of activity tends to decrease the rate of learning, which slows down the rate of system improvement. As indicated by the death spiral mechanism (Ford 1999), this form of slowing down tends to be difficult for businesses that are used to growth.

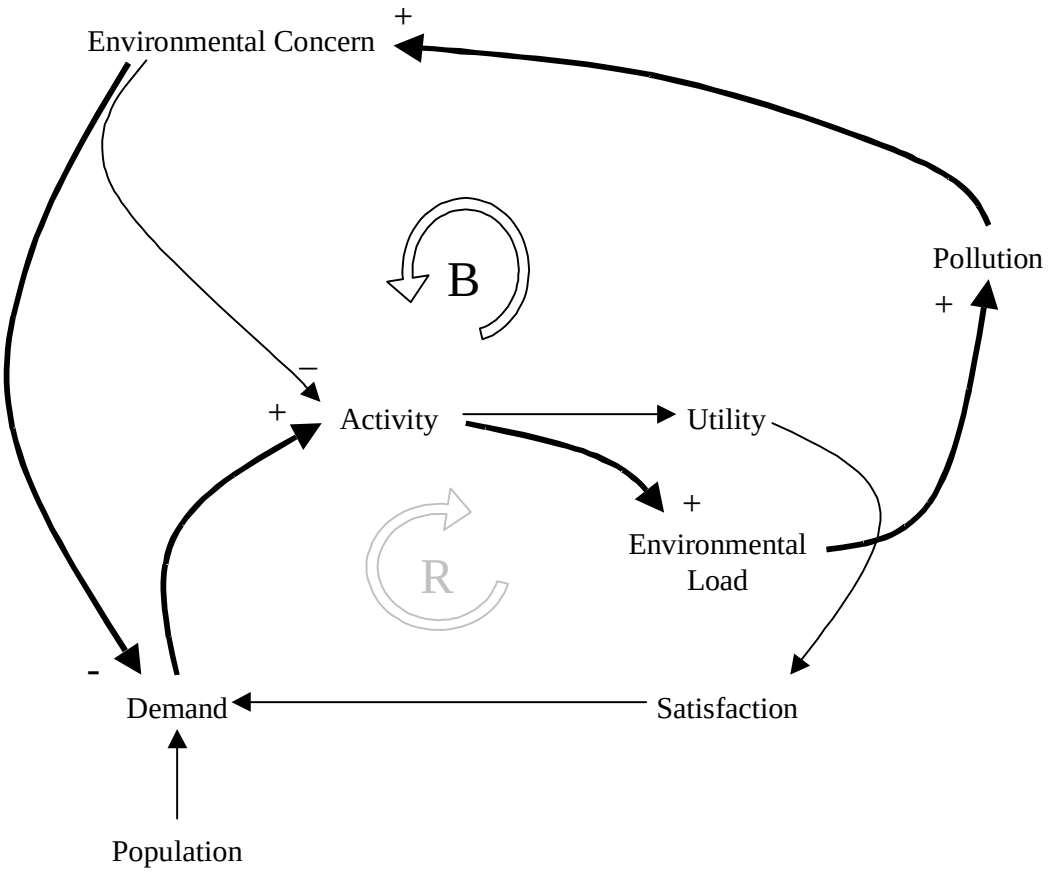

Figure 3 *An Environmentalism Loop*

Clean Technology Loop

The clean technology concept, as used in the Systems Thinker paper (Schley and Laur 1997) is rather new. It has been described for example, by Clift (1995) also, but so far it is rather unspecific from a methodological point of view. It is similar to the UNEP clean production concept but in Clift's view it focuses more on human benefit and service, rather than concentrating on products per se. Clift also focuses on a distinction between clean technology and clean-up technology. In this view clean-up technology means end-of-pipe pollution abatement and an essential difference is that clean technology aims for development of new technology to achieve simultaneous financial and environmental advantages.

This combined view means that the goal is to make the environmental improvement in such a way that the business profitability also improves, basically by doing the right thing from the outset. Consequently we focus on this goal in figure 4. The model in the Systems Thinker paper mentioned above shows a clearer feedback from clean technology to the business loop and in later sections we will take an additional step to combine these ambitions.

Figure 4 focuses on the improvement of efficiency to reduce environmental load, because we think this is the main ambition for the clean technology thinking so far. In this perspective we get a balancing loop that aims to cut down on the environmental load if it increases (too much). If this is true then there is no reinforcement of the clean technology concept itself. As illustrated in figure 4, a clean technology ambition may very well coexist with a profitable business but from this point of view there does not seem to be any reinforcement of the clean technology concept itself.

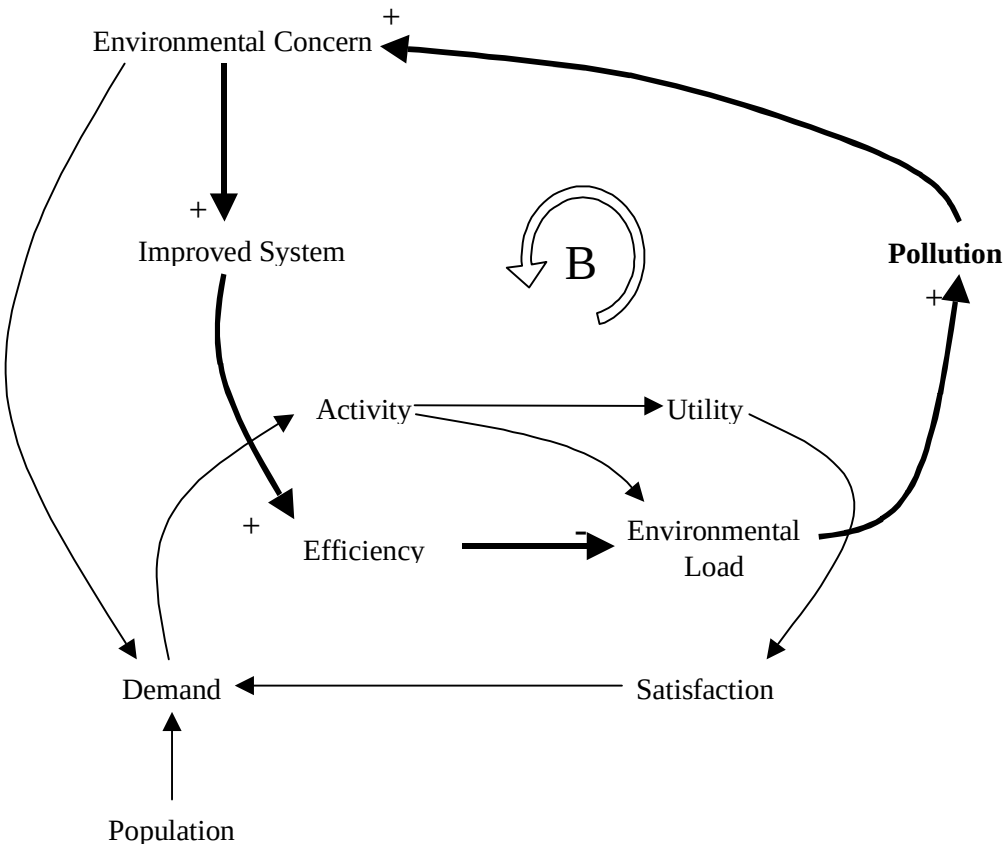

Figure 4 *Clean Technology focus on effectiveness improvement to reduce the specific environmental load per utility.*

At a basic assessment level it is important to distinguish between production for present consumption and investment to enable future supply. The key issue here is that the interest in enabling human sustainability extends over a considerable period of time, and is not limited to one single point in time. From this point of view, environmental assessments should be made in relation to one specific (predefined) sum or integral of production volume over a defined period of time (Karlsson 1995), see formula1. In some interesting cases we get a lower total environmental load, and also less increase in total system entropy, if a certain activity (investment) is performed (now) than if it is not.

$$\int_{t=0}^{T} E \text{ (With technology development)} < \int_{t=0}^{T} E \text{ (Unchanged technology)} \qquad (1)$$

During the development period, the build-up of new systems and primary production of recyclable materials normally results in a higher level of specific environmental load, and a higher rate of increase in total global entropy, as illustrated in figure 5. But once the new system is ready and when readily recyclable materials are available, this may enable a lower rate of addition to global entropy, for each fixed quantity of production.

The curve in figure 5 illustrates a hypothetical case of particular sustainability interest. For alternative cases and for specific loads, the curve may look different. Furthermore, it is also relevant to note that technological development often leads to an increase in consumption volume, through increasing consumer possibilities to perform additional activities

There are also other important time-related aspects. Even when a development investment is remunerative from a long-term perspective, it still normally causes a short-term increase in pollution level. The investment activity causes both a (temporary) change in pollution level and a change in long-term pollution rate (trend).

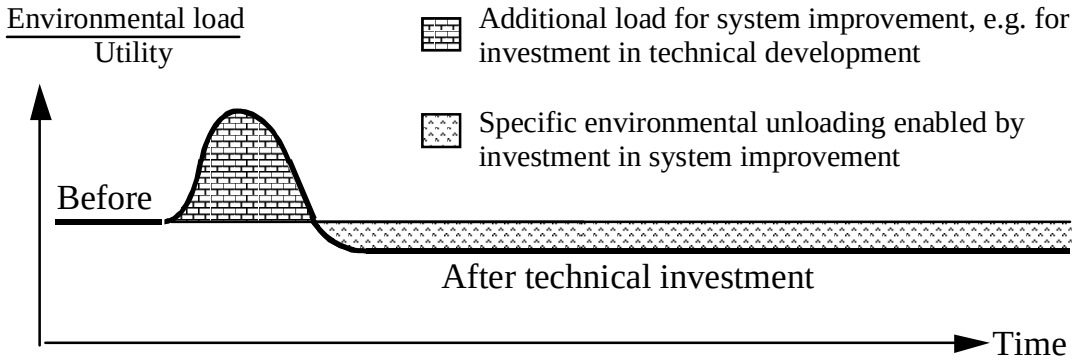

Figure 5 *Typical trend curve for environmental load when an investment enables improvement in efficiency.*

An investment activity causes additional environmental load. Assuming that the specific environmental load is lower than before the investment, when the new technology comes into operation, the pollution level then begins to decrease. This decline will continue, and if the improvement in environmental load rate is large enough and if the length of production period is long enough, the pollution will decrease to a level that comes to be lower than extrapolation of the original trend of environmental pollution development. In actual fact, if the general level of pollution increases, we are dealing with a change from one rate of degradation to another. This is a common perception of the environmental state of evolution today, and it implies that there is no time to lose.

The Sustainable Business Development Loop

The business loop is important to keep up momentum in a modern society going and at a basic level the goal to improve effectiveness is common for business profitability and environmental adaptation. However, consumption growth tends to increase the environmental load, and it seems important to focus on clean technology. But if clean technology is conceptualized as a separate interest, as in figure 4, then there is no clear interconnection with the business loop. We now take a step further by suggesting a view that combines the clean technology ambition of improving effectiveness with the business interest to organize appropriate activity.

From a traditional production oriented view, the clean technology concept focuses on efficiency and as indicated in table1, this also applies for environmental science views such as LCA. Consequently, the word efficiency was used in the figure 4 illustration of the clean technology thinking. However, we now want to clarify a more explicit focus on relations to improvements of customer utility, service value and satisfaction. From this point of view the aim is to do the right thing, and consequently we now replace the efficiency word for this parameter with the word effectiveness.

A New Business Perspective

The traditional business view tends to focus on volume, but from a rational point of view the basic business interest is to increase effectiveness. To be able to make good money a firm has to be at least as effective as its competitors in producing utility. In an information society where people become more and more knowledgeable, the focus changes from quantity to quality. The business loop in figure 4 could be redrawn to show the loop - Activity - Effectiveness - Utility - Satisfaction - Demand – Activity, etc. However, we also want to show the clean technology focus on Improvements and from this starting point we get the approximately eight-shaped loop in figure 6.

From an environmental point of view the most crucial aspect of the sustainable business development loop is that the effectiveness increases at least as much as the volume of material consumption, i.e. at least as much as the volume of business activity. If this is the case then the environmental situation may improve although the volume of consumption increases

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The Sustainable Business Development Loop

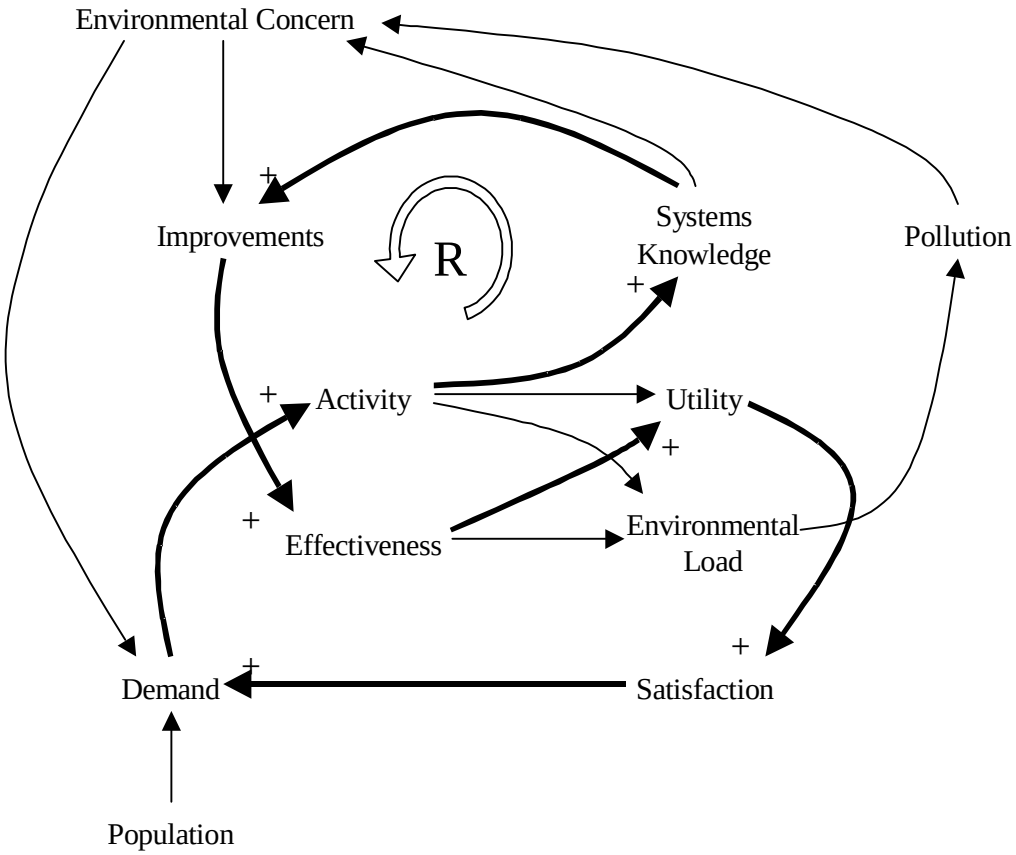

Figure 6 *The Sustainable Business Development Loop, aiming to clarify the use of clean technology in business for human support in the environment.*

- On the one hand, it is often proposed that economic growth is good for the environment, because, above some level of income, there is an empirical correlation between increasing per capita income and some measure of environmental improvement (Arrow *et al* 1995).. The economic growth concept may also have a basic relation to the development of recyclable resources. "Theories about economic growth claim to deal with the genesis of new resources" (Dahmén 1994). Growth may be a way to shift from a base of diminishing returns to one of increasing returns (Arthur 1996)
- On the other hand, it is questionable to use economic growth itself as an overarching goal. For example, it is environmentally relevant to be critical of the creation of "unnecessary" needs, through marketing, etc. "Economic growth is not a panacea for environmental quality …….What matters is the content of growth" (Arrow *et al* 1995).

The processes that can connect activity to improvements are experience, learning and creation of new knowledge. This build up of system knowledge should also give priority to environmental considerations, as illustrated by the upper loops in figure 6. However, the environmental interest should not be presented as an antithesis to the human interest. We find it more rewarding to focus on environmental knowledge as a part the system knowledge, which we need to enable long-term human sustainability. The reinforcing Sustainable Business Development Loop illustrates an intrinsic ability to grow through learning and business development. However, it should be noted that all business systems have to exchange resources with external systems. The outer loop in figure 6 illustrates that it is important to take environmental aspects into consideration. The concept “environment“ as used here focuses on relations to ecological systems through factors such as air quality. From a general point of view an analogous interdependence also applies in other dimensions e.g. to customer preferences, industrial networks and legal requirements. To a large extent System Knowledge deals with relations to external systems.

The Sustainable Business Development Loop focuses on the business connection from effectiveness to customer utility in order to show that a firm’s profitability is dependent on operational effectiveness rather than volume of activity. This deviates from the conventional clean technology focus on the connection of effectiveness to reduction of environmental load because we think that link is of secondary interest from business point of view. Customers do not normally purchase reductions in environmental load.

One drawback in relation to the expressed in figure 6 view is that, in a short-term perspective the market primary deals with the relation between amount of utility and volume of production. This also relates to economies of scale that has been a major method to achieve industrial efficiency. However, the customer utility value of a product depends on how well it fits the particular customer’s needs, and from this point of view there tends to be a diseconomy of scale. Consequently, we think the view in figure 6 is relevant to a customer oriented business perspective.

The critical aspect of the Sustainable Business Development Loop is that it strengthens the link from Activity to System Knowledge. Here we think it is necessary to focus on the individual, because, in reality, all learning takes place at individual level. Consequently, it is important to observe and give individual rewards for learning that contributes to system knowledge. We need to strengthen the individual interest in learning so that as many as possible really tries to learn for the future from the activities they perform and participate in.

Figure 6 illustrates a possibly endless intertwining development loop with a primary focus on system improvement and effectiveness to increase utility and satisfaction. From this point of view there are both positive and negative influences on the amount of environmental load and

the key issue to enabling long-term sustainability is to increase effectiveness at least as much as consumption. The conceptual link to describing the possibility for continued activity is the resource concept.

A integrated view of production and consumption of resources

The general management perspective on industrial activity is that it is an organization process and a system to transform resources into utility. Business activity also leaves a residue of wastes (Karlsson 1998).

The main tools for business management are economics and accounting, and this view is illustrated by the two right-hand feedback loops in figure 7. From this point of view the most explicit sustainability goal for a firm is to maintain and increase a company's assets, by balancing cost with sales, or rather by developing sales to cover costs. To enable continued profitable existence of the company; it is necessary to compensate for the inevitable degradation and obsolescence by reform of organization and technology, etc., and by adaptation to environmental changes. Both the company itself and the business environment are dynamic. At the same time a company is dependent on raw material from its environment, i.e. from external resource supplies. A company's activities also influence its environment. Environmental assessment methods focus on the negative external impacts and include resource consumption.

In a basic long-term perspective, it can be noted that raw material resource values originate in development of knowledge about their usefulness, e.g. iron ore was not a resource until man learned to produce and make use of iron. In such a holistic perspective, it is obvious that there may be a positive feedback loop from activity output to potential for future input, as illustrated in figure 7. This positive feedback may happen through directly related effects such as future savings in production load(Karlsson 1995) or learning by specific experience. It also evolves as a network effect and is influenced by general development of technical knowledge. This is noted in some modern economics models, such as the R & D investment perspective in the framework for Techno-economic analysis (Grandstrand 1994). However, the mainstream business view focuses on the production side, which can be internalized by the analyzed activity system. Consequently, there seems to be a need for conceptual development to make the external positive feedback loop more explicit.

The positive feedback on (environmental) supply of raw materials is easy to understand. The positive external feed back effect on environmental pollution is more difficult to conceptualize. It does not primarily focus on ecological restoration, of e.g. water systems and industrial sites because in such projects it is the clean up itself that is the produced utility. This can be compared with an analogy to the biological systems: where, air, water can be treated as resources for the living cells, which are vital for their survival. However it is fruitful to focus on the indirect effects, such as an improved recycling system, which enables environmental unloading, thereby decreasing pollution through a more effective material supply. The non-renewable resources also get their usefulness through development of knowledge.

Figure 7 aims to illustrate the sustainable development perspective as a balanced view on feedback effects, in a general sense. The negative part of this loop is already in focus in environmental science and elsewhere. However, the positive part of the external feedback tends to be neglected, both by economists and by environmental scientists. Of course, there may be properly operating positive feedback independently if it is not observed by these sciences. To enable a relevant scientific dialog on sustainability issues it seems important also to clarify the external positive feedback mechanism.

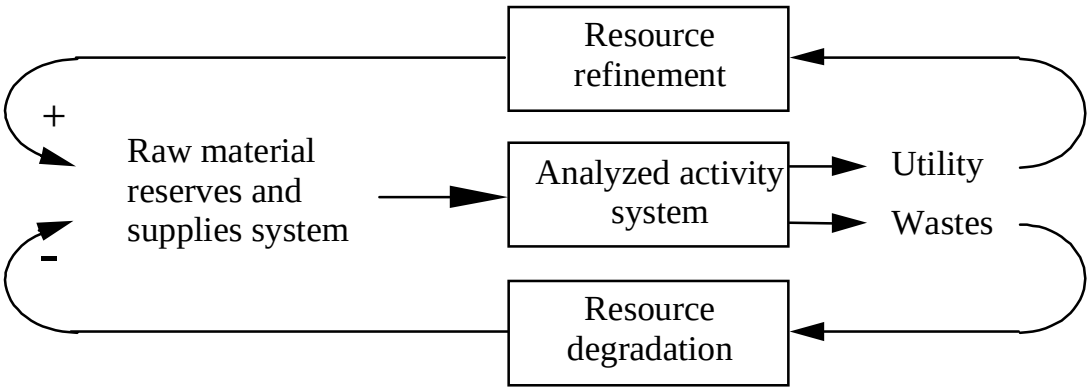

Figure 7 *An analyzed production system in relation to a dynamic superior level resource system view, or a sustainable development view on a product system.*

This current change of view is also depicted in business papers, for example in a recent issue *Harvard Business Review*: "Whereas yesterday's businesses were often oblivious to their negative impact on the environment and today's responsible businesses strive for zero impact, tomorrow's businesses must learn to make a positive impact".(Hart 1997)

There is a need for a change of perspective on resource management, and a new business paradigm seems to be evolving, for instance in a new approach to management, accounting and controlling:

> *Activity presupposes that resources are given. It proceeds as long as coherent resources are jointly available. Due to the continuous destruction of resource by activity, they cannot be free. As long as resources appear to be plenty, the firm can be considered an entity that organizes activity by exploiting resources to achieve its results. The ability to continue activity is the ability to create profits that allow access to scarce resources. Presupposing the existence of some natural abundant or 'infinite' resources has been part of the traditional perception of economy.*
>
> *However, all resources are limited. Consequently, if they are to be consumed, they must first be created. Creating resources must be considered a goal to be achieved. The firm must be redefined as an entity that creates the resources necessary to continue its activity.*(Nørreklit 1996)

From this view, resources are not a stockpile but more like a well from which one takes water over and over again. Using this resource metaphor, the recyclable matter in a stockpile, in itself, is not a resource. The actual resource is the ability to use the matter in effective production. This means that the resource concept describes an effectiveness ability that enables activity. In relation to figure 6, on the one hand, the intertwined loop is dependent on resources and, on the other hand, the long-term supply of resources depends on learning and system improvements. We do not think that it is easy to keep this process in sustainable operation, but it appears to be possible, and at least we have to try.

An example of systemic resource value

The + in figure 7 describes creation and production of additional resource value. Production values, such as refinement of material properties to achieve recyclability is reasonably easy to grasp. However, recycling is a new part of the material market and so far recyclability is normally not noted as an economic value at the point of product sales. Knowledge is more difficult to evaluate and properties such as general experience and tacit knowledge are even

difficult to conceptualize. Furthermore, physical characteristics also arise and grow as superior level systemic properties. Consequently, it is very difficult to evaluate prospective external values. For example, it is difficult to know what future opportunities may arise as a result of today's developments in information technology and communications. To illustrate this, we take a brief look at the development of the electricity supply and the growing appreciation of the utility of an electric product, the refrigerator.

The refrigerator today provides great value for many people by enabling storage that keep the food fresh. This is one important tool for the industrialized life style of today and most people would probably be prepared to pay much more than they presently do for the refrigerator part of their electricity consumption, if the alternative was losing the possibility of cold storage. Once we have learned to take use of it and grown accustomed to its reliability, it becomes obvious that the refrigerator and its electricity is of great value. But lets try to rethink this as a prospective valuation question.

One hundred years ago there was hardly any electricity supply and there were no electric refrigerators. The actors who were trying to raise money for electrification had a hard time convincing people about the advantages of electricity. Each individual turbine, generator, transformer, power line etc. only made a minor impact on societal conditions. But the electric net started to grow and based on activity and experience the different components improved. The electric power supply started to be reliable, and numerous appliances such as the refrigerator were developed. As a combined result the electric refrigerator became more and more reliable as a form of cold storage and we now realize its value. However, it would have been very difficult to explain this value to someone one hundred years ago. At that time hardly anyone would have been prepared to put their trust in an almost 100% reliability of the electricity supply and fresh food was only considered to be available at certain times. Even fifty years ago there was no demand for cold household storage and only a limited demand for reliable electricity supply. Consequently, each development of and investment in an electricity supply system component has normally been considered to be of limited importance. But as a result of systemic development a lot of people now have continuous possibilities to use electrical appliances and there is lots of knowledge about how to make use of such appliances. This systemic property applies both at an individual consumer level and at a societal level, and it is a basic reason for the long-term business success of electricity-oriented companies during the last century. It is easy to see the systemic value when looking back, but it is often very unclear in a prospective view.

Is sustainable business growth environmentally possible?

One key issue is to clarify what the word 'growth' actually means. One can argue that growth is a very basic process in nature for plants, animals, and ecological niches. The basic flow in ecological systems is that growing plants use elementary matter from dead plants. In this way, life itself is maintained by a succession of specimens of the same or different kinds. Analogously, there is a market succession of different business activities and firms that make subsequent use of a number of different resources. From this point of view, business growth is an essential process to enable continuous support for society.

Most environmentalists object to the economic growth concept as being unsustainable from a long-term point of view. At one level, this may be criticized as a static perspective. However, from a dynamic point of view it is also questionable whether continuous growth of the total business volume is possible.

In figure 6 the Sustainable Business Development model focuses on business development through continuous learning as an ever-improving engine for human sustainability. The main

loop focuses on the driving mechanism and mobilization of resources to keep society going. This primarily deals with an extension or clarification of the traditional business growth mechanism. But, if this were the main actual mechanism what would happen to the environment?

From operational point of view, the Utility/Load quotient aims to show an explicit measure for the interrelation between business interests and environmental concerns. As discussed, the basic criterion for long-term sustainability is that this quotient should increase at least as much as consumption volume.

We want to stress that this compensation is difficult to achieve in today's situation of population increase and rapidly growing demand. Theoretically, however it is possible, because our consumption volume measure relates to the amount of utility. The required improvement in effectiveness may be possible to achieve through multidimensional and multilevel systemic effects. From a motivational and societal structure point of view it is a tremendous challenge to make the required rapid change of development path.

It may be more realistic to focus on reduction of consumption per capita. However, our main problem with the environmentalist perspective in figure 3 and also with the clean technology loop in figure 4 is that they lack incentives to keep the system running. These views focus on analysis and control, but they do not describe the driving mechanism required to keep the human supply system in operation. However, the traditional business interest in figure 1, by itself, may be strong enough to keep sufficient 'speed' of societal activities and then the main supplementary need could appear in the control dimension. Consequently, the Sustainable Business Development view does not replace a specific focus on environmental awareness. To illustrate this we have included an outer environmental concern feedback loop in the figure 6 Sustainable Business Development model.

Another effect, which is not visible in the figure 6 view of the relation between activity and environmental load, is that additional production and consumption cause additional environmental load. When a new solution is more effective this additional production load is a form of investment. However, consumers also often keep most of their old products and then the new products they buy add additional loads.

Conclusion

A more dynamic view on the human ability to live sustainably is evolving. This means that the traditional interest in distribution of resources is supplemented by a stronger interest in societal mechanisms for resource mobilization. Such processes can be described by system dynamics modeling. However, it has been difficult to conceptualize the sustainable development mechanism. The environmental concern has often been described as a self-contained interest or as a balance against business development interests. This paper is inspired by the clean technology focus on effectiveness and takes an additional step by suggesting a system dynamics model, which includes effectiveness as an explicit link in the business development loop. The model also shows how a business system's sustainability may be improved by creation of system knowledge about relations to external systems and environmental concerns.

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