Environmental management in different organizational forms

Preparing environmentally relevant decision-making in different types of business firms

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1 Introduction

In practice, environmental management is often limited to dealing with emissions into the air, water and soil, noise emissions and waste in the workplace. It is often forgotten that these current problems were caused by to the fact that in decision-making about production, too little attention was paid to the consequences for the environment. By doing so, major environmental results can be achieved. For example, the environmental effects of alternatives may already be considered at the stage of designing the product or when making choices about production technology. Such considerations to not only concern environmental pollution during production, but also the effects of the recovery of raw materials, the use of the product and waste phase. On the basis of these concepts we may distinguish two approaches in environmental management.

Firstly, the sources of current environmental pollution are located in the workplace, where people perform activities on substance and energy flows using machines and equipment. Such sources are noise emissions, emissions into air, water and soil, and waste production. Dealing with these emissions is called the *source-oriented* approach to environmental management.
Secondly, the current sources are largely the result of previous business decisions concerning the development, construction and continuation of the production equipment. Environmental considerations have received insufficient attention, or there is an inability to remove the problem areas that were found. The introduction of environmental considerations into decision-making is called the *cause-oriented* approach to environmental management. In this stage the more fundamental changes can be weighed. This preventive approach is aimed at preventing sources of environmental pollution.

This paper gives a more detailed description of the cause-oriented type of environmental management. Particularly we shall deal with the question of how such management may correspond to internal organization. The following questions are answered:
1. Which main forms of business management can be distinguished? (Section 2)
2. Which decision-making in firms is environmentally relevant? (Section 3)
3. How does environmentally relevant decision-making take place per main form of management? (Section 3)
4. In allocating environmental tasks, how can the way in which environmental decision-making takes place be taken into account? (Section 4)

The paper is concluded with a summary.

2 Main forms of management

To be able to operate successfully, a firm is dependent on its environment. In addition to the generally dominant market and competition considerations, other environmental factors may also affect business management. Here we may think of specific demands imposed on the production process (i.e. by the license-granting authorities) or demands concerning the firm's socio-economic policy (imposed by authorities and trade unions). It is the task of the management to weigh the various requirements in shaping the primary processes. These primary processes do not consist only of production itself but also of essential functions such as the purchase of raw materials and resources and the sale of products. Thus it is the primary processes themselves that lead to the substance and energy flows that are so important to environmental management. If we now draw a general, much simplified, business model on the basis of the above, we obtain the picture given below:

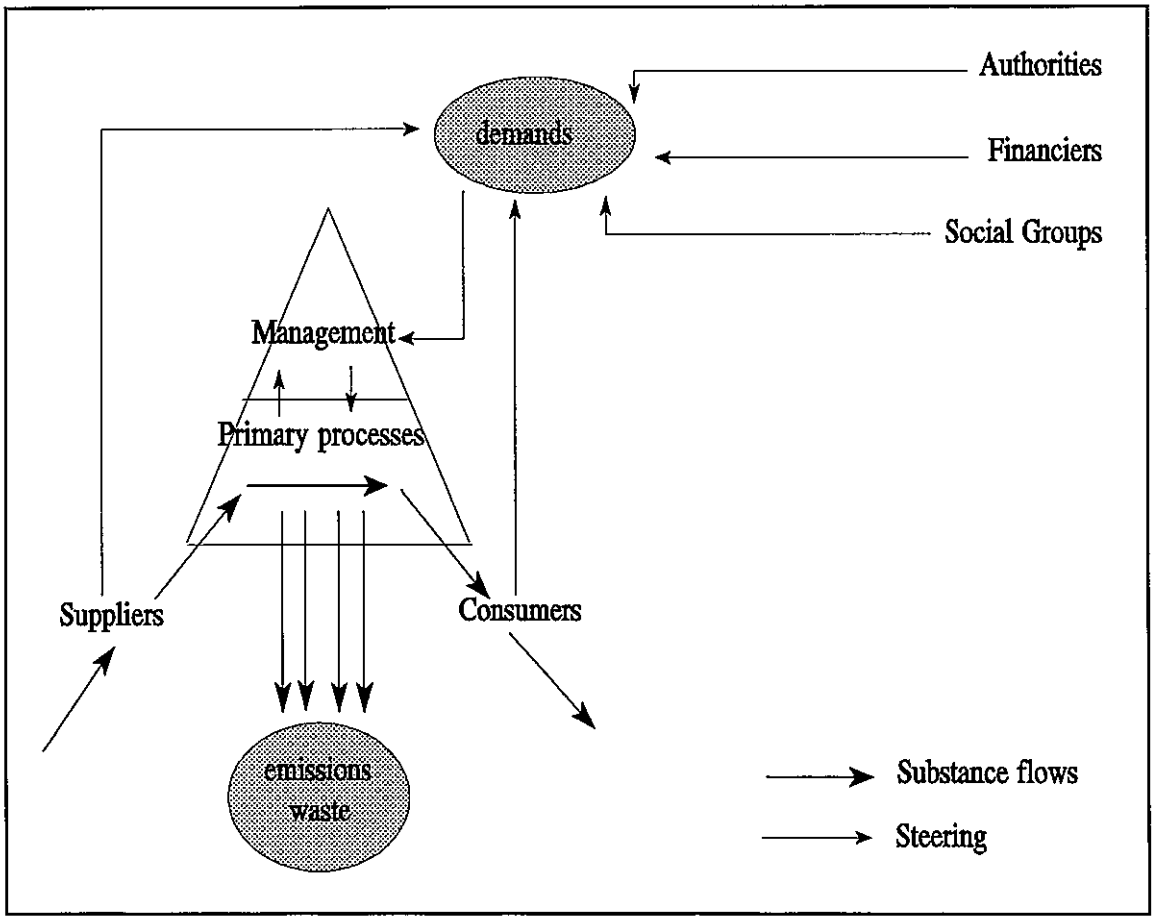

Figure 1: Substance Flows, Firm and Environment

Changing market and competition relations must lead to adjustments in the primary

processes[1]. Choices are determined largely by market dynamics. Generally speaking, business management has to respond to market dynamics. Dynamic markets require a form of management which can deal with rapidly changing demands from consumers. Less dynamic markets mainly call for a form of management that is able to keep the cost price low. Thus firms can be characterized on the basis of their form of business management. This specific form of management, i.e. the *production method*, is characterized by:

1. The *products* manufactured by the firm:
   If the market(s) is/are very dynamic, i.e. if consumer preferences change rapidly, the product will be revised very frequently (indicated as 'High Innovation Frequency' in Figure 2) and be closely adapted to the client's wishes ('High Product Specificity' in Figure 2). The order precedes production and there is little distance between the producer and the individual client.
   If consumers preferences do not change or change only slowly, we see little market dynamics and far less product adaptations ('Low Innovation Frequency' and 'Low Produkt Specificity' in Figure 2). The orders are preceded by production (programming), and there is a large distance between the firm and the individual customer.

2. The *technology* used by the firm:
   Low market dynamics result in relatively high investments being made in productivity-enhancing equipment and automation. After all, the low product specificity makes the price a major competitive factor. However, this does affect the flexibility of the production arrangement, leading to a situation which is characterized by product-specific mechanization and automation of the production arrangement to keep the cost price as low as possible.
   Vice versa, a dynamic market leads to more process-specific mechanization and automation with a higher flexibility where the range of products is concerned.

On the basis of these two characteristics we may distinguish production methods on the basis of continuous, series and piecemeal production.

In the case of *continuous production* the products are put on the market indirectly in large numbers through importers, wholesalers and trade enterprises. Often production is based not on orders but on supplies, and only a small number of products are manufactured at a production site. The life cycle of a product from development up to the moment it is 'taken off the market' is a long one, and the frequency of product innovation is low. The price/quality ratio is a major competitive factor. The economic and technical life of the tools, machines and installations together with the large amount of invested capital makes far-reaching changes a long-term matter.
We see standard finished products, semi-manufactured products which are processed by

[1] Although in our elaboration we devote extra attention to environmentally relevant characteristics of the organizational and decision-making structures, this is an approach with a broad base of support (Skinner, 1969; Mintzberg, 1979; Hayes and Wheelwright, 1979 a and b, and 1985; Wheelwright 1985; Lammers, 1987; Botter, 1988; Fisscher c.s., 1991 and De Bruijn and Lulofs, 1992).

a large number of purchasers, or means of production which can be used in a general way. Examples of such products are foodstuffs such as bread, semi-manufactured products such as building wood, basic chemicals such as chlorine, and basic metals such as steel. Examples of standard means of production are wheelbarrows and storage racks.

In series production we should distinguish between the production of consumer goods and the production of semi-manufactured products.
In the case of *series production of consumer goods*, just as with continous production, market sales take place through intermediate trade, so that we see an indirect interaction between producer and consumer. However, consumer preferences with regard to the products change more rapidly than in the case of continuous production. Here the product is not tailor-made to the demands of the individual consumers, but to the idea the producer has of the preferences of (part of) the consumers. So we see considerable amounts of a standardized product which was developed with a specific group of consumers in mind. However, due to changing consumer preferences product innovation takes place regularly. Thus the life cycle of the often durable consumer goods is considerably less than in the case of continuous production. Examples of such products are audio and video equipment, household equipment, cars, bicycles, (office) furniture ad clothing. The life cycle of these products varies from some six months to around four years.
In the case of *series production of semi-manufactured products* for the production of consumer goods in series production, we see direct interaction between the producer and the consumer. This means that the product to be supplied is tailored to the requirements of the individual consumers. Examples are the subcontractors that work in many branches of industry, e.g. a firm that supplies synthetic parts for the automobile industry. The means of subsistence of such subcontractors are usually closely linked to a limited number of consumers. The products they supply are large amounts of semi-manufactured products, made to order according to customer specifications. As far as the frequency of product innovation is concerned, the manufacturers of these products are forced to follow the wishes of their customers.
Regarding the production technology to be used, in series production choices need to be made between some basically conflicting considerations. On the one hand, mechanization and automation of the production arrangement can reduce cost price and strengthen the firm's competitiveness. At the same time regular product innovations force the entrepreneur make any large investments in mechanization and automation flexible enough so that he will not be faced with forced depreciations each time.

In the case of *piecemeal production* there is direct interaction between the producer and the consumer. The consumer informs the producer directly of his wishes regarding product specifications. Orders precede production. Product sales are determined by the extent to which it is possible to produce the desired product in the desired quality. However, this does not imply that a whole new product is made for every consumer; rather, the entrepreneur's general basic concept will be respecified every time on the basis of consumer requirements. Within certain limits, the range of products is infinite. These limits are determined by the product technology available. Examples of such products are made-to-order production equipment and luxury yachts.

In the following figure gives the characteristics discussed above are summarized on the basis of production method.

Production method	**Product** - *specificity* - *innovation frequency*	**Technology** - *mechanization* - *automation* - *flexibility*
continuous *finished and semi-manufactured products*	- low specificity - low innovation frequency	- product-specific mechanization - produkt-specific automation - low flexibility
series *finished products*	- average specificity - average innovation frequency	- process-specific mechanization - process-specific automation - average flexibility
semi-manufactured products	- high specificity - average innovation frequency	
piecemeal *finished and semi-manufactured products*	- high specificity - high innovation frequency	- process-specific mechanization - process-specific automation - high flexibility

Figure 2: Production Method, Product and Technology

Meanwhile it has become clear that any turbulence in the environment will affect the features of products and technology. Realizing these features requires the right kind of internal organization of the firm. Here we are faced with a third and fourth feature of production methods, i.e. the organizational structure and the decision-making structure.

The organizational structure is the way in which tasks, powers and responsibilities are allocated to persons and departments and the way in which persons and departments are related to one another (Heijnsdijk, 1992). In the organizational structure we first distinguish the horizontal allocation of tasks, which may be either functional or product-oriented. Next we distinguish the vertical allocation of tasks, which concerns the number of organizational levels and relations between line and staff positions.
The decision-making structure concerns the positions in the organizational structure where the contents of decision-making is actually being prepared, the temporal horizon of decision-making, the allocation of formal decision-making powers and the extent to which decision-making is governed by certain fixed rules.

The following section explains how environmentally relevant decision-making takes

place per production method on the basis of the forms in which organizational and decision-making structures occur in production methods.
In anticipation, Figure 3 gives a survey of the various forms of organizational and decision-making structures per production method.

Production method	**Organizational structure** - *horizontal task allocation* - *vertical task allocation*	**Decision-making structure** - *centralization* - *formalization* - *target/contents*
continuous *finished and semi-manufactured products*	- strong, centralized hierarchy - preparatory staff important[2] - functional task allocation - staff and line strictly separate	- strongly centralized decision-making power - strongly formalized procedures - aimed at process improvements
series *finished products*	- strong, centralized hierarchy - preparatory staff important, also for product variation - functional task allocation - staff and line separate	- centralized decision-making power - strongly formalized procedures - aimed at both process and product improvements
semi-manufactured products	- centralized hierarchy - preparatory staff important, particularly in case of product variation - functional task allocation - staff and line not strictly separate	- decision-making power lies with the management, preparatory staff and medium-level executives - formalized procedures - aimed at product improvements
piecemeal *finished and semi-manufactured products*	- weak, decentralized hierarchy - both functional and product-oriented task allocation - workplace and exmple staff central - no boundary between staff and line	- strongly decentralized decision-making power - few formalized procedures - aimed at product improvement

Figure 3: Production Method, Organizational and Decision-Making Structures

As mentioned above, the possibilities for deviating from this typology are limited. For instance, a firm that does piecemeal production using a technology, organizational structure and decision-making structure that belongs with continuous production, cannot compete or has difficulty competing: flexibility is too low, the distance to the customer too great and the invested capital too high. It should be noted, however, that a firm can consist of elements which have different types of business management. An example is the 'special products' department of a series-production firm.
The extent to which the organization pays attention to other demands than market demands (see Figure 1) likewise depends on the production method. If certain require-

[2] This preparatory staff consists of planners, controllers and process developers, among others (Mintzberg, 1979).

ments are considered sufficiently important, the organizational structure will provide tasks which have to ensure the translation of these requirements into relevant decision-making situations within the firm. If the features of a firm's organizational and decision-making structure are known, we have a suitable point of departure for the organization of cause-oriented environmental management.

3 Environmentally relevant decision-making processes

In designing our model of business decision-making we have used a cone-shaped model. This cone is characterized by the fact that when going down in the cone, the temporal distance between decision-making and the realization of the decisions that were taken (i.e. the realization of the primary processes) diminishes, while the amount of detail is increasing. In such a cone model, therefore, strategic decision-making is located close to the top of the cone, while operational decision-making is located near the bottom (viz. Paine and Anderson, 1983, and Anderson, 1990).

Strategic business decisions are aimed at long-term continuity and concern choices with regard to products, production technology and firm sites. Operational decision-making concerns the initiation, coordination and control of the primary processes. Both strategic and operational decisions are environmentally relevant insofar as they entail *potential* environmental pollution when implemented. This makes environmentally relevant decision-making a part of the 'normal' decision-making process within a firm.

In the case of *environmentally relevant strategic decision-making* the issue is future environmental pollution as a result of decisions regarding:

* the product:	i.e. the composition of the product and its use as laid down in the design of the product;
* production technology:	i.e. the intended production process, the equipment to be used, machi- resources;
* location:	i.e. the physical location where the firm is managed.

In the case of *environmentally relevant operational decision-making* the issue is future environmental pollution due to the starting-up, maintaining and changing of production. Environmentally relevant decisions concern the following in particular:

* the choice of raw materials and resources;
* the choice of equipment, machines and installations;
* the planned use of substances and equipemt, including:
  - the purchase, installation, maintenance and exploitation of tools, machines and installations;
  - the ordering and use of raw materials and resources;
* the planned delivery, storage and transport of:
  - raw materials and resources;
  - working supplies of raw materials and resources;
* the planned transport, storage and delivery of:
  - the products;
  - any secondary products;
  - waste matter.

Summarizing, there are good reasons to devote attention to *all* environmentally relevant business processes in trying to accomplish a considerable reduction of the environmental pollution by firms. The question of which processes are environmentally relevant can now be answered briefly as follows: both (a) the primary processes (where the sources of environmental pollution are located) and (b) strategic and operational decision-making (which caused the sources) insofar as this concerns the environmentally relevant aspects of business management.

An important element of cause-oriented environmental management is the allocation of tasks to those places where environmentally relevant decision-making is taking place. The performance of these tasks should ensure the introduction of environmental considerations into strategic and operational decision-making. In short, the performance of these tasks means that all environmentally relevant decisions within the firm are subjected to an environmental test. In the following section we shall indicate per production method where and how environmentally relevant decision-making is taking place. Per production method, instructions are given for the allocation of cause-oriented environmental tasks.

4 Environmental management and environmentally relevant decision-making

So as not to have to repeat ourselves we shall begin by mentioning a number of issues which should always be taken into account in task descriptions and task allocation.
First this concerns the question of whether a separate environmental function or environmental department exists or needs to be set up. Secondly, linear management should also be 'evaluated' as to its efforts regarding the environment. Task descriptions within the line should correspond to this. This is necessary in order to let the supporting activities, e.g. those of a preparatory staff or environmental department, penetrate into the whole complex of considerations which are dealt with by the linear management. The final responsibility for environmental management remains with the line management. Naturally, one should watch out for any competence and coordination problems between the environmental coordinator or environmental department, if any, and: (a) the linear organization and (b) the preparatory staff.

4.1 Environmentally relevant decision-making in continuous production

Continuous production is aimed at the standardization of products. This requires a far-reaching control of the production process and a strong hierarchy. In view of this strong hierarchy, formal powers of decision are strongly centralized in the case of continuous production. As a rule, staff and line organizations are sharply separated on the basis of their tasks and responsibilities. The main decision-making actors, particularly where strategic decision-making is concerned, are the firm's top executives and the preparatory staff.
In this form of management it is clear that it is of the utmost importance that environmental management begins at the strategic decision-making phase and also carries a lot of weight when the final decisions are taken. After all, decisions on products and production technology will establish the situation for a long time to come. In the

meantime the main emphasis lies on (minor) improvements of the existing product arrangement. Already during the strategic decision-making phase several persons are involved in various positions. Particularly the preparatory staff, e.g. the process developers, often plays an important role in preparing the, albeit not very many, but far-reaching changes. Thus different interests are introduced from different positions. The objective is to obtain extensive and high-quality information. This is evidenced by specialization and careful preparation, making it possible to introduce environmental interests as well on the long road of decision-making.

Due to strong specialization we see only limited potential for growth[3] at the upper and central levels. This results, in the case of continuous production, in a linear organization consisting of a relatively large number of levels from the top down to the workplace. Thus, environmentally relevant decision-making involves other positions and persons than strategic decision-making. At the start of operational decision-making, many of the decisions are determined by the preparatory staff. These decisions are confirmed by the linear management at a high level. As the distance to actual production diminishes and the level of detail increases, the contribution of the lower linear management becomes more and more important.

All the above means that there are quite a few links in the decision-making of a continuously producing firm which should be covered by environmental management. Thus the incorporation of the environment into the organizational structure, necessary to influence environmentally relevant decision-making, is a major issue in this type of firms. Now what are the points of attention regarding cause-oriented environmental management in continuous production?

1. Tasks, powers and responsibilities must be set out within the extensive organizational structure. This may accomplish the following, as regards the crucial environmentally relevant decision-making process concerning product and product technology (and choice of location, if relevant):
   - that in preparation and decision-making sufficient attention is given to environmental considerations by the preparatory staff;
   - in view of the various partial interests which are served from various functions within this preparatory staff and top-level executives, that the environmental interests are introduced from a position of sufficient importance and quality;
   - that the influence of environmental considerations on preparation and decisions is laid down in formal procedures.

2. In addition, the strict separation between staff/line and the relatively large number of hierarchic links needs to be taken into account. In introducing environmental considerations into environmentally relevant operational decision-making, the obvious course of action is to:
   - allocate the tasks regarding the introduction of environmental considerations to

[3] With growth potential we refer to the number of subordinates who are managed directly (i.e. without any intermediate levels).

the preparatory staff at the start of operational decision-making;
- at a lower level in the decision-making cone, allocate the tasks regarding the introduction of environmental considerations to the production management.

4.2 Environmentally relevant decision-making in series production

In series production we once again distinguish the series production of consumer goods and that of semi-manufactured products.

- *Series production of consumer goods*

As compared to continuous production, in the series production of consumer goods environmental decision-making takes place somewhat differently. Particularly the -many minor- changes in the products are not part of strategic decision-making. Strategic decision-making concentrates once again on markets, but is more general where the product is concerned. Due to the lack of specifications it is difficult to judge the environmental effects of the products at the strategic decision-making stage. Choices regarding production technology and locations, which strongly limit flexibility for a longer period of time, are prepared more intensively, however there are usually less people involved and less effort is made than in continuous production. The preparatory staff plays an important role in this type of decision-making. In larger firms this role is often a more dominant one than in smaller firms.

The precise product design really takes place at the stage of operational decision-making. The medium-level executives and preparatory staff play an important role here. In view of the shorter life cycle of the products, this means extra tasks for the preparatory staff particularly in the fields of marketing and product design. To be able to follow changing consumer preferences, a thorough knowledge of these preferences is a prerequisite. In view of this involvement with the product and its development, the separation between staff and linear organization, particularly among the medium-level executives, is somewhat less strict than in the case of continuous production.
The preparatory staff operates not only for the firm's top-level executives, as in the case of continuous production, but may also be mobilized by its medium-level executives to supervise both adaptations in product technology and product adaptations. The responsibility for the implementation of these changes often lies with the medium-level executives. However, the 'go or no go' decision as a result of the centralized decision power is often taken by the top.

The number of links in linear organization may be quite considerable in larger firms. Also here the objectives are specialization and standardization. This leads to an organization which is characterized by clearly separate and clearly circumcribed positions, a great many hierarchic links and horizontal task allocation. This entails the risk that the initial general attention given to environmental considerations is insufficiently implemented during the elaboration in operational decision-making.

In view of this situation we may mention the following special points of attention for the design of environmental management:

1. Regarding environmentally relevant strategic decision-making:
   - Strategic decision-making about the products is often so unspecific, that it is questionable whether much environmental results can be achieved here. For each specific firm, it can be verified whether a general environmental test is desirable.

   This does not apply, however, to decisions on production technology and locations. Environmental considerations should be an intensive part of decision-making. This decision-making is dominated by the preparatory staff.

2. Regarding environmentally relevant operational decision-making:
   - As regards product designs and adjustments in production technology, the introduction of environmental interests will have to take place particularly at this stage of decision-making.
   - the preparatory staff may well be charged with the task of initiate and monitoring this. An advantage of this is that the preparatory staff is involved both in strategic decision-making and in operational decision-making. Allocating these tasks to the preparatory staff is an obvious choice, therefore.

- *Series production of semi-manufactured products*

Series production of semi-manufactured products takes place in closer consultation with the consumers and often on the basis of consumer specifications. This means that the tasks of the preparatory staff with regard to the product are more intensive than in the case of the production of consumer goods. After all, a minor deviation from the required specifications may make the semi-manufactured products unsalable. For the organizational structure this means that the tasks of the medium-level executives are partly taken over by the preparatory staff. Thus the strict dividing line between staff and linear organization tends to blur in the case of series production of semi-manufactured products; these tasks may even be performed by the same employees. However, it should be monitored here that environmental arguments are not snowed under by the multitude of other considerations and tasks.

Formally speaking, long-term decision-making may take place at the top of the firm. Materially speaking, however, the powers of decision lie with the top-level executives, preparatory staff and medium-level executives together. As regards the series production of consumer goods, cooperation between the medium-level executives and the preparatory staff is becoming increasingly important. This opens the possibility of allocating environmental tasks to the medium-level executives as well.

4.3 Environmentally relevant decision-making in piecemeal production

Usually we see only a limited presence of strategic decision-making in piecemeal production. It concerns only general choices regarding the markets which are targeted and the type of products. After all, in the case of piecemeal production the firm needs to be able to respond rapidly to the specific wishes of the consumer. Naturally the firm management should nevertheless focus on future possibilities.

Decision-making is aimed at the realization of product adjustments and improvements, in consultation with the consumer, since sales are determined by the possibility of producing the desired product in the desired quality. Here flexibility is the key word. Therefore, product innovation is taking place constantly. The limits are set by the available production technology. Minor adaptations and investments take place on an ad-hoc basis.

In view of the dependence on consumer requirements, the lines running from the top-level executives to the workplace must be as short as possible in the case of piecemeal production, since each individual product is basically designed together or in consultation with the customer. This means that the preparatory staff, together with the lowest-level production management and the workplace plays an important part in product development and production. Therefore, piecemeal production calls for decentralization of decision-making powers and a strong emphasis on operational decision-making. Partly as a result of this the separation between line and staff will be present only formally, giving such an organization some of the features of a matrix organization. A positive circumstance in piecemeal production is the fact that planning and actions are often performed by one and the same person. Naturally this stimulates the implementation of measures.

What are the consequences of this method of business management as far as the necessary incorporation of environmental tasks into the organization is concerned?

1. Regarding environmentally relevant strategic decision-making:
   - Strategic decision-making with regard to the markets and products to be supplied is usually too general in nature to expect a lot of results here from the introduction of environmental considerations. Environmental considerations should be an extensive part of considerations only in the case of decisions on production technology and a possible choice of location.
   - Since a preparatory staff for the support of strategic decision-making is often lacking, the responsibility for weighing environmental considerations lies exclusively with the firm's executive management. If the required expertise for this is lacking, however, inviting external advice is an obvious step.

2. Regarding environmentally relevant operational decision-making and the workplace:
   - Environmental results can mainly be obtained from the activities of the preparatory staff and in the workplace. As we have found, these activities are strongly interconnected. Often there is hardly any distinction between staff and linear functions. A separate staff department for environmental affairs is not an obvious choice. This makes it essential to give responsibilities, during product development, to 'core functionaries' who can introduce environmental considerations during operational decision-making. Adding the issue of the environment to the tasks of the preparatory staff and possibly the workplace is a more obvious step, therefore. Because of the interwovenness of the various activities, personal interests and abilities may also be important reasons for the allocation of environmental tasks, in addition to the formal positions of officials who are eligible for environmental tasks.

- If there is a separate environmental official or even department, access to operational decision-making and the workplace will have to be guaranteed. Given the desired speed of action the hierarchy is likely to be small, after all, and work is not done according to formal procedures. Besides there is a strong focus on products and customer preferences. Because of this an independent department, whether it is big or small, may soon become isolated.
- In this form of production there is often little space to become extensively involved in matters which do not serve production directly. In addition to little space within functions, problem areas regarding the supply of information and expertise in the area of the environment will also have to be dealt with. The nature of the tasks will have to entail that specific education and training involves relatively large numbers of employees.

5 Summary

The cause-oriented type of environmental management should see to it that all environmentally relevant decision-making processes are controlled. This means that environmental management must correspond to the way in which environmentally relevant decisions are taken. By looking at which form (or forms) of management occurs (or occur) within a firm, environmental management may then be tailored to these specifications. This approach to cause-oriented environmental management provides for the following:

1. In *strategic decision-making* about locations, buildings, products and product technology, the following is provided:
   - the systematic gathering of information on the environmental consequences of alternative choices during the raw materials, production, consumption and waste stages;
   - looking for alternative choices that are more environmentally friendly;
   - using a weighing method to allocate weights to the environmental consequences within the whole complex of considerations.

2. In *operational decision-making*, which is aimed at setting up and maintaining a production arrangement in the working methods, the following is provided:
   - the systematic gathering of information on the environmental consequences of the choices that were made;
   - looking for environmentally friendly implementations;
   - weighing environmental and other business considerations.

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