Chapter 11
SOURCES OF IDEAS AND BARRIERS TO INNOVATION IN LARGE CORPORATIONS

11.1 INTRODUCTION

Large and/or old organizations are commonly conceived of as hampering creative and innovative work. The aim of this chapter is to explore this issue on the basis of perceptions of people involved in innovative work. Thus, representatives of principal functions, levels, positions and professional categories in the corporations have been interviewed specifically regarding this matter. The aim has been confined to providing recognition of and insight into the multitude of barriers to innovation in particular. No attempts have been made to assess the frequency and severity of different types of barriers in other than qualitative terms.

In this context the word 'source' pertains to a stage of an information and communication process, a stage that significantly changes the information content. It is far from clear cut how to identify a source, and networks of sources without beginnings and ends are possible. Usually, however, there is in a given context a consensus about where to stop in the identification of sources. The concept of the 'idea' has a rich history of philosophical thought. Here, however, the 'idea' will just signify a coherent conceptualization of a possibility. The word 'barrier' refers to obstacles in a process or a course of events. These obstacles may alter, delay, aggravate or prevent a certain outcome.

11.2 EMPIRICAL FINDINGS

11.2.1 Sources of ideas

Sources of ideas, as stated in the interviews, have been grouped in the following overlapping groups:

(a)   external sources;
(b)   sources on management levels;
(c)   sources in organizational functions;
(d)   sources relating to history;
(e)   miscellaneous sources;

and are explained herewith:

(a) *External sources*. External R&D at universities and institutes is seldom mentioned as a source of specific product ideas for the corporations, at least not in the engineering industry. External inventors are often mentioned as a valuable

source of such ideas. However, the corporations do not consider it necessary to actively seek these people, since these corporations are often approached by them and 'the name of the corporation is enough'. Each corporation has a loosely structured 'satellite organization' of independent inventors, consultants and advisors who are regarded as external. Aside from being a flexible resource and a possible recruitment source, this satellite organization may be a productive way to relate to individuals on the fringes of the proper organization.

Concerning the 'corporate neighbours', that is customers, competitors and suppliers to the corporation, their ideas generally filter through some organizational unit in the corporation such as a marketing or an R&D department. Qualified customers may act as important sources of product invention depending upon the 'balance of knowledge' between customer and supplier concerning technology and customer production economy and needs. A similar argument applies to suppliers as a source. This balance of knowledge varies in different industries. Bulk producers do not have customers as important sources of invention — while, for example, the defence industry does. Suppliers of machinery account for many innovations in the processes of their customers. Suppliers may also have information about competitors, but that kind of source is mentioned marginally. Naturally, competitors substantially affect innovative work, although not by being explicit sources of ideas and information. The information exchange among competitors differs from one industrial sector to another. Companies within the mining industry are said to be traditionally very 'closed' to each other (but opening up), while the automotive industry is very 'open'. The exchange of ideas and technological information, partly formalized through licensing, may become very complicated, especially in technologies that are expensive for the individual companies such as jet engine technology.

(b) *Sources on management levels.* When speaking of sources of ideas at different levels of management, it is hard to distinguish between sources of 'genuine' ideas, on one hand, and sources of significant influences on the shaping of ideas, on the other. Mainly the levels of top management and R&D management will be treated here. Top managers differ somewhat concerning their actual role as idea generator and 'pusher'. 'Pet ideas' from the top are not hard to find historically, although their frequency seems to have declined. At present, most top managers are not — and do not regard themselves as — idea generators for innovations. Sometimes their ideas and initiatives for innovation concern acquisitions or joint ventures. Top managers with a technical background want to take an active part in stimulating and reviewing innovative work to varying degrees. Their overview and basic technical knowledge may enable them to make combinations of ideas, knowledge and productive factors and initiate pre-studies and co-operation.

Comments similar to those above about top management's role in idea generation apply to R&D management above project management level (see Section 7.2.3). Although influential in many corporations, this level of management seems to be more selective and directive than generative. Specific areas of interest and/or competence allow R&D managers to make certain contributions, but in general their role in idea generation is indirect and managerial rather than substantial.

(c) *Sources in organizational functions.* Here a distinction will be made between the basic functions R&D, production and marketing. These functions may be separated and integrated in different ways into the organization, but as sources of ideas they are in general recognizable. Ideas for product innovations from marketing people sometimes concern 'wild' but technically unrealistic ideas. Mostly, however, their ideas concern marginal improvements of a short-range nature, while R&D people are said to account for the main part of the more radical ideas with long-range implications. Marketing people, and especially sales people in close contact with customers, are said to have difficulties in raising their vision over the immediate customer needs, as perceived through complaints, desires, trouble-shooting and the like. This opinion is held by people in marketing and R&D as well as general management positions, especially at Alfa-Laval and SKF, which have engineer-intensive marketing. On the other hand, similar opinions are delivered about R&D people, who are said often to go on with mostly refinements of some original ideas.

Sources of ideas for product innovations within the production function are rare, while production is the main internal source of process innovations. This is especially so in heavy process industries, for example, at KemaNobel, SKF, Boliden and Iggesund, where the production function traditionally has attracted technically talented people.

The distribution of sources within the three functions is generally considered to be very skew. Almost always there are only a small number of individuals prolific in ideas. Every R&D manager pointed out the skew distribution of ideas among people. Key inventive people are not, however, necessarily tied to an R&D department. Thus the distribution of sources within the organization may be very much affected by the distribution of key inventive people within the organization.

(d) *Sources relating to history.* Often ideas have evolved in the past; then they have been shelved and finally considered again in more or less modified versions ('brushed up'). In this way there may be a continuum between renovation and innovation. Advances in supporting technologies, maturing of markets, supply shortages, or changed price relations may revive old ideas or technologies. Also current and completed projects as well as products on the market are sources of ideas or may be viewed as such. Such 'spin-offs' are an important factor in self-perpetuating developments, while spin-offs in unexpected areas are rather rare. In industries with traditional directions along which improvements are made, such as the steel and certain engineering industries, the continuity in project successions is high and they may sometimes be described as 'eternal projects'.

Zeitgeist may sometimes be referred to when the pattern of sources is diffuse, or 'development is in the air' or 'everybody is running for the ball in a way'. To name the individual or the corporation that is first out to 'put together the key pieces' as a source of invention during such circumstances is somewhat misleading.

(e) *Miscellaneous sources.* Sources of information may often be appointed sources of ideas. This includes many conventional sources such as literature, travels, *ad hoc*

contacts, colleagues, conferences and fairs. For instance, work on further improvements is considered to be largely a question of being aware of the existence of knowledge and this brings in literature as an important source.

Ideas may also emanate from active search and stimulation through campaigns, permanent 'suggestion boxes', the application of some specific design or method of idea generation, the use of outside consultants etc. Most corporations have at some time tried something of this kind. Certainly, temporary efforts and suitable communications will tap people's ideas, of which a small fraction then turn out to be usable. Specific sources of this kind have not been mentioned as yielding significant innovations.

A comment upon the so-called gatekeeper and new product searcher is also justified. A few corporations have people with such roles more or less formally assigned. There are so far no examples of these people having generated or transmitted ideas for innovations. It is, however, hard to be conclusive about such formally assigned roles because of the short time perspective in the cases involved.

11.2.2 Barriers to innovation

The identification, separation and classification of barriers to innovation are at least as difficult as for sources of ideas. Roughly 140 such barriers were indicated in the answers. However, sometimes interviewees skip 'the conventional barriers' and identify some of more specific interest to them.

There are many ways to classify the barriers. The presence of perceived barriers more or less all the time everywhere has made a grouping similar to the one of sources of ideas suitable. Thus, the barriers to innovation are grouped in the following overlapping groups:

(a) external barriers;
(b) management barriers;
(c) organizational barriers;
(d) historical barriers;
(e) resource barriers;
(f) people barriers;
(g) miscellaneous barriers;

and are discussed more fully below:

(a) *External barriers*. The relations with external R&D people may involve barriers (for example, in recruiting talented people). Industrial R&D has sometimes had a low status among academics (for example, in the pharmaceutical industry).

Among customers there may be a fear of 'letting people in' to study their problems. Or they simply do not have time, for instance, in a boom when there is no opportunity for a supplier to make experiments using the production equipment of his customer. Conservatism among customers varies: low technology industries or customers with a small scale of production such as in the food, agriculture, or graphic industries are considered to be conservative, while the situation is different in, for instance, the energy or computer industry. Different

nationalities also vary in this respect. 'Customers in the United States are very conservative, Japanese customers are more progressive, and the Russians are even bold when they finally buy'. Customer conservatism also varies within industries or groups of customers. Progressive customers may even stimulate an innovation which finally finds a small market, since progressive customers may not be representative customers. It is not just that 'the market was not mature'; the market was perhaps never there, with the exception of a few 'advanced' customers.

Barriers in relation to suppliers are mentioned only in exceptional cases. Shortage or uncertainties of supply may even breed innovations. (Germany during World War II provided classic examples of shortage-induced substitutions.) Shortages of raw materials gave incentives for developing new or improved processes or products at, for example, Boliden and Iggesund. A limited supply of human material for experimental work in the pharmaceutical industry is another example of a supply-oriented barrier to innovation.

Competitors may create barriers to innovation by several defensive actions such as pricing out small inventive companies, creating barriers to market entry, 'squeezing' by vertical integration, buying and 'freezing' patents or companies. Mostly, however, competition is referred to by interviewees as promoting innovation.

Another area of perceived barriers is societal action and reaction. Legislation, consumerism and environmentalism are sometimes said to hamper innovations. Broadened responsibilities for quality control of products and processes make innovative work more costly while at the same time the returns on development costs are doubtful. Process industries (Boliden, Iggesund, KemaNobel, SKF) and consumer industries (Astra, Volvo, KemaNobel, Philips) have been affected particularly. For large corporations the competitive picture is said to be at most marginally changed by environmental regulation. The profitability picture may sometimes change in favour of more expensive and profitable products, which meet raised standards, but no competitive advantages are considered to exist in developing products that outdo environmental and safety standards.

(b) *Management barriers*. It is easy to complain about managers and regard them as too passive, active, negligent, careful, slow, conservative, opinionated, misinformed, rigid, preferential etc. As mentioned before, higher levels of management are directive and selective rather than generative towards innovations. It is then natural for people involved in operative work to regard management's selective action as barriers rather than sound selections in some sense. On the other hand, managers may just as easily complain about operative people not generating good ideas or coming up with results fast enough: 'There will always be money available if good ideas come up'. The conceptions of 'good' may vary, however.

Conflicts between managers are also seriously harming innovation (see Chapter 10). Personal traits of managers vary considerably and many times barriers are more related to a specific person than to a group of people in a similar management position.

First, there is the issue about managers' competence regarding technology and

markets. There are examples of top managers overestimating their technological knowledge and pushing their pet ideas. This is a very effective barrier to innovation. Other projects will suffer, and at the same time, as people do not believe in the project, its chances of success will be reduced. Mostly managers' unawareness of their own obsolescence will also prejudice their opinion of the ideas and work of others. Some managers will act as plugs in the organization, and if they affect recruitment and promotion around them, the barriers tend to be reproduced. The possibilities to take detours around such barriers or put them aside in the organization are greater on lower levels. Such possibilities may also increase as time passes. In other words 'the last resort is just to let time work for you'.

One is inclined to conclude that the ability to appreciate and couple knowledge in different fields, among which one is a specialty, is rare among technical managers. There are many examples of conservative effects due to this phenomenon, sometimes reinforced by promotional preferences.

The case of competent but domineering managers is sometimes also mentioned. Their ideas and work are good, but there is little room for initiatives from people around them. After some longer period of time they will be surrounded by people who accept a domineering manager. Some old and highly esteemed engineers tend to create such regimes, which may work very well until the day they leave. Moreover, the distribution of power and influence among management levels is affected by promotion or reorganization. Promotion of a domineering manager may leave a 'hole' in the organization, or decentralization may create too powerful managers on the level below. Instances of this were caused by, for example, divisionalization.

Second, there is the issue about managers' competence to handle people and relations. Judging people and ideas in combination is essential. Also the judging and handling of deviant behaviour is considered important in innovative work. Inability to identify and handle the inventive and entrepreneurial elite and the relations those people create around themselves clearly acts as a barrier to innovation. Management's attitudes in this respect vary, however:

It is like football. Either you let everybody pass to the elite player or you take him out of the team. (Subsidiary Managing Director of Astra-Hässle)

These researchers should not become prima-donnas. (Corporate R&D manager)

The manager just above an inventive person may be important as a provider of support and protection. However, examples are also given of managers on this level who do not tolerate subordinates who are more competent than themselves.

The career system is pointed to as a barrier since it favours individuals rather than groups. When positional goods are scarce, people will tend to compete or leave. People in organizations involve themselves in a mixture of competitive and co-operative behaviour. A divisional manager with problems of competition and conflicts among his sub-managers said that he was trying to create a climate of evaluation that favoured the ability of a manager 'to make the whole work'. However, it was 'his' own whole he referred to, and at the same time there was competition about the corporate managing director position involving the divisional managers.

The third subclass of management barriers concerns management action in making policies and decisions. Generally, managers are accused of passivity, slowness or conservatism in these respects. The degree of specificity in directing innovative work is often low on higher management levels (see Chapter 5). On the other hand there is the obvious effect of a policy that it will tend to favour action 'within' and discourage action 'outside' its delineated area of application, thus in itself acting as a barrier. Higher management's provision of timely resource decisions is sometimes pointed to as inadequate. Of course, resource decisions imply risk-taking. If the distribution of risks has a peak among managers in a decision-making process, a delay is likely. It is not only a matter of total risk to the corporation; it is also a matter of perceived ego risks by engaging in a decision. It is a well known fact that it is easier and involves less ego risk to say 'No' to a proposal, even if inaction involves a large risk to the corporation.

Conservative recruitment policy is mentioned as a barrier. This is related to the management's perception of what kind of competence is needed. Traditional industries often favour their traditional professional categories, in both recruiting and promoting. Some managers are also overly cautious in reacting to proposals to recruit qualified personnel.

Attitudes to and climates for innovation in the organization are substantially influenced by higher management. They affect it by their mere behaviour and not only by making proclamations and emitting signals. People learn the preferences of higher management and increase the probability of receiving support for different initiatives and proposals. Management attitudes towards open communication and co-operation, enthusiasm, creativity etc. tend to be reflected and reproduced in the organization. Managers may be unaware of how their behaviour is interpreted and how they affect the taking of initiatives at lower levels. Here the absence of indicated barriers is an ambiguous sign.

If a policy towards innovation is enunciated, it has to be demonstrated. Top management at both SKF and Alfa-Laval point to projects which have been accepted partially on the merit that they are somewhat odd but show people in the organization that there is room for such projects. (Similarly, there are internal PR projects that work the other way around, that is, some projects are created at lower levels so that higher management easily understand and appreciate them.) Thus, top managers may want to avoid the demonstration of total rejection of radical innovative ideas, since that might harm the climate for all kinds of innovation.

(c) *Organizational barriers*. This group of barriers is not very well separated from other groups. Here we will deal with barriers that are related to the characteristics of an organizational structure. A common conception is that the size and complexity of an organization will act as an important barrier. This pertains to both structure and behaviour. It is rather common to conceive of large corporations as possessing a large amount of inertia. Caution, resource orientation, conservative selection of people, defensive attitudes, established structures, etc. are all attributed to large organizations as distinguished from small ones. The small organization, on the other hand, is said to be flexible, creative, responsive and so on.

Some structural features related to size and complexity, which have been mentioned as barriers, are:

- long, critical paths of evaluation and decision making concerning ideas and projects;
- diffuse areas of responsibility;
- many lines of communication;
- departmentalization;
- rigid structure of salaries, promotion and status.

Repetitiveness of certain operations is also a feature of large organizations, a feature that works also in favour of an increased level of bureaucracy. Problem solving behaviour focuses on incremental innovation and the making of small refinements whose effects will multiply. Routines will be established, specialization will increase, and the organization will get settled in a rigid network of behaviours. To create and implement radical change close to dominating and traditional operations is generally thought of as meeting barriers. Processes of selective attention work in favour of existing operations and resources. Moreover, attitudes, status patterns and behaviours evolve that reinforce the traditional 'core' of the large organization. As opposed to small and young ones, a large organization generally has a history of growth, experience and pride of achievements. All this will act as selective barriers outside the mainstream of existing operations and ideas for their improvement. One must, however, remember that some behaviours in large organizations with mature products are simply rational or practical. The long periods of time before even minor changes in high-volume products may be introduced on global markets are necessary for several obvious reaons and are not just due to some kind of unavoidable inertia. Sometimes changes are also collected and introduced batch-wise, giving rise to product generations.

The critical assets of an organization are potential barriers in the sense that they absorb attention and resources. The defence of large market shares, concern about production economy in a capital-intensive industry, concern about raw material sources, and defence of important products against technological substitution are examples of actions that are mentioned as barriers to radical innovation in the corporations. Excessive 'cost thinking' or 'profitability thinking' are also frequently mentioned as dangerous for innovations.

Large resources and innovations interact, as has been the case at Alfa-Laval. High prices have been needed in order to give a yield to the large resources of the corporation. High prices need in turn innovative or high-quality products, which in their turn require still larger resources and thus a vicious circle is created.

The phrase 'organizational barriers' may lead the thoughts exclusively to the interaction across boundaries in the organization. Many such barriers are mentioned, but mostly they are well known due to their prevalence. A simple list of boundaries important in this respect would include boundaries between:

- R&D – production – marketing;
- different levels in the organization;
- project organization – line organization;
- central – regional operations.

Finally, the now famous 'not-invented-here effect' is often mentioned as a common and powerful barrier to innovation as well as to transfer and co-ordination and 'NIH-effects exist everywhere'. This effect works across every organizational boundary but especially around R&D groups. Ideas from 'the field' or from external inventors are said to be subjected to NIH-attitudes from internal R&D, and people in some corporations criticize themselves for being self-sufficient.

(d) *Historical barriers*. Examples of barriers related to history are the traditions and conservatism within and around the corporation. To some extent this has been dealt with above, and this group is another means of describing and emphasizing these barriers. Historical experience tends to be selective towards new ideas. People in some sectors of industry and some corporations develop notions of what does not fit that particular industry or corporation. The arguments and the selection of supporting evidence are refined and difficult to argue against. Also success experiences are easily reinforced. Some engineering corporations have successfully employed a trial-and-error approach to R&D and innovations and persist in this behaviour until concrete signs of inadequacy show up.

The existence of a large traditional part in the organization as a product of historical growth has also been mentioned above. References to this part as producing barriers to radical innovations are frequently made. All traditional products such as passenger cars, separators, ball bearings and metals have at some time acted as barriers to work on radically different products. The same holds for those corporations which have one predominant customer, such as a defence department, or which have one predominant professional category, such as mechanical engineers.

Original innovations frequently develop into barriers to future innovations in this way, and not only in traditional industries. Both individuals and organizations get more or less stuck in a line of development for some period of time. This is not unexpected; however, the corresponding barriers become reinforced and tend to be permanent until eroded by external rather than internal forces.

(e) *Resource barriers*. It is possible to treat most barriers to innovation as resource barriers. Resources will here mean time, money and personnel in the conventional sense used in budgeting. Generally, the barriers in this group are related to the level, the change of level and the distribution of resources.

Resource limits are inhibiting in later stages of development but not necessarily in the earlier ones. Idea generation and desk work may not necessarily suffer from shortness of money, time or personnel. Phrases such as 'motivation by starvation', 'the need is the mother of invention', or 'time pressures give the best results' point in this direction. Also, it may be argued that such shortages will keep development personnel from overachievement in technical perfection and having 'the best as an enemy to the second best'. Acting on the basis of such arguments is two-edged, though, and certainly long-lasting pressures or permanent struggles for critical resources will act as barriers to innovation.

Time, money and personnel are to a certain degree substitutable resources. There are, however, strong non-linearities in resource substitutions in innovative work. Time cannot be stored and used at convenience, and often additional

money can buy just marginal extra time. Two or more average researchers or inventors do not add up to a top one and 'hiring and firing' is seldom a great possibility. The inability of managers and operative people to understand that not only money but time and qualified people are needed to produce innovations is also listed as a barrier. Time is a resource that attracts much attention. Complaints of lack of time for idea generation, preliminary studies, following up spinoffs etc. are more common than complaints of lack of money and personnel for similar tasks. Day-to-day operations absorb attention and lead work away from possibly radical innovative work. A certain proportion of time budgets (mostly 10–20 per cent) is set aside for explorative R&D, preliminary studies, or just 'free' work in some cases. It is, however, hard to live up to this intention, especially since people assigned to that kind of work constantly tend to be in demand for other tasks.

Short-sighted thinking as a barrier is a variation on this theme. Short pay-off times, fast feedback of results and adaptive behaviour are manifestations of both a psychological and an economic nature. This 'local orientation' in time and space prevails on the group and department level as well as on the corporate level. The allotment of resources on the basis of the immediate past and the immediately foreseen future performance may, of course, reflect economic fluctuations in a harmful manner. R&D budget cuts or reassignment of talented R&D people in difficult times are common. Of course, the reverse also happens. Recent loss of market shares, a perceived threat of technological substitution, soaring quality problems, or a sudden discovery of a loss of leadership may up-grade innovative work. What is generally said in this respect is that over-reactions and drastic changes in resource levels are deterimental to innovation. Barriers due to sharp budget increases are perhaps not seen immediately but there are limits to the growth rate of an R&D organization (see chapter 3). Above these levels it will be difficult to keep up the average quality level of people, and newcomers will either absorb most of the time of others for their introduction or they will essentially be idle, which destroys morale. There will be small opportunities to assimilate newcomers into productive teams, management will be distracted, and — not the least important factor — resource excesses will raise envy and criticism in the surrounding organization.

Finally, there are the effects of resource distribution. Again, this is obviously a case of balancing somewhere in between. The merit of having very many or very few projects is doubtful, although synergy has to be considered as well. The assignment of people to projects and activities shows similar features. The splitting of the time of individuals on many activities is pointed to as harmful. The time required for intellectual 'set-ups' or 're-starts' is considerable, and some tasks simply have to be completed in 'a large step'. Both the indivisibility of some intellectual tasks and a limited time-sharing capacity of many inventive people speak in favour of concentration. On the other hand, changes in work assignments are stimulating to a certain degree, and new people on old projects may provide new angles of thought and action or break a standstill.

(f) *People barriers*. A list of barriers in people could again include almost anything. Those barriers which clearly fall in this category are surprisingly many.

Moreover, they do not constitute a very 'nice' picture of people involved in innovative work. Just as the distribution of achievements is skew among different persons, the distribution of personality features is skew among high achievers. Unbalanced talents, specialized abilities, strong emotions, high sensitivity to criticism, vanity and egotism are not uncommon. A rough subgrouping has been made below of cognitive and emotional barriers.

Examples of cognitive barriers are a lack of abilities to raise vision, to listen to ideas without having a visible hardware, to work creatively, to understand the problems and ideas of others, to communicate, to break habitual thinking, to think globally, to look far ahead, and to identify needs and opportunities. These cognitive barriers are also attributed to groups and departments. A whole generation of technicians may have difficulties in a transition to new technologies or new thinking in a field (for example, in a transition from tubes to transistors). Professional categories create language, norms and values that act as barriers (see Chapter 9). Different groups of people 'don't understand', and individual filters conform to group filters.

Emotional barriers have an animalistic resemblance. Superficially they may show up as cognitive barriers, since such barriers are much more *comme il faut* in an organization. That 'technologists easily fall in love with their solutions' may show up as an 'inability to understand and evaluate alternatives'. Nevertheless, cognitive and emotional barriers are hard to separate. The propensity of people involved in innovative work to identify and value themselves in relation to their work is deeply integrated in their whole psyche.

People also embark upon and push an idea or line of thought if this can favour their position. Perhaps it is not just a lack of clear-sightedness that makes some people dismiss certain ideas and stick to others but a vanity of being in the forefront and reaping the benefits from that. This feature facilitates invention and diffusion of new concepts, ideas and methods but may hamper necessary co-operative action towards implementation and innovation.

Although not a typical emotional barrier, secrecy is an important barrier around some people, who 'hold on to their ideas' and cautiously communicate them to others. Naturally, protection against leakages may be needed around innovative work both internally and externally, but internal secrecy and claims to being the originator appear to be in excess. The patent institute is intended to provide incentives and remove secrecy of ideas and knowledge. Similarly, procedures for internal recognition and compensation for inventive ideas may loosen up internal secrecy. Some idea and innovation search exercises simply function this way. It should also be mentioned that secrecy in some cases is used merely as a way to add to somebody's prestige.

A final comment will be made about the ageing process as producing cognitive and emotional barriers to innovation. It is commonly thought that individuals lose creative talents as they get older. This has proved to be a truth with many exceptions. Long-standing experience in a field will probably decrease the ability to 'think along new tracks', but selective attention may be just as fruitful. Also the confrontation between long experience and new problems or fields may produce creative thinking. Moreover, social abilities come later in life, abilities which are highly needed in innovative work. On the other hand, counteracting social

abilities may be at least as powerful. What is really disastrous is when creative, intelligent and socially able people are engaged in mutual sabotage.

No attempt will be made here to pursue an analysis of individual ageing and the emergence of emotional barriers. There are indications that important barriers of that type develop over a lifetime. Experiences of success and failure may develop into egotism, overcompensative action or bitterness over the years. People's need structure changes and so do their prospects of life as their future shrinks. People attain invisible assets they care about such as reputation, social relations, contacts and position. They attain more recognition, which increases their sensitivity about their images. In other words 'people get big and sore feet over the years'. Moreover, if they attain power, regulating criticism around them may cease. Dissenters leave or become silent and 'after forty, one does not risk the job to point out bad conditions'.

(g) *Miscellaneous barriers*. Most indicated barriers of some generality have already been accounted for, since the chosen groups have been both broad and overlapping. Perhaps what was unexpectedly missing deserves a comment. For instance, references to location as a barrier were seldom made. This does not mean that the benefits to communication of geographical closeness are not appreciated. There were more complaints about scattered locations than about a single remote location. Scattered locations hamper co-ordination, and especially in multinational operations it is a problem (see chapter 4). Locations remote from large cities or universities are not perceived as barriers to innovation in those corporations that have such locations. Location in small communities in which the corporation is regionally dominant is said to produce some benefits to innovative work such as 'people think of their jobs also in their leisure time'.

A remote location may hamper the recruitment of R&D people and managers. However, corporations with traditionally remote locations such as Boliden, Iggesund and parts of SKF and KemaNobel encounter no specific difficulties in recruiting from educational categories that have traditional connections with the corresponding regions. The engineering industry, on the other hand, sometimes experiences problems in recruiting qualified personnel to remote locations, and the pharmaceutical industry has deliberately located their R&D operations close to medical schools in large cities. Closeness to universities and communication possibilities have similarly influenced the location of R&D in parts of Kema-Nobel.

11.3 DISCUSSION

11.3.1 Empirical summary

A diversity of sources of ideas was found. Each corporation had on its periphery a loosely structured satellite organization which provided some inputs to innovative work. No corporation was self-sufficient in this kind of work, but external orientation and the dependence upon external sources of ideas varied among the corporations. It is difficult on the basis of the data here, to try to explain this variation, except to say that some corporations are more rigid in outlook and self-sufficiency.

Sources of both radical and incremental innovation were found both internally and externally. Moreover, the sources of ideas among people are skewly distributed with a few individuals as dominant sources of invention. Top management generally does not constitute a source of ideas for innovation. The role of higher R&D management is also more selective than generative. Historical activities are an important source in the sense that there is a high degree of continuity in innovative work. Not infrequently, there is a global contemporaneity in technological change, making sources of ideas diffuse and creating a sense of *Zeitgeist*.

Perceived barriers to innovation have an even greater diversity than sources of ideas. The most frequently mentioned barriers were related to management, organization and people.

Each industry seems to develop unique complexes of interacting barriers, yielding different patterns of innovation, for instance, in the automobile industry, pharmaceutical industry, food industry and process industries.

Perceived barriers among managers are partly due to the nature of managerial functions and partly due to inadequate competence and behaviour of managers. Many hierarchical layers and a 'tall' organization jeopardize innovations. Managerial risk is an additional risk dimension in innovative work.

Barriers are commonly attributed to the size and complexity of an organization as well as to behaviour in large organizations in general. Organizational barriers mentioned are rather conventional, and the same comment applies to barriers associated with traditions, conservatism and resource allocations.

People barriers are most frequently mentioned, especially barriers related to emotions. Specialized interests and cognitive abilities among individuals seem to correlate with a skewness in other personality features. The role of ageing is important in the development of cognitive and emotional barriers.

11.3.2 Pluralism, competition and co-operation

Several of the empirical findings above are supported by other studies (see, for example, Jewkes *et al.*, 1969, p. 228). A pluralistic outlook on sources of ideas, and especially an increased degree of external orientation, appears to be of value at the corporate level. The same may hold for certain forms of internal competition, but competition also tends to create barriers. Internal competition at the individual level seems to be of particularly negative value in innovative work, while internal competition on a project or R&D unit level may be productive.

An emphasis on historical continuity and the accumulation of incremental innovations has been found by several authors, including Jewkes *et al.* (1969). Barriers to innovation may both increase and decrease continuity in this respect. The pace at which genuinely new developments are conceptualized and materialized is smoothed and slowed down by several of the barriers encountered. On the other hand, the complex of barriers in a certain industry may shelter it from

developments in different technologies until a breakthrough occurs. The innovation by invasion phenomenon, described by Schon (1967), which some traditional industries have been exposed to, is an example of this.

The continuity of technological change and the incremental nature of innovations have an important implication for management. It might well be that a manager with an aim to encourage innovations overlooks the potential of alterations in on-going work. At the same time it is true that work on improvements has a tendency to centre around certain parameters and established standards of improvement, which act as barriers to innovation. The point is that a manager looking for radical innovation excessively, but well aware of this said tendency, will hinder any kind of innovation. The finding by Marquis (1969) that small incremental innovations with internal sources contribute significantly to commercial success, is supported here.

A contemporaneity of technological advances in certain fields is indicated by the data. Contemporaneity in innovative work also has an implication for management. It does not necessarily imply a 'rat-race' policy, but if inventive leadership is not aimed at, a rapid catch-up must be built on a relative advantage in the absence of barriers.

That barriers associated with management, organization, and people are frequently mentioned may seem natural where large corporations are concerned. However, neither the grouping of barriers, nor the distribution of emphasis here is in accordance with the findings in the report published by Arthur D. Little Inc. and the Industrial Research Institute Inc. in 1973. The latter study is also based on perceptions of barriers to innovation as expressed in interviews. The perceived barriers are divided into seven groups, namely barriers relating to:

(a) markets;
(b) corporate organization and behaviour;
(c) existing government policies;
(d) finance;
(e) lack of 'seed capital' for independent entrepreneurs;
(f) technological factors; and
(g) labour unions.

The specific complexes of barriers in different industries are also pointed out. The important barriers are found to be related mainly to marketing but also to finance, corporate organization, government policy and the lack of seed capital.

Several explanations of the difference in emphasis between this report and the present study are relevant. First, there are some differences in method and focus. The 1973 report focused on public policy. Interviews were conducted with 120 key executives in seventeen large and seven small industrial firms as well as with officials in government, financial, and labour institutions. Besides, a preliminary list of groups of barriers provided a pre-selected focus on marketing, finance, organization and government policies. Thus, a broader context for innovation than the corporation was focused on. References to 'people problems' in innovation became subsumed under corporate organization and behavioural perspectives, and further research was suggested to illuminate such internal corporate barriers. In the present study, on the other hand, perceptions of market-related barriers are classified as external barriers, while barriers related to lack of (external) marketing ability are treated under management, organizational and people barriers.

These explanations do not seem to compensate adequately for differences in emphasis, and further explanations must be sought. It might very well be the case that perceptions, interpretations and classifications are valid and that the results reflect differences between corporations operating in the United States and Sweden. The principal differences indicated would then be that market-related barriers are more emphasized in United States corporations and people-related barriers are more emphasized in Swedish corporations. Explanations of such a difference would then have to consider differences in problem awareness and internal versus external orientation and/or differences in the extent to which these types of barriers exist in the United States and Swedish corporations and/or differences in the propensity to explain barrier effects in terms of market-related factors or people-related factors. In a competitive and individualistic American culture one may be more sensitive to market conditions and less inclined to associate barriers with lacking abilities of people to cooperate. It may not be totally the other way around in Sweden, but co-operation certainly is a valued feature in the corporations.

Concerning implications for management, the diversity of barriers is again an argument for pluralism as was the case with diversity of sources. The singularity of many critical relations and positions in a traditional organizaton, in which hierarchy after all is a strong and basic feature, is conspicuous. Organizational features such as clear boundaries, clear lines of authority and communications and well-defined and stable goals and subgoals, conforming behaviour, regulated processes and comprehensive co-ordination, are all subjects of wide-spread and deep-rooted esteem, which almost form a kind of organizational aesthetics. Fluid boundaries, primary and secondary responsibilities, temporary structures, dual ladders for promotion, extended positional goods and detour possibilities, multiple lines of communication, and flexible and multiple goals represent a counter-aesthetics, involving fewer unproductive barriers.

The mere size of an organization in terms of turnover or number of employees should have a remote relation to barriers to innovation. With the exception of scale advantages in certain types of R&D, effects of size and complexity are mainly due to the chosen form of organization and management. New ventures, small innovation companies or business development units spun-off from a larger organization may be management responses to barriers associated with size and complexity.

The prevalence of people-related barriers puts a premium on behavioural skills, and an interplay between technological, economic and behavioural skills is a salient feature of innovative work in large corporations. This emphasizes an additional dimension of traditional entrepreneurship.

11.4 CONCLUSIONS

A diversity of sources of both radical and incremental innovation were found both internally and externally. A loosely structured satellite organization on the

periphery of the corporation provided inputs to innovative work to a varying extent among the corporations. Sources of ideas among people were generally skewly distributed. Top management and also higher R&D management were selective rather than generative.

Among a wide variety of perceived barriers to innovation, the most frequently indicated ones were related to management, organization and people rather than to the resource situation or the business environment. These findings differed somewhat from those of the 1973 report (Little et. al.), the principal difference being that market-related barriers were more emphasized in United States corporations and people-related barriers were more emphasized in Swedish corporations. One out of several possible explanations could be the relative cultural differences in sensitivity to market competition versus internal co-operation.

Internal competition among individuals on both operative and managerial levels appears as a barrier in innovative work, while internal competition on a project or R&D unit level as well as external co-operation may have a positive effect on the rate of innovation. A general conclusion would be that the age and ageing of organizations are creating barriers to innovation and that the size of an organization *per se* is not creating barriers to innovation but that the principal determinant is the chosen form of organization and management.