

# MANAGING TECHNOLOGICAL KNOWLEDGE WITHIN THE ORGANISATION



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*Baie Suid-Afrikaanse maatskappye wat gesofistiseerde vervaardigings-tegnologieë gebruik, koop die kennis van oorsee in die vorm van ontwerpe, instruksies, opleiding en hulp in probleemsituasies. In 'n poging om hierdie gebondenheid te ontsnap, word dikwels groot bedrae geld in eie navorsing en ontwikkeling belê. Die skrywer is van mening dat daar dikwels 'n middeweg tussen dié twee uiterstes bestaan. Daarom is dit goed om te kyk na tegnologiese kennis-bestuur as 'n aparte en potensieel winsgewende aktiwiteit.*

## INTRODUCTION

In the typical technology-based organisation there are many activities, often widely scattered and disconnected from one another, which are concerned with new technological knowledge. Only some of these, such as research and development, engineering and technical library services are formally recognised while others, equally important, usually occur implicitly through the activities, of various people as part of their duties.

These include the knowledge, experience and creativity of various staff members which frequently are not fully recognised or utilised, and various practical adaptations and improvements of existing processes, all of which could be of great value to the organisation.

I believe that there are many organisations which can gain much by looking at the management of technological knowledge as a separate, worthwhile and potentially profitable activity. There was a time when it was assumed that if you collected a number of scientists and engineers in a research and development department, new discoveries and inventions of immense benefit to the organisation would pour forth.

In recent years it has become clear that the R & D activities must be provided with competent leadership and management to make it productive and of benefit to the organisation. Essential as this development is, it has not yet gone far enough. There are many needs, sources and applications of technological knowledge scattered through the organisation which ought to be coordinated and managed. This is particularly true of organisations in countries such as South Africa which obtain much of their technological knowledge from sources other than the R & D department.

The system of technological knowledge in an organisation will be examined using a deceptively simple framework for identifying needs, sources and applications, as well as implications for management.

## IDENTIFICATION AND DIAGNOSIS OF NEED

Before starting costly and time consuming efforts to obtain technological knowledge it is worthwhile giving explicit attention to diagnosing the nature of the situation and to identify as clearly as possible what technological knowledge is needed. Stated in this way it is an obvious truism with which few would argue. In practice however this step is frequently not given the attention it deserves.

### Selection of Channel

The channels or sources of information\* selected often depend on the preference, prejudice and past experience of the persons involved in this stage. Without making a careful analysis executives will turn to overseas suppliers of know-how when they plan to erect a new plant. A production manager encountering a problem in the manufacturing process could attempt to solve it himself, call in consultants, refer the problem to overseas suppliers of know-how or pass it on to the R & D department depending on his analysis of the problem and his opinion and past experience with these various sources of technological knowledge.

It is obvious that much of the success of the search for helpful new knowledge will depend on selecting an appropriate source. This step thus deserves careful study and yet this is rarely done.

### Importance of Proper Diagnosis

In its management development courses the Harvard Business School considers the diagnosing of problems so important that it devotes the greater part of its famous case study technique to this aspect. The implication is that if a situation is diagnosed properly the other decision steps are easy in comparison.

\* The various channels or sources of technological knowledge are discussed in section 3.

### Proactive or Reactive Triggers

It is interesting to be aware that needs or opportunity can be anticipated and that an organisation can have a proactive approach to situations. In such cases the organisation acts in an entrepreneurial or innovative fashion and becomes a leader in its field. Other organisations wait until problems arise and then react to it. It invariably takes time to acquire technological knowledge and organisations which only react when problems have become serious could find themselves falling far behind.

### Where do ideas originate?

It is frequently implied that the task of the R & D department in an organisation is to innovate and to come forth with new ideas, discoveries and inventions. Most hindsight studies of successful innovations indicate that the original ideas did not come from the R & D department, but from various unusual and unlikely sources. Thus xerography was invented by a patent lawyer, colour photography by two musicians and the diesel electric locomotive was developed by an automotive rather than a locomotive firm. Some reflection will confirm this trend. The scientists and engineers of a large organisation are usually busy improving the existing product rather than working on new ones.

New ideas frequently occur when a person moves from one activity to another or when a person works at an interface of two different activities. He sees things in a different way from those who have been working in that area for a long time. He is unaware of the pitfalls and "impossibilities" which inhibit new ways of thinking. He meets people with different and stimulating ideas. He can sometimes apply experience gained in one field to problems encountered in another.

Such people who move across boundaries are frequently sources of new ideas but they often find it difficult to pursue the ideas further. Boundary spanners in an organisation are salesmen, technical service men, product managers, engineers and managers and frequently do not possess the technical expertise of those in the R & D departments. The latter are often so busy with their research and projects that they are seldom exposed to the changes which stimulate new ideas.

Ideas can therefore originate anywhere within or without the organisation, and with likely or unlikely persons. It is not the specific task of the R & D department to be creative in new ideas. They will obviously participate in this process but their task is to investigate ideas and problems, to improve their technical feasibility rather than to feel obliged to generate them as well. This implies a receptivity and willingness to follow up ideas generated by others. In practice many R & D departments are reluctant to follow up such ideas, unless they come from high status people. I believe that part of this reluctance originates from a misconception that their primary task is to create ideas as well as to do the necessary research and development work to make the ideas feasible in practice.

### Determining Scope

Proper diagnosis will assist that the scope of search for technological knowledge is of appropriate magnitude. Unless this is carefully done, the organisation could easily devote a lot of resources and time on a major project only to find at the end that the problem was not worth such efforts and solved itself in the mean-time. At the other end of the scale an inadequate effort is equally valueless. A small section within the R & D department is for example unlikely to come up with a commercially competitive process on which large overseas corporations have spent decades perfecting in research, development and production. There is a relatively small window between triviality and difficulty where there are potentially fruitful opportunities for own research and development.

In the diagnosis phase a major aspect of management creativity is concerned with the scope of the project. How big should it be and how does it interact with other activities? Bower refers to this as the definition phase in project development. One person will see a project as a problem of getting a small scale production plant underway. Another will see a large plant producing several related products. Still another will point out that a total interrelated marketing and raw material supply system must be implemented to make the production activity viable.

### SOURCES OF TECHNOLOGICAL KNOWLEDGE

The average person will typically contrast two main sources of technological knowledge. These are buying know-how as patents, licences or other forms of know how agreements on the one hand and generating it in its R & D department on the other. The library and its associated technical information service would be considered as a third source of general information.

Some reflection will however indicate that it is useful to identify a whole spectrum of sources of technological knowledge between the extremes of purchase and own R & D. These two sources, though the most obvious, are in fact expensive compared to the others.

The spectrum of knowledge is listed and discussed below.

### Generation of New Knowledge

With this category is meant formal R & D within the firm. Since this activity usually requires time it is particularly necessary to identify and diagnose the need for new knowledge very carefully otherwise one could find after doing a lot of work that the results are not adequate to solve the problem or that the problem itself is no longer acute.

The R & D department requires direction from top management without it stifling creativity and enterprise. This is necessary to ensure that new developments fit the business of the organisation. Once again it is essential that the initial recognition and analysis of need and a proper diagnosis of the situation is carried out.

## **Mobilising existing knowledge**

Many problems can be solved or developments progressed by mobilising and applying knowledge which already exists within the organisation or its close associates. Men with technological experience and knowledge often work in positions such as marketing or management where they are no longer in intimate contact with problems and needs of the organisation. Sometimes they have encountered similar problems in previous occupations. At other times a few remarks or bits of information from unlikely members of the organisation serve to trigger off considerable improvements.

It is however not a simple matter to tap the collective wisdom of an organisation. It should once again be kept in mind that there are many potential contributors to a problem. The problem is to identify who these contributors are and how to mobilise their efforts.

People who have previously worked in other industries and other countries are often valuable sources of technological knowledge which are often inadequately tapped. Sometimes associated companies, supplying firms or major customers can assist.

The crucial ability in managing this aspect well is to ferret out potential contributors, to judge the value of their advice and to act on those parts which are sound.

## **Adaptation, Improvisation and Improvement of Existing Knowledge**

Adapting a product for increased acceptance in local markets, improvising with local resources to achieve competitive results and improving on a production process already being used are important sources of technological knowledge. These activities occur almost spontaneously and without specific direction or leadership within most organisations.

There are many examples of companies which had to utilise these methods to make imported knowledge work. The plant, built on overseas know-how failed to work and South African personnel had to improvise, improve and adapt in order to make it work.

South African engineers and scientists are often exposed to a wider range of activities compared on their more specialised counterparts in the advanced economies of the world and as such they tend to excel at improvisation, adaptation and improvement. Firms need these activities to progress and to avoid obsolescence. However in certain cases suppliers of overseas know-how are very reluctant to allow local experimentation in minor activities such as South Africa.

## **Imitation**

Levitt claims that in the U.S. most "new" products launched by companies consist mainly, if not totally, of imitations of existing products. He refers to "reverse R & D" to describe a process whereby the company starts with a finished product and does various tests and development work to achieve a means of production.

Most organisations are proud of own developments and innovations but keep silent about imitation which in fact is the more common source of new knowledge and products. This is a false pride which could discourage organisations from using a valuable and cost effective channel of technological knowledge.

Japan built a strong economy on purchased knowledge and imitation and own invention became a significant factor only at an advanced stage of development. South African companies and organisations should give explicit and unashamed attention to imitation as a source of new processes and products.

## **Hiring People with Knowledge and Experience**

Few organisations have deliberate policies to appoint men with previous experience as a source of technological knowledge. In South Africa there is a general reluctance and a feeling against mobility of men past middle age and at senior levels.

Fringe benefits accumulate with years of experience. Employers are reluctant to employ older men and existing employees often resent newcomers being appointed over their heads. The acceptable procedure is to appoint young graduates from technical institutions and Universities and to train them within the company or by arrangement at a supplier of know-how or to allow them to experiment in the R & D department.

There are many South Africans both in the country and overseas who have had many valuable years of experience with large overseas corporations. They are well versed in the technology and methods of these companies and could be valuable sources of technological knowledge for companies who understood how to attract and keep them.

## **Literature and Technological Information Services**

This is one of the better developed channels of technological knowledge. It is also one of the cheaper sources of knowledge and should be exhausted before employing the more expensive channels such as R & D or purchasing know-how.

One of the main problems with this channel is the high noise level. Useful information is often buried under an avalanche of low quality or irrelevant material. Much printed matter says very little in many words or is more concerned with propaganda than content. Modern technical information services attempt to weed out low quality information.

It is surprising how few people can intelligently and diligently read technical articles and translate the information into useful knowledge for their organisations. Technological Gatekeepers who have this ability are essential links in using this channel of technological knowledge.

## **Visits**

Organisations can, as a rule, obtain much more information from visits by their members to other organisations or from visitors than they actually do.

Overseas visits are too frequently seen as a perk or reward for faithful service rather than a source of useful information. Sightseeing or entertainment interferes with proper notetaking in evenings and are causes of fatigue during interviews or walks through plants. On his return the organisation often neglects to make full use of the information gathered by the traveller.

Cultural barriers can often inhibit effective acquisition of information on overseas visits. This factor could well be given adequate attention in selecting candidates for visits. It is sometimes better to send a young graduate who studied a year or two previously at an overseas University than a more senior, older person. The young man will find it easier to establish informal relationships which are conducive to better transfer of information. He will understand the background of references to politics, sport, regional and other jokes, habits which offend and the many other unspoken cultural factors which influence communication. He will also be less likely to have a wife, children or a house to worry about on his travels.

There are visits and negotiations which require visits by older or more senior people. It is better to send a few people regularly on overseas visits than many people only a few times. With his regular visits the person builds up relationships with people and an understanding of their background which improves and becomes more effective with each visit.

In choosing candidates for regular visits preference should be given to people who are natural gatekeepers of technological and other knowledge, i.e. people who enjoy collecting and disseminating knowledge.

### Consultants

Consultants are employed to cope with a temporary surge in a certain type of work or for certain expertise which they possess, or for both. It is important to identify clearly what is required from consultants and exactly what their contributions are to be, so that this channel of knowledge can be effectively employed. On a large project it would be wise to request submissions from competing consultants on the way they propose to tackle the work and how they will employ their resources. Such submissions are also useful to limit excessive charges by consultants. Consultants are particularly useful in situations where an organisation has no experience or where the situation is encountered very infrequently. In cases where it is not worthwhile to appoint own staff, or where staff of sufficient calibre would demand very high salaries and other intellectual rewards, it is better to hire their services than to attempt to employ them.

### Acquisitions or Mergers with other Organisations

Companies in the same corporate "family" can often be useful sources of technological information. The problem often is one of communication and of mobilising the necessary information existing in some hidden part of a large, diversified organisation. Access to specific technological knowledge could be one of the major reasons for a merger or an acquisition or it

could be a bonus which, if vigorously exploited, could benefit the organisation considerably.

### Buying know-how

In buying technological knowledge adequate diagnosis is once again very important. It should for example be very clear whether the company is buying access to a major invention, some fairly dramatic new knowledge, access to reputation or a trademark or cumulative experience. In many cases the buyer of know-how buys reassurance that this manufacturing facility will produce at a certain volume, at adequate quality and a competitive cost. These qualities are achieved by using designs, training, start-up assistance and other forms of practical production experience and knowledge. The technological knowledge in such cases consists of cumulative experience rather than results of research, invention or laboratory development.

Suppliers of know-how, particularly if they are large overseas corporations, frequently prefer to include the following two clauses in their contracts which, seemingly innocuous, are usually to the disadvantage of the buyer.

These clauses are:—

- (i) "Protection of Market". According to this clause the buyer of know-how is protected on his home ground from competition by other members of the "family" in various countries. The supplier of know-how will assist in finding export markets for surplus production by locating shortages within the "family".
- (ii) "Free exchange of Developments". By paying a continual royalty the buyer of know-how has access to developments made to the process by anyone in the "family". The buyer is expected to supply knowledge of any improvements and developments free of charge to the supplier of know-how.

The main objections to these clauses are as follows:—

- (a) The Protection of Market clause does not protect the local company from competition by users of other suppliers of know-how for the same process while at the same time his own export markets are severely restricted. The export marketing arrangement usually works only for temporary surpluses after an expansion phase.
- (b) The Free Exchange of Developments clause tends to inhibit development and improvement because there are few incentives to spend money on these experiments. Often the supplier of know-how will actively discourage experimentation.

In practice local companies often find it difficult to obtain the promised steady stream of technical assistance promised before contracts were signed.

South African engineers, scientists and production managers have strength in improvements, adaptation and marginal development. It is often better to buy the knowledge outright, sever connections with the supplier of know-how and inspire own technical men

to keep developing and improving. This will develop a dynamic outlook in all aspects of the company, including marketing, while the dependent mentality is not conducive to competitive success. There were many occasions where South Africans had to make plants work after expensive purchased knowledge had proven inadequate, which proves that local men are particularly competent in pragmatic development work. Should the company require new knowledge at a later stage it can start afresh, possibly buying the new knowledge from another company, thus benefiting from the experience of more than one supplier of know-how.

### **Towards a Strategy for Managing Sources of Technological Knowledge**

Many South African companies using sophisticated technology are manufacturing under tuition from overseas suppliers of know-how. Knowledge is purchased in the form of designs, instructions, training, and start-up and problem-solving assistance.

In an attempt to escape these bonds many advocate heavy investment in own research and development.

The above analysis shows that there are many intermediate and often less expensive steps between these extremes.

There could be many benefits from explicitly managing the function of technological knowledge within a large technologically orientated organisation. Rather than choose between them, a company can then simultaneously use most of the abovementioned sources of information. It will, however, then be coordinated and channels will be matched according to the need of the situation. Once again the importance of clear identification and diagnosis of need is a prerequisite to a effective management of technological knowledge.

Instead of attempting to jump from management under tuition to own invention, a company could also devote a lot of attention to imitation, adaptation, improvisation and incremental improvement.

### **UTILISING TECHNOLOGICAL KNOWLEDGE**

There are frequently several barriers to effective utilisation of technological knowledge once it has been obtained. The most common are caused by inadequate definition of need and diagnosis of the situation. The problem may no longer be relevant or acute or the information obtained may not solve the problem.

Another problem occurs when ideas and knowledge are developed which are sound and could lead to profitable business opportunities or valid application, but for various reasons the company declines to use these. In such cases the company could gain by sponsoring these ideas in separate companies in which it has (or does not have) a shareholding.

Many South African companies have over the years developed knowledge of their own which could gainfully be sold. Although still small in absolute terms, royalty income from South African developments are on the increase.

Many companies are, however, unaware that they may have knowledge on the shop floor or in their manufacturing plant which, if properly utilised, could be of great value. This knowledge needs to be recognised, mobilised and properly marketed.

Know-how is not only sold as such in the form of patent rights or licences. Knowledge can be traded and exported in many ways. Knowledge can be used to make products competitive on local markets (compared to imports and other locally produced items) and on export markets. It can lead to new products with high profit margins with little competition. It can be used as a basis to establish partnerships or subsidiaries overseas. Sometimes the product itself cannot be exported but the methods developed can.

Management is often very proud of their efforts to improve, invent or adapt production machines, but they forget that knowledge as well as a physical product can be sold. It is not easy to sell sophisticated knowledge as a licence from a country lacking the image of a sophisticated, technologically advanced country. While such efforts must be supported continually, it could be easier and more lucrative to judiciously establish partnerships or subsidiaries in other countries.

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