

Translation of Technological Knowledge - the Tacitness of Codified Knowledge

Anna Reuithe
Susanne Åberg,
Department of Business Studies
Uppsala University,
Box 513,
S-751 20 Uppsala,
Sweden,
Tel: +46 18 471 13 71
E-mail: anna.reuithe@fek.uu.se,
susanne.aberg@fek.uu.se

Introduction

Technological knowledge is often considered to be universal in character, i.e. possible to understand provided that a person, or a company, has a certain technological expertise. Given this, the transfer of technological knowledge should not be affected by language differences. When technological knowledge is transferred, however, it is almost inevitably changed, or translated, into something different from the original form. The question raised in this paper is therefore: Can a technology be coded, understood and evaluated *as such* in order to see its potentials used in another setting, i.e. is technological knowledge universal?

Technical matters are often documented through the use of written or verbalised language. In this paper we discuss the impact of language on transfer of technological knowledge. We claim that different dimensions of language affect how technological knowledge is translated, and thus used, in a new setting. In this context, new technological knowledge entails combining resources in a new way, and this, in turn, may result in technological development. In this paper, however, we are focusing on the language aspects of technological knowledge, and how language can affect resource use as well as how resource use affects language, rather than technological development *per se*.

Here we intend to look more closely at codified knowledge and thereby question the very definition of it. We claim that codified knowledge is not really universal, i.e. coded so that it can be understood by others in the same way as it was intended when coded. There are elements of tacitness even in codified knowledge.²⁵⁹ Our reasoning will be exemplified in the

²⁵⁹ The cases that awoke the idea of writing this paper can in some ways be seen as very different from each other. One of the cases discusses transfer of “high-tech knowledge”, while the other could be seen as more of “low-tech knowledge” transfer. The first case deals with the problems of formalising technology transfer from CERN, the European Laboratory for Particle Physics, to industry in primarily Europe; while the other depicts the transfer of knowledge within the construction industry, and more specifically the knowledge of building multi-storey timber houses, and how attempts were made to transfer this knowledge from the U.S. to Sweden. There are, however, also some similarities. Both studies revolve round the problem of transferring technological knowledge, and both cases point at some of the difficulties with this transfer. In addition, as has already been mentioned, both cases deal with cross-firm as well as cross national transfer of technological knowledge. For a presentation of the two cases, see Reuithe, A. & Åberg, S. *On Particle Accelerators and Timber-houses – How Network Dependencies Condition the Transfer of Technological Knowledge*, a paper to be presented at the 16th IMP Conference in Bath, September 7-9, 2000.

later part of the paper with a written document, a Swedish patent from the technical area of timber-constructions.

The Concept of Knowledge

The concept of knowledge has been widely used for a long time within the fields of economics and business studies. It is appealing to find a concept that in a way can explain performance differences between firms: knowledge becomes a “garbage can concept” that can explain many things. The concept of knowledge is quite abstract. In order to be a useful tool to analyse empirical data, the concept must be concretised. In our view, knowledge is not an item that can be moved around unproblematically. It must be related to a specific context to have any meaning. Studying knowledge related matters from a network perspective (cf. Ford ed. 1998, Håkansson & Snehota 1995) technological knowledge can be seen as built in, individual and/or collective knowledge of both tacit and explicit nature of how resources can be combined in order to create value. A resource, in turn, can be defined as an element, material or immaterial, that has some known use (Håkansson & Snehota, 1995).

As hinted at above, the combination of resources require knowledge. Håkansson and Snehota (1995) state that “When different company activities are carried out and resources are used, some kind of knowledge of how they can be combined is needed. This knowledge of resources is only partly explicit, which means that it can be articulated, codified in the form of documents or books, and thus is relatively easy to transfer. Perhaps the main part of the knowledge necessary in order to use resources and to undertake activities is more difficult to articulate. It is “tacit” in nature” (p. 14). When discussing knowledge in relation to technical development, this distinction between two forms of knowledge, tacit and explicit, is often made. (Polanyi 1966, Nonaka & Takeuchi, 1995, Håkansson & Snehota, 1995). Explicit knowledge is seen as “knowledge of rationality” (mind), “sequential knowledge” (there and then), and “digital knowledge” (theory). Tacit knowledge, on the other hand, is seen as “knowledge of experience” (body), “simultaneous knowledge” (here and now), and “analog knowledge” (practice). (Nonaka & Takeuchi, 1995:61) In other words, explicit knowledge can be seen as objective, while tacit knowledge is perceived as subjective.

As can be seen from the quotation by Håkansson & Snehota, and from the very definition, explicit knowledge is often considered to be relatively easy to transfer. The problem, according to many researchers, is to successfully transfer tacit knowledge. If tacit knowledge means knowledge that can not be transferred and decontextualised, we can agree on this distinction. A problem with such a definition is, however, that it is very hard to operationalise. It can only be known after an attempt of transfer whether a certain technological knowledge related to certain resources was tacit or not. Therefore, tacitness is often related to non-coded knowledge or know-how, and explicit knowledge to coded knowledge.

Belussi and Pelotti (2000), for example, use the concept of codified knowledge instead of explicit knowledge for what they call objectified knowledge. In their words: “Codification refers to a form of “objectivated” knowledge (a set of justified true beliefs), thus an explicit form of knowledge that is related to the scientific results of basic research and innovative activity (a body of facts, information, principles and practical understanding of science)” (2000: 2). Further, the authors claim that codified knowledge can be classified in two ways: “As *disembodied*, it refers to the progress of science and technology /.../. Or as *embodied*, if it lies within technological “tools” such as scientific instrumentation, new machinery /.../

etc.” (ibid.). According to Belussi and Pilotti, many researchers claim that more and more knowledge is codified in society today, and that the scope of what can be codified is continually expanding, and that “the codification of knowledge is central to the modern process of dissemination, transfer and retention of knowledge” (2000:4).²⁶⁰

Critique and research on the matter is often either criticising the clear cut distinction between the two forms (tacit vs. codified knowledge), like Belussi and Pelotti, or investigating what is considered to be the problematic part, i.e. the tacit knowledge element. In this paper, however, we are more concerned with the concept of codified knowledge, and what we call “the tacitness of codified knowledge”. Is explicit knowledge, using the operationalised definition where explicit knowledge is the same as codified knowledge, as unproblematic as it might seem from the distinctions made above?

Language

Coding of technological knowledge can be done in different forms; numbers, graphs, maps, diagrams, texts etc. In this article we have chosen to discuss technological knowledge coded into language, both in written and spoken forms. The role of language in society and in relation to for example human knowledge has been much thought of and discussed by our great philosophers and by academics in the area of linguistics. Ferdinand de Saussure (1970), often seen as the father of semiotics, viewed language as governing on the individual: our notions are formed by the language that happens to be ours. Saussure claimed that words like all other “language signs” are made up of two arbitrarily related parts; the signified and the signifying. He also claimed that language can never be understood by adding its parts, on the very opposite you have to start from the whole in order to find the elements. The elements are not defined positively by their contents, but negatively through their connections to other elements in the language system: A sign is what the other signs are not. (Saussure, 1970)

The concept of language has several dimensions. The first, and most obvious dimension concerns different national languages. Perhaps it goes without saying that knowledge transfer across language borders may complicate a successful implementation of knowledge in the new setting. Some research has also been made regarding the impact of language on multinational management (Marschan, Welsh & Welsh 1997; Marschan-Piekkari, Welsh & Welsh 1999:1, 1999:2). These studies show that it is not certain that a shared company language, what the authors call language standardisation, within an multinational corporation (MNC) ensures meaningful communication (Marschan, Welsh & Welsh 1997). On the contrary, communication may be hindered by lack of language fluency. Within the MNC, the translations of information into the shared company language, and then new translations into the language of the countries where the different subsidiaries are located tend to distort the information (ibid.). The knowledge is translated, and the outcome may be something completely different from the original version. It was also discovered that the language can play different parts in a business relationship. It can function both as a barrier, as a facilitator, and as a source of power (Marschan-Piekkari, Welsh & Welsh 1999:2), all depending on whether the people that are supposed to communicate speak the same language fluently or not.

²⁶⁰ Opposite to this, tacit knowledge is a subjective knowledge linked to the abilities that an individual possesses on the basis of practical experience (Ibid).

When discussing different languages, it is not far fetched that the notion of national languages springs to mind. But there is also the dimension of professional language: within professions a certain terminology is used, within companies a special language can develop and even in sub-groups within the same company different “dialects” can emerge. Groups of specialists tend to develop a common professional language within the group. Likewise, companies involved in long-lasting and intense business relationships tend to develop a shared language code. Close interaction between individuals from the two companies as well as common technical experiences lead to both common coding and common understanding of the content behind the codes (cf. Saussure’s distinction between signifying and signified.) A common language in its turn will ease further interaction between the two companies. And since technical development is said to often emerge on the borderline between companies, this ease of interaction will in its turn enhance technical development! This reasoning is in line with Ludvig Wittgenstein’s (1953) late view of language. According to Wittgenstein an explanation of the meaning of a word must be seen as a preparation for the use of the word. He meant that the activities related to certain words are often disregarded in common conceptions of the relationship between language and reality. A strict interpretation of the Wittgenstein view of language would make all knowledge coded into language tacit, because in order to understand a word, according to Wittgenstein, one has to understand the signified objects role in the practical circumstances where it serves a function.

So far we have discussed common coding and stated that it will have positive effects on the ease of technical development. We will now turn to the situations where the parties involved in the development do not have a common language.

Translation

In the absence of a common language a translation is needed in order for the parties to understand each other and the message that has been coded. Latour (1986) depicts a translation model, where “the spread in time or place of anything – claims, orders, artefacts, goods – is in the hands of people; each of these people may act in different ways, letting the token drop, or modifying it, or deflecting it, or betraying it, or adding to it, or appropriating it. The faithful transmission of, for instance, an order by a large number of people is a rarity in such a model and if it occurs it requires explanation” (p. 267). This implies that for instance knowledge will necessarily change when it “travels” from one person to another, or from one place to another. It does not mean, however, that translation by definition is negative for the outcome, nor does it mean that parts are always taken away when translations occur. It may very well be the case, that things are added during the translation, and that the outcome is richer in some way than the original version. The only thing the translation implies, is that you will never end up with the exact same thing once for example information has moved from one place to another. Thus, translation can take place due to a number of reasons, and it can manifest itself in various ways, but a transfer without translation is difficult to find.

The concept of translation is, of course, commonly used within linguistics. Some of their thoughts have a bearing also on our discussion. If we for example look at Saussure’s claim that a language is a system that can only be understood by starting from the whole and not from its parts (1970: 117), then translation will be a lot more complicated than is often considered. This means that for example a text cannot be translated word by word, without the translator understanding the content, and the context, of the whole text. Using Saussure’s view of language, the benefits of dictionaries are marginal; in order to understand a negatively defined sign the context would have to be looked up. To complicate the matter

further, Saussure also claimed that words are made up of two arbitrarily related parts; the signified and the signifying (1970: 93ff). The translator therefore needs insight in not only the whole text of signifying words, but also of the whole system that is signified with words. Wittgenstein's declaration that not only the signifying and the signified, but also the practical circumstances where a word is used in order to achieve something has to be known, makes the task of translation even harder. Does a person reading a technical report on how to construct a multi-storey timber-frame house really understand the text? That would then have to do with if he understands the signifying words in this contexts, what they signify and how they function, i. e. what activities are carried out in relation to the descriptions made.

In the next section follows a short example of a written document and a discussion of the tacitness of this document of codified knowledge in relation to different readers.

Patents – Codifying Technological Knowledge

Unarguably, technological knowledge is transferred in different ways between actors. Sometimes, this is done through interaction between individuals or companies, but this is not always possible. In many cases, technological knowledge must be written down in some way, or codified, so that some sort of transfer becomes possible at all. Many firms believe in the importance of protecting their strategic knowledge. One way to protect technological knowledge is to gain exclusivity by patenting it. The word "patent" is derived from the Latin expression *litterae patentes*, which means open letters or public documents (www.prv.se, 00-06-26). It is claimed that the modern patent system was developed during the industrialisation in the second half of the 19th century. A patent can be described as an agreement between the state and an inventor, where the inventor gets a monopoly for a certain time period provided that he or she gives technical information to the public. (ibid.) A patent can also be seen as a way to codify technological knowledge.

As mentioned above, a patent is a way to protect technological knowledge. One reason why this is interesting is that technological development is costly both in time and resources. First and foremost, the patent protection gives the holder exclusive right to exploit the invention commercially. The patent holder also has the right to sell the patent or license the right to use it (this license right can cover the whole patent or just parts of it). The protection gained, however, varies from country to country, both in time and coverage. It is therefore of limited interest to talk about patents in general terms, and consequently we will focus on Swedish patents. PRV, the Swedish Patent and Registration Office, is the public authority granting patents, as well as registering trademarks, designs and names. A Swedish patent is valid for 20 years, starting from the day the application was filed.

When an inventor or a company wants to file a patent application, a patent agent is often used. The reason for this is that PRV only issues general directions on patents and how to apply for a patent, but they do not help with the formulation of applications. Whether a patent agent is used or not, however, the application starts with a careful formulation of the special patent claims. These claims decide the extent or scope of the patent, and are thus extremely important. The technical content of a patent application should be given in a description, patent claims, a summary and, if necessary, drawings. Once the application is submitted to PRV, an examination is made to see if all the formal requirements on the application are met. Thereafter a technical examination is carried out by a patent engineer at PRV. Aspects that are considered are: technical effect, reproducibility, news value and "height of invention" (i.e. the invention should differ considerably from previously known inventions. This requirement

is said to be met if the invention is not close at hand for a professional in the field). A patent engineer at PRV makes his or her statement about the application, and either the application is accepted, or it has to be resubmitted in some way. Finally, the application is either approved of or rejected, and the applicant is informed. A patent application is made public after 18 months, or when the patent is granted. Before this event, only the applicant, the number and the title of the application are known.

Once the patent has been granted, annual fees have to be paid. In the beginning these are quite low, but the older the patent gets, the more expensive it becomes to pay these fees. Provided that the annual fees are paid, the technology, product or production method patented is protected, and people or firms infringing on the patent rights may have to pay damages. In extreme cases, the sentence can be fines or even jail. Thus, a patent is intended to be a guarantee that an invention is used by the inventor, or at least by the person or firm paying for the patent application. In reality, however, it may be hard to control patent infringements, at least if it concerns infringements abroad.

The patent that will be examined and discussed here concerns “a procedure for the making of notches in a timber latch, and latches for walls of timber”. The patentee in this case is Södra Timber. Before we present and discuss the content of the patent, however, we will start by depicting the context of this patent – multi-storey timber-frames in house building.

Development of Multi-storey Timber-frame Technique in Sweden

It has been forbidden in Sweden since the late 19:th century to build multi-storey houses using combustible material for framing. In the turn of 1993 /-94 this law was, however, replaced with functionally based requirements, which opened up for the possibility to use timber-frames in large buildings. The change of requirements was interpreted as interesting by some individuals related to the construction and timber industry, not the least since a large majority of the American residential homes in several storeys are built with a frame of timber, to a much lower cost than the corresponding Swedish cost for multi-storey home-production.

SÖDRA²⁶¹, Swedens largest forest owners’ society, had in the spring of 1991 decided to support research and development in the area of timber with 33 MSEK for a period of six years. The following year a research-program “Multi-storey buildings with timber frame and light system of joists” was started in a co-operation between Södras daughter company Södra Timber and the Department of Structural Engineering at Lunds Institute of Technology. The program had a budget of 4 MSEK for four years²⁶². Later it was decided that the theoretical conclusions made by the researchers involved in the program would be tested on full-scale conditions in conducting a real multi-storey building-project. The buildings, one of four storeys and one of five, was situated next to SÖDRA:s head office in Växjö in the south of Sweden. The building project was started in 1995 and the first tenants moved into the new buildings in may of 1996. This turned out to be one out of the first two multi-storey timber-frame building-projects that was conducted in Sweden after the change of requirements.²⁶³

²⁶¹ SÖDRA is an economic society with near 33.000 privat forest owners in the south of Sweden as members. Together they own 1,9 miljon hectare forest. Their turnover is 8,2 billion SEK and they employ 2.500 persons.

²⁶² The research-program was in 1993 extended into a Nordic project in Nordic Wood, financed by Nordisk Industrifond. The project ”Trähus i flera våningar” (Timber-houses in many storeys) run for five years with a budget of 22 MSEK.

²⁶³ The other project Orgelbänken, concerned a four-storey building in Linköping. It was built by Skanska for the local housing firm Stångåstaden, and was completed a few months earlier, in march of 1996.

The large Swedish building-firm, Skanska, constructed the buildings, while SÖDRA and Skanska started a common daughter company, Trähus Sydöst, that functioned as commissioner and owner.

In order to test a method for prefabrication of timber-frames the elements; roof frame, wall components (including the timber latch) as well as floor components, were produced in a field-factory next to the building site. After the buildings were completed Södra Timber have continued on developing the technology for prefabrication of multi-storey timber-frame buildings. Special attention has been given to the main problem-areas found during the construction of Wälludden; the difficulties eliminating the spread of sound between storey and apartments, and matters of stabilisation related to the light timber-frame. Their development work has been conducted at Södra Timber Specialprodukter (Special-products) in Hultsfred.

Patenting the Timber Latch

The patent in question concerns, as mentioned above, a latch for a timber wall and a procedure for making of the latch. The technical details of the latch and of the procedure for making it is described in some detail. It is also stated that the notches make the latch more stable and isolating for both sound and heat. Four figures showing the latch with notches is also attached and explained in the application. Other than this patent, that was applied in 1997 and granted in 1999, two other patents have been applied for by Södra Timber in the same technical area of timber frames for housing.

How come Södra Timber has chosen to patent the latch? SÖDRA is, through its members, a large forest owner. Even though their daughter company Södra Timber own five sawing-mills in the south of Sweden, the majority of their sales are of bulk-character. Only around 20% of total sales is, for example, sold to end-users, whereas the other 80% is exported or sold to Swedish wholesalers. A patent for a construction-related component seem rather distant from their main production. What has to be kept in mind, however, is that the latch is a small, but rather central, piece in a larger development trial concerning multi-storey timber-frame buildings and in establishing this technology in Sweden. As much as attempting to communicate and/or protect the technical aspects of the component, we guess that Södra Timber is demonstrating their seriousness in the development effort.

Another, related question concerns the reader of the patent document. Who will read the text and find useful information in it? Since the patent document as such holds very limited information of the context of the component, we assume that the reader has to be familiar with much of the surrounding technical circumstances in order to evaluate its usefulness. A large order of joists, one of the other two components that Södra Timber has applied to patent, made by Skanska supports this speculation. Skanska is, as was described above, Södra Timber's old partner of development at the Wälludden-project. They will use Södras system of joists in a multi-storey timber-frame building-project for the Swedish housing fair in 2001: "BO01".

Discussion

Our point of departure in this paper was that more and more knowledge is claimed to be codified, and that this is seen as an unproblematic task. If the codification is unproblematic, so should the transfer of knowledge be. But what is being codified? Is it the same knowledge as was intended, just parts of it, or something completely different? What happens during the

codification? And are there tacit elements in codified knowledge? Language is often believed to be codifiable, or written down in some way, but inevitable translations lead to changes in the message. A common belief is that these solutions will be easy to transfer, and that the knowledge will in no way change on the way from one place to another. The knowledge is perceived as given (see figure 1).

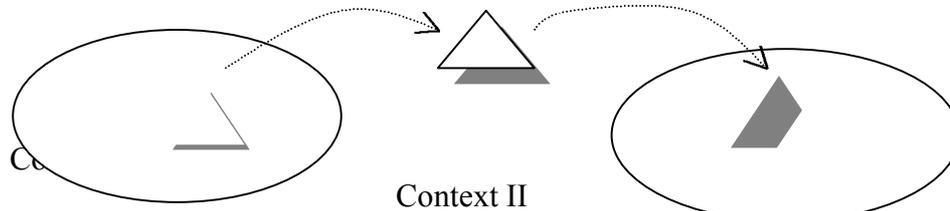


Figure 1: “An unproblematic transfer of technological knowledge”

We do not only believe that it is difficult to separate tacit knowledge from codifiable knowledge, but also that there are always tacit elements in what is believed to be codified knowledge. Thus, what is believed to be codifiable is written down, but what is signified (the “meaning behind the words”) differ between different receivers and between receiver and sender, which leads to a first translation of the knowledge. If the codification then is translated into another language, and transferred into a new setting, a number of additional translations take place, and the message is further changed.

How large the translative task is depends more on the parties involved in the “coding and decoding”, i. e. on the sender and receiver or receivers, than on the message as such. If the contextual and/or relational gap between the two is large, so is the task of translation. Thus, interaction serves as a learning tool in relation to language differences. Both parties then function as a sender and receiver and both are able to modify the communication in relation to the other party in order for him to understand. This is probably one of the reasons why so much technological development is done within established business relationships.

This paper has dealt with written documents, and especially patents, as a way to transfer technological knowledge. We have also said that technological knowledge is developed in interaction within networks. A technical document, however, can be transferred from one context to another, and thus from one network to another.

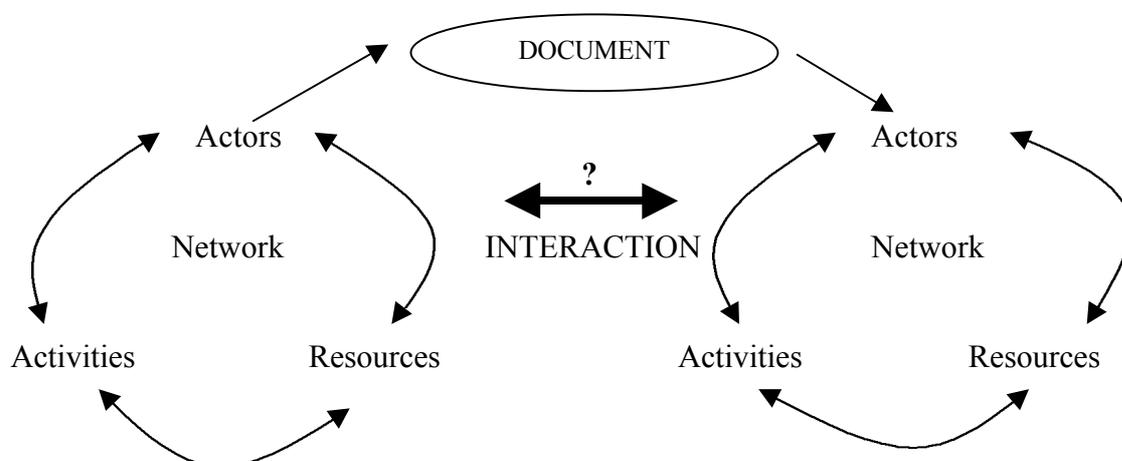


Figure 2: Potential interaction between networks (partly based on Håkansson, 1989:17)

Whether a text is to be considered codified or not therefore depends on the reader (or listener), in relation to the sender, rather than on the text as such. Is the person acquainted with the terminology used? Has he or she some former experience with the technology described? From what angle is he or she making comparisons if indirectly acquainted? Does he or she know the background of the person writing the document enough to know what meaning they give different words? Instead of focusing on the document, textbook or conversation as such, we need to focus on the people involved and on how and if they are related.

In addition to the acquaintance between the persons, the degree of tacitness in the translated document has to do with the interaction between the resource constellation at the place of origin and in the network of the person reading it. Are the signified objects the same as they are at the place of origin, i.e. are their position in relation to other resources the same?²⁶⁴ Finally, if one, in order to understand a text, needs to be familiar with the signified objects' function in practical circumstances, the tacitness also has to do with the activities that are performed in relation to the technology, product or production method described in the document.²⁶⁵

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²⁶⁴ C.f. de Saussure's definition of a sign

²⁶⁵ C.f. Wittgenstein (1953)

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