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Why all this fuss about codified and tacit knowledge?

Björn Johnson, Edward Lorenz and Bengt-Åke Lundvall

This paper starts with a critical assessment of the recent paper by Cowan, Foray and David. It also provides the authors' own assessment of why the tacit/codified distinction is important in relation to economic analysis and knowledge management practice. The criticism of Cowan, Foray and David centres on three points. Firstly, it is argued that the discussion on codification must make the fundamental distinction between knowledge about the world (know-what) and knowledge in the form of skills and competence (know-how). Secondly, it is argued that the dichotomy between codifiable and non-codifiable knowledge is problematic since it is rare that a body of knowledge can be completely transformed into codified form without losing some of its original characteristics and that most forms of relevant knowledge are mixed in these respects. Thirdly, we contest their implicit assumption that codification always represents progress. We conclude that for these reasons their intellectual exercise of extending definitions of what is codified and possible to codify, while in principle addressing very important issues related to innovation policy and knowledge management, ends up having limited practical implications for these areas.

1. Introduction

One recent issue of *Industrial and Corporate Change* focused on the distinction between codified and tacit knowledge. The contribution by Cowan, David and Foray was especially ambitious in its attempt to redefine what should be analysed and debated in this field (Cowan *et al.*, 2000; subsequent page numbers refer to this paper). Our paper takes as its starting point a critical review of their contribution, and gives its own assessment of why the tacit/codified distinction may be important in relation to economic theory and knowledge management practise.

Expressed succinctly, Cowan *et al.* argue that very little knowledge is inherently tacit and impossible to codify, and that from an economist's point of view whether or not codification takes place will depend on a comparison of costs and benefits. They contend that uncodifiable knowledge is 'not very interesting for the *social* sciences' (Cowan *et al.*, 2000: 230), and they encourage economists to put it aside and focus their attention on knowledge that is codified or codifiable. Moreover, they argue that a lot of *apparently* tacit knowledge is *actually codified*. In order to make this argument, new

ancillary concepts such as 'the code-book' and 'the displaced code-book' are introduced. More or less explicitly they argue that, on balance, codification is a good thing and that, for different reasons, too little knowledge actually gets codified or made explicit.

Our criticism of the paper centres on three points. First, we argue that any discussion of codification must make the fundamental distinction between knowledge about the state of the world and knowledge in the form of skills and competence. Second, we argue that the dichotomy between codifiable and non-codifiable knowledge is highly problematic. Our point is that any body of knowledge might be codified *to a certain extent*, while it is very seldom that a body of knowledge can be completely transformed into codified form without losing some of its original characteristics. Finally, we are not convinced that codification *always* represents progress, something that seems to lie behind most of Cowan *et al.*'s argument. In our conclusion it is recognized that it is useful to focus on codification as one potential source of learning. But we also point out that the major intellectual operation of extending what is codified and possible to codify does not have much practical consequences on areas such as knowledge management.

Before entering the discussion of these points it might be useful to consider why we should bother about codification of knowledge at all.

2. Motivations and questions

Cowan, David and Foray's (hereafter CDF) interest in codification is motivated mainly by its relevance to the debate on public support of research. The proponents of inherently tacit knowledge are, it is argued, coming up with mistaken arguments regarding science policy and they tend to end up either as being against public support of science (p. 221) or in favour of techno-mercantilist views (p. 224).[1]

Somewhat paradoxically, these issues, while raised as the motivation for the article, are only briefly alluded to in the conclusions (p. 250). The major conclusion in this respect is the quite modest one that there is a need to introduce several other analytical dimensions before it is possible to move on to policy recommendations. The paper ends:

> Those interactions, as much as the effects of changes in information technology, will have to be studied much more thoroughly before economists can justly claim to have created a suitable knowledge base upon which to anchor specific policy guidelines for future public (and private) investments in the codification of scientific and technological knowledge. (p. 250)

[1]It is not made clear why the different views on tacit knowledge should give rise to different policy conclusions. Techno-mercantilist conclusions—in the form of an insistence upon strong legal protection of intellectual property—could as well emanate from an analysis treating knowledge as information. Exaggerated expectations on what intellectual property rights can do could give rise to arguments against public support for generic science.

It is important to note that the original issue of science policy has been narrowed down quite substantially. The policy area indicated by 'public (and private) investments in the *codification of* scientific and technological knowledge' is one aspect of science policy but it is certainly not the only one (our italics). For instance, investing in the training of Ph.D. students will typically involve establishing career patterns resulting in skills that are not easily codified and which can only be learnt in an apprenticeship-type interaction with more experienced scholars.[2] This slip of meaning from scientific progress in general to codification of knowledge is significant because it illustrates a general tendency in the CDF paper to regard codified knowledge as a privileged form that can be positively distinguished from the more primitive common sense and guru-types of knowledge.

3. What is codification?

The definitions of what it is possible to codify and what is already codified given in the paper are extremely wide and basically refer to the use of language. The fundamental argument appears to be that all knowledge for which a 'code-book' exists can be considered codified. A code-book, on the other hand, can be identified, or very nearly identified, with a language, in the sense of a vocabulary and models (see also Cowan and Foray, 1997). This leads to the conclusion that everything that is articulable is codifiable, and that everything that has been articulated is actually codified.[3]

A distinction is made between data, information and knowledge. Information is defined as a 'message containing structured data, the receipt of which causes some action by the recipient agent' (p. 216). The nature of the action is determined by the agent's knowledge, which the authors define as her 'entire cognitive context'. In a passage that is difficult to follow, the authors also claim that (other) information forms part of this cognitive context and may quite possibly form the critical part. This could be read as saying that individuals mainly use (other) information to decode and interpret information. Although the authors do not state it explicitly, this would imply that information is synonymous with coded knowledge.

Without getting too far into a philosophical discourse on language and knowledge (where we recognize our narrow limitations of expertise), we wonder if it is really acceptable to argue that knowledge is what can be expressed in a language and nothing else? Doesn't this amount to taking a rather extreme position on the scale between positivism and cognitivism on the one side and hermeneutics and contextualism on the

[2]When interviewed about the background for their success as scientists, almost all Nobel Prize winners pointed to their interaction with other and more experienced Noble Prize winners as a key element in their career.

[3]While the authors do qualify this claim on p. 228, in what follows the qualification is set aside and knowledge which is 'articulated (and thus codified)' is contrasted with 'unarticulated' knowledge (p. 330).

other sided? And is it not correct that this reasoning by itself makes the issue treated in the article—the relative importance of tacit knowledge—irrelevant?

4. Why codification is important

The most important reason for making the distinction between tacit and codified knowledge might not be the issue of the government's role in science and technology policy. We cannot see why there should be any simple relationship between emphasizing the importance of one type of knowledge and recommending a more or less active role for governments in supporting science. It does not make any difference if you believe that most of what constitutes economically important knowledge is tacit, or if you believe that it is codified but that intellectual property rights are highly efficient means of protecting such knowledge. The conclusions should be identical.

Cowan, David and Foray also argue, more interestingly, that the view that (inherently) tacit knowledge is important may undermine the basis 'not only for standard micro-economic theory but also for any attempt to model human behaviour' (p. 218). Here, they touch upon important issues. We do not share the view that modelling human behaviour cannot be done in a world with agents acting on the basis of partially tacit knowledge. But the models used need to be richer in dimensions that standard micro-economic theory neglects. Learning skills that are tacit normally involves social interaction and gives rise to more complex motivations for behaviour than those assumed in models of 'economic man'. Put differently, if the world were based on people acting as computers, programmed with optimizing algorithms and fed by information, it would certainly be *much less difficult* to 'model human behaviour'. Economists could, for instance, safely neglect all progress in psychology, anthropology and sociology. So, the debate on the role of tacit knowledge in the economy is also about what kind of analytical models are the most adequate when it comes to understanding economic dynamics.[4]

We would like to point to three other areas where the debate on tacit and codified knowledge is of special importance and where it may have very practical implications. One covers the set of organizations that are directly specialized in contributing to competence building in society. The second area covers different aspects of knowledge management at the level of the firm. The third area relates to international developments and to the impact of codification on opportunities for less-developed regions and countries.

Organizations that are directly specialized in contributing to competence building in society include schools, universities and research institutes. Here the relative import-

[4]In our view it is a mistake to argue that the goal of modelling in some symbolic language should be to provide a complete and psychologically accurate description of human knowledge and behaviour. Reading models, like reading any text, necessarily involves interpretative efforts that draw on tacit and shared understandings specific to particular communities of scholars. To insist that a model's representation of knowledge should be complete (fully codified) if the model is to be of any real interest not only rules out a place for appreciative theorising, but also, in our view, can only lead to an impoverished understanding of human behaviour.

ance of tacit knowledge may affect a number of practical issues. What kind of training should be offered and what kind of skills should be established in this sector? How far can information and communication technology (ICT) and virtual e-learning substitute for face-to-face interaction? How should universities interact with external users of information and knowledge? If all important knowledge was in a codified form, training arguably could rely on abstract modelling, and the direct face-to-face interaction could be substituted by e-learning and electronic networks connected to external users of knowledge.

Knowledge management at the level of the firm also has to take into account the relative importance of tacit vs. codified knowledge. Firms can access tacit knowledge by hiring experts and taking over other firms, and this knowledge can be protected by long-term contracts with employees. Codified knowledge may be bought in the market and be protected by patents and other forms of intellectual property rights. Codification processes may aim at transforming tacit elements into a codified form. In this instance the choice of strategy depends greatly on what degree codification of specific types of knowledge can take place.

The third area relates to international developments. The distribution of income and wealth between the countries in the world has grown more and more unequal for quite a number of years. These increasing inequalities seem to be connected to the access to knowledge-related resources. Clearly, if increased codification, or making knowledge explicit, would make it easier to transfer knowledge to developing countries and to access, absorb and utilize the transferred knowledge in these countries that would make codification critically important. What forms of codification, if any, could help the parts of the world that have been left outside knowledge-intensive global networks to be integrated and get benefits in terms of economic development? Is there an 'electronic divide' that can be closed by distributing computers and internet access more evenly world-wide, or is it rather a 'learning divide' that needs to be closed by investments in people and by institutional change.

5. Four different kinds of knowledge

At the very end of the CDF paper a distinction between declarative propositions (know-why and know-what) and procedural knowledge (know-how) is mentioned (p. 249). It is argued that this distinction is important but too often neglected in the literature. This last point is crucial. We believe that codification has radically different meanings for the two kinds of knowledge and that the authors would have got much further in their analysis had they made these distinctions early on and stuck to them. When these distinctions are not made explicitly there is a risk that 'knowledge' collapses into one or the other of these categories. Over all, CFD tend to focus on know-why and know-what to the neglect of know-how and know-who (see below for definitions).

The distinction between tacit and codified knowledge can help answer some of the questions related to innovation policy and knowledge management—but only to a

limited extent. A richer taxonomy is needed to reflect some of the complexities involved in storing and sharing knowledge. We have suggested that knowledge may be divided into four categories that in fact have ancient roots (Lundvall and Johnson, 1994).[5] They are defined at the level of the individual but the same logic may be applied to competencies at the organizational level.

Individual knowledge consists of 'know-what', 'know-why', 'know-how' and 'know-who'. On the organizational level these categories correspond to 'shared information databases', 'shared models of interpretation (including company stories)', 'shared routines' and 'shared networks'.

Know-what refers to knowledge about 'facts'. The population of New York, the ingredients of pancakes, the date of the battle of Waterloo—these are all examples of this kind of knowledge. Here, knowledge is close to what is normally called information—it can be broken down into bits and communicated as data. It is relatively easy to codify know-what.

Know-why refers to knowledge about principles and laws of motion in nature, in the human mind and in society. This kind of knowledge has been extremely important for technological development in certain science-based areas, such as the chemical and electric/electronic industries. Access to this kind of knowledge will often make advances in technology more rapid, and reduce the frequency of errors in procedures involving trial and error. Usually we think of know-why as codified, but as already pointed out, codification is normally incomplete, for example in the sense that science-based activities partly build on personal skills.

Know-how refers to skills—i.e. the ability to do something. It may be related to the skills of artisans and production workers, but in fact it plays a key role in all important economic activities. The businessman judging the market prospects for a new product or the personnel manager selecting and training staff use their know-how. It would also be misleading to characterize know-how as practical rather than theoretical. One of the most interesting and profound analyses of the role and development of know-how focuses on the scientist's use of skills and personal knowledge (Polanyi, 1958/1978). Even finding the solution to complex mathematical problems is based on intuition and on skills related to pattern recognition that are rooted in experience-based learning rather than on the carrying out of a series of distinct logical operations (Ziman, 1979: 101–102). Parts of know-how may be possible to articulate and parts of it may be

[5]Knowledge has been at the centre of analytical interest from the very beginning of civilization. Aristotle distinguished between *epistèmè*, knowledge that is universal and theoretical; *technè*, knowledge that is instrumental, context specific and practise related; and *phronesis*, knowledge that is normative, experience based, context specific and related to common sense ('practical wisdom'). At least two of our categories have roots that go back to these three intellectual virtues. Know-why is similar to *epistèmè* and know-how to *technè*. But the correspondence is imperfect, since we will follow Polanyi and argue that scientific activities always involve a combination of know-how and know-why. Aristotle's third category, *phronesis*, which relates to the ethical dimension, will be reflected in what is said about the need for a social and ethical dimension in economic analysis and about the importance of trust in the context of learning.

codifiable, but there will always remain irreducible differences between the skills of a heart surgeon and the code-book she uses.

In a more mundane sense that may be of great relevance to everyday problems of knowledge management in firms, there is a variety of evidence showing that an individual's use of even basic mathematical skills may be highly dependent on experienced-based learning. Lave (1988), for example, has shown how arithmetic skills learned in school transfer poorly to other problem domains. In everyday work activity, an individual's ability to control and orchestrate such cognitive skills is tied to specific features of the problem-solving context. In part this is because arithmetic use in everyday settings is structured by the practical nature of the problem to be solved. It also has to do with the way the physical setting, including plant layout, may provide information that helps to generate particular solution strategies (Scribner, 1984). This suggests that in practice there may be a 'know-how' dimension to our use of even basic forms of 'know-why'.

Know-how is typically a kind of knowledge developed and kept within the borders of the individual firm or a single research team. As the complexity of the knowledge base increases, however, co-operation between organizations tends to develop. One of the most important reasons for industrial networks is the need for firms to be able to share and combine elements of know-how. Similar networks may, for the same reasons, be formed between research teams and laboratories. In this context there are interesting complementarities between codified and tacit knowledge. Firms often publicize their scientific research results in journals or present them at conferences. In this way they send signals about their specific knowledge resources and competencies and selectively invite collaboration in more tacit knowledge areas (Hicks, 1995).

This is one reason why *know-who* becomes increasingly important. The general trend towards a more composite knowledge base, with new products typically combining many technologies, each rooted in several different scientific disciplines, makes access to many different sources of knowledge more essential (Pavitt, 1998). Know-who involves information about who knows what and who knows what to do. But it also involves the social ability to co-operate and communicate with different kinds of people and experts. Know-who is highly context dependent. Its character and usefulness depend on social capital in terms of trust, networks and openness. It follows that it is rather difficult to codify.

6. Information technology and codification of the four categories

Databases can bring together know-what in a more or less user-friendly form. Information technology extends the information potentially at the disposal of individual agents, although the information still has to be found, and what is relevant has to be selected and used. The effectiveness of search machines specifies how accessible data actually are. Even with the most recent advances in this area, access to this kind of

knowledge is still far from perfect (Shapiro and Varian, 1999). Even today, the most effective means for obtaining pertinent facts may be through the 'know-who' channel, i.e. contacting an outstanding expert in the field to obtain directions on where to look for a specific piece of information. An additional problem is the stability of access to data through the internet. Information easy to find and access today may at a later date be removed without trace.

Scientific work aims at producing theoretical models of the know-why type, and some of this work is placed in the public domain. Academics have strong incentives to publish and make their results accessible. The internet offers new possibilities for speedy electronic publishing. Open and public access is, of course, a misnomer, in that it often takes enormous investments in learning before the information has any meaning.

Know-who, directed towards academia, can help the amateur obtain a 'translation' into something more comprehensible. This is one strong motivation for the presence of companies in academic environments, and sometimes even why these companies engage in basic research. Some big companies in science-based areas contribute to basic research. They publish results and tend to move toward becoming 'technical universities'. But at the same time, the close connection between academic science and the exploitation of new ideas by business in fields such as biotechnology tends to undermine the open exchange that has characterized academic knowledge production.

To gain access to scientific know-why, it is necessary, under all circumstances, to pursue R&D activities and to invest in science. This is true for individuals and regions as well as for firms. Completely free 'spill-overs' are much less available than assumed in standard economics (Cohen and Levinthal, 1990). Moreover, in fields characterized by intense technological competition, technical solutions are often ahead of academic know-why. In these cases technology can solve problems or perform functions without a clear scientific understanding of why it works. Here, knowledge is more know-how than know-why.

Know-how is the kind of knowledge where information technology faces the biggest problems in transforming tacit or non-explicit knowledge into an explicit, codified format. The outstanding expert—cook, violinist, manager—may write a book explaining how to do things, but what is done by the amateur on the basis of that explanation is, of course, less perfect than what the expert would produce. Attempts to use information technology to develop expert systems show that it is difficult and costly to transform expert skills into information that can be used by others. The failures are legion, as are the often exaggerated claims made by the proponents of these systems (Dreyfus and Dreyfus, 1986: 106–117). It has also been demonstrated that writing an expert system always involves changes in the content of the expert knowledge (Hatchuel and Weil, 1995). This is not only true for an individual's skills and competence, but also for professional skills and for team competences. Eliasson (1996) has illustrated the limits of using management information systems as a substitute for management skills by pointing to the strategic failures of IBM and other big ICT firms who should be in a privileged position when it comes to developing such systems to their own advantage.

Today, as much as in the past, the transmission of know-how depends on lengthy processes of apprenticeship during which the novice is integrated into an established 'community of practice'.

Know-who refers to a combination of information and social relationships. Telephone books that list professions and databases that list producers of certain goods and services are in the public domain and can, in principle, be accessed by anyone. In the economic sphere, however, it is increasingly important to obtain quite specialized competencies and to locate the most reliable experts, hence the enormous importance of good personal relationships with key persons one can trust. Electronic networks cannot substitute for these social and personal relationships. Standards such as ISO 9000 cannot fully respond to these kinds of needs.

This means that the social context may support, to a greater or lesser degree, the formation of know-who knowledge, while the cultural context determines the form it takes. When characterizing national business systems, Whitley emphasizes factors having to do with trust and the capacity to build extra-family collective loyalties (Whitley, 1996: 51). This is also an important aspect of the concept of social capital (Woolcock, 1998). Especially in situations where technological opportunities and user needs are rapidly changing or where the knowledge base is not well documented, it is necessary to meet face-to-face from time to time in order to solve problems.

New developments in information and network technologies may constantly change the borderline between what is and what is not meaningful to codify. Virtual reality and new multimedia may combine with telecommunication techniques in such a way that more expert knowledge can be located, selected and accessed over the internet. So far, all great expectations about what can be done through information technology have proven to be exaggerated, and until the opposite is demonstrated we should not expect large-scale changes in interaction patterns around knowledge and learning. This does not rule out very advanced experimental use of the technologies.

7. Degrees of codifiability of different kinds of knowledge

An important contribution by CDF is to make it very clear that economic incentives affect the efforts to codify knowledge, and that a distinction should be made between what has actually been codified and what could be codified if the effort was made. We believe that another distinction is more relevant, namely the one between fully codified knowledge and partially codified knowledge.

Taking our starting point as know-how-type knowledge, we have argued that it is exceptional for human and organizational competencies to be fully transformed into codes. But, at the same time, it is almost always possible to transform aspects of them into a codified form. *Differences in the amount of competence that is lost* in the transformation process are crucial for its attractiveness. This is important because it affects how costs and outcomes of 'codification projects' should be perceived.

You can certainly write down some basic rules on how to play tennis and to make

love, but you cannot make explicit the full capability of the skilful behaviour of Hingis and Casanova. Here, codifiability is very low and knowledge transfer includes a lot of interactive learning. (To say that all Casanova's skills are possible to codify but that the costs of doing so are very high seems to us to be not only a rather empty statement but also a mystifying one.)

The scientist who makes a laboratory experiment may get much closer to documenting the process fully and to doing so in such a way that others can repeat it with an almost identical outcome. Here it is important to note that one criterion for scientific research is that it should take place under controlled conditions and that a major objective is to make sure outcomes are not dependent on specific personalities and environments. In this case, the problem of knowledge transfer is more related to a lack of absorptive capacity in terms of the necessary institutional support. But even in this case the codification is incomplete in the sense that the personal knowledge of the scientist cannot be fully included in a codified message. Her competence and ability to draw conclusions on the basis of observing complex evolving patterns is something that has to be learnt in direct interaction with more experienced scholars and it remains personal knowledge.

This illustrates that codification can capture more fully causalities, procedures and descriptions than it can capture actual skills and competencies. It is easier to codify a description of the world than it is to codify ways to manage and change the world. It also illustrates that important aspects of human cognitive capabilities such as pattern recognition and pattern using are much more difficult to codify than simple logical statements of causality. To argue, as CDF do (p. 228), that only very little knowledge is impossible to codify, indeed so little that it can be safely ignored when discussing the economics of codification, seems to be an unhelpful exaggeration. The acquisition of workable tacit knowledge is in many areas a long and costly process without many codification leeways.

8. Articulation and codification—what comes first?

Immediately it seems reasonable to assume that articulation takes place before codification. When something has been said, it can be written down—cf. the definition of codified knowledge as 'structured data and the necessary instruction for its processing' and as 'knowledge reduced to symbolic representations'. The CDF paper argues the opposite: 'Articulation being social communication, presupposes some degree of codification . . .' (p. 228). Later on this boils down to the more categorical 'Articulated (and thus codified)'. And it is assumed that there is a category of knowledge that is codified but not articulated—it is at this point that the somewhat mystifying idea of 'the displaced code-book' is evoked. Here the concept 'code' seems to have become much wider than it was in the original definition (notations and rules). We want to make two critical comments on the assumption that all articulated knowledge is codified. First, 'articulation' and 'social communication' may take place through gestures and miming

and do not necessarily involve the use of a language. Second, even when articulation takes the form of a use of language, it is dubious to argue that it presupposes 'codification'.

To argue that the art of bicycling is 'codified' because the person on the bicycle is saying 'I am now adjusting my balance to avoid falling over' is not especially useful to the novice bicycle rider. Certainly it will not substitute for the experienced-based learning she will have to go through to achieve a competent performance. Taken literally, the position of CDF boils down to saying that everything we can 'talk about' is not only codifiable but, actually, already codified. This makes it difficult to understand why codification processes, such as those involved in writing an expert system, are such complex and costly affairs. Certainly experts are able to talk about what they do. Maybe it would be possible here to distinguish between different degrees of articulation. Again it seems more interesting to discuss degrees of codification rather than 'either/or'.

9. Codification as progress; the value premises

There are certain contradictions in the CDF paper between the micro-economic assumptions made ('choices will depend on perceived costs and benefits') and the critical reflections made on the actual degree of codification. On the one hand, the argument is built around a standard economic assumption: agents tend to do what is best for them. Specifically, agents are assumed to codify whenever it is profitable.[6] On the other hand, the second part of the paper (pp. 244–245) gives a number of illustrations of situations where private agents have codified knowledge to a lesser degree than they should have done *had they been fully rational.*

In the light of these contradictory statements it is difficult to avoid the conclusion that, in general, CDF consider codification of tacit knowledge as an improvement; as in some sense a step forward. But why? Does it lead to greater intellectual satisfaction of knowing and understanding for a larger number of people? Does it promote economic growth and development—in the South as well as in the North?

It is not at all clear which set of value premises it is that makes codification a good thing in private and societal terms. We believe that it might be useful to make explicit—to codify?—the value premises behind the calculation of social costs and benefits of codification processes.

One reason to take a positive view of codification might be that making knowledge explicit and distributing it widely may affect societal goals like democracy, intellectual and educational standards, openness, trust, etc. An possible but somewhat naïve

[6]In an example in the paper the authors refer to the experienced pilot who guides the complete beginner to a happy landing and how the experienced pilot becomes aware of different routines that he does not normally recognize that he is pursuing (p. 220). The example is used to demonstrate that implicit knowledge can be made explicit when incentives are strong enough (the fact that most people would not be willing to fly with a complete beginner at any price even if he was guided by an experienced pilot illustrates the limits of material incentives).

hypothesis would be that codification tends to bring us closer to these goals; making knowledge explicit is in itself an act of human and social progress and enlightenment. The ideal society is one with complete transparency where all relationships are explicit and perhaps even written down in contracts.

An alternative but less harmonious view is that important parts of the knowledge structure are better left implicit and tacit. One reason for this is that in a world of unequal power tacit knowledge may provide a protective belt against exploitation for individuals and groups. The process of codification affects and is affected by the distribution of power, as well as being affected by the benefits and costs of learning and change.

10. Decreasing the realm of tacit knowledge to good effect?

It is important to note that when it comes to both the creation and utilization of knowledge, tacit and codified knowledge are complementary. It does not seem to be a good idea to regard them as being in contradiction to each other or as simply substituting for each other. It is more useful to refer to a 'tacit dimension' of knowledge rather than to a 'knowledge stock' divided into a tacit part and a codified part, and then decide if the border between the two parts should be moved. Neither does it seem to give a good picture of knowledge management to visualize economic agents as using conventional cost–benefit criteria to decide if codification pays or not, increasing the codified realm if, and only if, marginal benefits are higher than marginal costs. Since knowledge, as well as future learning and forgetting, change through the act of codification, the idea of an economist with a simple one-line answer 'the choice will depend on perceived costs and benefits' (p. 241) seems to us to be oversimplifying things.

The difficulties of using marginal benefits and costs as criteria for decisions about decreasing the realm of tacit knowledge are illustrated by the numerous failures of codification projects. It seems to be quite common that projects aiming at making vast bodies of tacit knowledge explicit run into serious difficulties. In big consultancy firms we see new forms of knowledge management where the basic idea is to codify, transfer into databases, and thus centralize the tacit knowledge and competencies held decentrally by a large number of employees. This is supposed to increase the efficiency of knowledge management and improve the productivity of the organization or firm in question. Examples can be found both in the government sector, e.g. employment agencies, and in the private sector, e.g. quality control and certification in connection with insurance.

The problems in such projects are of different character. One thing is that the costs and time required are usually vastly underestimated. Another, more serious, thing is that the process includes not only transformation from tacit to codified knowledge, but also direct losses of knowledge. Parts of local tacit knowledge never get codified at all but rather are inactivated, and after a time forgotten and lost. Furthermore, the intended process of knowledge codification and centralization normally also leads to a

process of organizational change and new kinds of knowledge management. This process takes considerable time and the problems to be tackled by the organization will change during the process. A big investment in codifying certain routines will often prove to be in vain because the problems to be solved are no longer the same. More generally, one of the strongest disincentives for codification may be the high degree of uncertainty that characterizes a system under constant and rapid change.

In fact, it is probably rare that the main purpose behind a codification endeavour is finding the optimal degree of codification. It is more likely that it has to do with power struggles within the organization. Changing the control of knowledge is often an instrument for changing the power structure, and codification and other changes in the structure of knowledge may be better explained as elements in a process of power struggle than as an exercise in equilibrating marginal benefits and costs. The close relation between power and knowledge has been emphasized by Foucault (Gordon, 1980), and it seems to be a serious omission that this dimension has been neglected in the discussion of knowledge codification.

11. Dysfunctional codification?

Furthermore, the proposition that 'the realm of "the tacit" can be greatly constricted, to good effect' (p. 229) may also be exaggerated in another sense. The observation that there is a 'tacit dimension of knowledge', that one knows more than one can tell, has been made not only by philosophers but also quite some time ago by economists. Keynes, for example, may be quoted as saying that an economist always knows more than he can explain. Since Keynes's time, economics has witnessed a veritable surge of codification, and building formal models has almost become the only accepted way of creating and communicating economic knowledge. Softer, less codified knowledge about what is going on in firms, research organizations, government agencies, etc., is not considered important for the progress of economics and is not supported by the academic incentive system. As a result we are now in a situation where many economists can 'explain' much more than they know. Crucially important connections between different kinds of knowledge have been swept aside in a futile pursuit of codification based on exaggerated expectations of its benefits. The realm of tacit knowledge has been decreased and it is not obvious that it has been 'to good effect'.

Wittgenstein stated that you should not speak about the unspeakable[7] and a similar consideration might be called for in relation to codification. The intelligent use of science and technology depends in a crucial way on social interaction, and the skills in interacting with people are becoming increasingly important. Should such skills be codified to a much higher degree in order to increase economic efficiency? Some of the examples in the CDF paper actually seem to argue that this would be a good idea. The

[7]'Darüber man nicht sprechen kan darüber muss man zweigen.' Statement number seven in *Tractus Logicus Philosophicus.*

authors are calling for 'accurate descriptions of what agents are doing' and it is argued that firms can 'expect great benefits from codification' of organizational structures when it comes to using ICT efficiently.

We believe that there are aspects of human behaviour in the economic sector (quarrelling, flirting, telling stories and playing golf are among the daily activities of management) that would change their social and economic meaning were they transformed into explicit codes. The daily social interaction pattern may work well only as long as it remains implicit. To codify human relations may have a negative impact on their intrinsic value (and make life more boring). In a sense it is parallel to the observation that 'you cannot buy trust and, if you could, it would have no value whatsoever' (Arrow, 1971).

12. Codification and knowledge sharing

In the CDF paper codification is mainly seen as a process transforming knowledge into a format that makes it possible for knowledge to be stored and transferred as information. It is implicitly assumed that codification always involves a process that makes knowledge more accessible to a collectivity of agents. This might not always be the case, however. If you want to avoid others getting access to your personal email, you would typically group mails under misleading labels. Individuals may thus develop their own personal secret codes.[8] Furthermore, in radio and telecommunication, codes are often used for cryptograms.

Shared codes may also have as their aim to exclude others. A usual phenomenon among children is to develop their own artificial language that excludes adults from their secrets. Private organizations may develop internal codes to avoid competitors accessing their trade secrets. 'Economic intelligence' is a growing activity in the private and the public sector and a response in terms of establishing secret codes is to be expected. In fact, according to the *Oxford English Dictionary*, a code is 'a system of symbols used to represent assigned and often secret meanings'.

A more general phenomenon that is recognized in the CDF paper is that organizations and professional communities develop local codes that make communication more efficient but exclude outsiders from understanding what is going on—this is one side of 'epistemic communities'. Sometimes it may be quite difficult to distinguish between efficiency-driven codes and a lingo aiming at keeping customers, clients, patients and parishioners at arm's length (Catholic priests giving sermons in Latin illustrates the phenomenon). The point here is that it is necessary to analyse the impact of codification on public access to information from case to case rather than assuming that it always works in the direction of increased public access to knowledge.

[8]In doing so you would, of course, indirectly have to draw upon common language and codes but the intention and result of the codification would still be to exclude others from access.

In the paper, the focus seems to be on a specific kind of codification:

> Its obvious reference is to codes, or to standards—whether of notations or of rules, either of which may be promulgated by authority or may acquire authority through frequency of usage and common consent, that is by de facto acceptance. (p. 225)

This definition, with its emphasis on 'common consent' and 'acceptance', shifts the focus away from situations where the introduction of codes has as its major aim the exclusion of access to information.

13. Conclusions

There are many interesting observations in the paper by Cowan, David and Foray and many points of clarification are made in relation to dubious concepts popular among economists such as 'stocks of knowledge'. In addition we find the general thrust toward understanding the transformation of knowledge between different forms highly relevant. Our critical comments on the value premises for promoting codification should not be misunderstood. It is, for instance, obvious that processes of codification are at the very core of scientific progress, especially in the natural sciences.

We also recognize that codification initiatives in organizations and communities may be one way to trigger and stimulate processes of learning. One way to see this would be to describe a process where 'the displaced code-book' gets reconstructed and made explicit. This could start from a situation where the members of a firm may be able to talk about knowledge issues, but the models implicit in their daily talk are incomplete and the vocabulary is ambiguous. The process of trying to write down in a more precise matter what it is they know may then serve the useful function of making them aware of these flaws and limitations. It leads to a refinement of existing models and an improvement of existing vocabulary.

Another type of learning process, less locked into the codification discourse and trajectory, could be one where the collective reflection, explication and documentation of practises raises awareness of alternative ways of doing things and thereby contributes to institutional and organizational change. The first model might be most relevant in stable environments such as natural science where problems encountered may remain basically the same over extended periods of time. The second type of impact on learning would be much more relevant for knowledge management in business firms and especially for firms in turbulent environments.

We are critical to the proposed conceptual framework, however. Much of it appears to be little more than a sophisticated language game with limited practical implications. Taken at face value, the concept of the displaced code-book corresponds rather well to at least one aspect of what Polanyi intended by the tacit dimension of knowledge. It does not seem all that different from his example of the text of a manual for driving that has been shifted into the back of the mind of the experienced driver. The practical

implications of operating on the basis of codifiable knowledge with or without a displaced code-book are far from obvious. There is nothing to say that it is necessarily easier to codify because there was once a manual.

Similarly, many of the policy arguments based on the 'stickiness' of knowledge that CDF are highly critical of in their introduction could be resuscitated based on the notions of the code-book and epistemic communities. The authors observe that the specialized knowledge needed to read a (displaced) code-book may include 'knowledge not written down anywhere' (p. 225). In such circumstance one would suppose that the only way to acquire the necessary knowledge is by becoming a member of the relevant epistemic community. Yet these communities, in the authors' words, 'may be small working groups . . . who are engaged on a mutually recognized subset of questions' (p. 234). The argument raises important policy issues around the conditions of access to and membership in such communities, issues that unfortunately are not taken up in the paper. Yet one can easily see how the tacitness of the knowledge needed to 'read' the displaced code-book implies some stickiness in knowledge flows.

The new definitions do not in any fundamental way change how to understand the reality of learning and knowledge. Furthermore, in the future there will be a need to prepare students for lifelong learning based on social interaction. There will also be a need for face-to-face interaction among scientists and between academic experts and experts in private firms. Corporations will need to manage both the tacit skills of their employees and their use of intellectual property rights. Developing countries will need to have direct access to expertise, and it is not correct when the World Development Report from 1998/99 starts with the following promising words: 'Knowledge is like light. Weightless and intangible, it can easily travel the world, enlightening the lives of people everywhere. Yet billions of people still live in the darkness of poverty—unnecessarily.' Learning remains an interactive and social process and it is something rather different from a transfer of codified knowledge.

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