From Business Modeling Based on the Semantics of Contracts to Knowledge Modeling and Management

Pierre Lévine **and** **Jean-Charles Pomerol**

LPAC, 120 Avenue Charles de Gaulle, 92200 Neuilly/Seine, France

LIP6 Laboratory, case 169, Université Pierre et Marie Curie, 4 Place Jussieu, 75 252 PARIS 5, France.
Jean-Charles.Pomerol@lip6.fr

Abstract

We argue that knowledge management cannot be separated from firm modeling. We, therefore start from a firm modeling methodology hereafter called "Approach Based on Contract" (ABC). In the method ABC, the contract (explicit or implicit) between a firm and its clients is the first step of the modeling. This contract is progressively refined in an interactive top down and bottom up approach in which each design team (DT) enters a sub-contracting process with the others DTs involved in same business process. The sub-contractualisation and its parallel design process stop when the model resulting of the lowest DT groups is so simple that it can be operationalized.

We then discuss the interest and consequence of our approach on knowledge modeling, knowledge management, on the hierarchy of the firm and on manpower management.

1. Introduction

Since the work of Henri Fayol and Frédéric Taylor, much effort has been devoted to understanding the relations between knowledge and how businesses function, yet few overall methodologies have emerged. Attempts at modeling certainly go back a long way, but ideas and methods have taken a long time to surface. Bertalanffy's theory of systems and Wiener's cybernetic approach count among the first sources of inspiration for modeling a business. Since the nineteen seventies, the computer specialists have taken over the job, the design of software requiring a highly formalized approach. This has brought with it a profusion of methods from MERISE to object methods such as UML [7, 17].

Alongside this essentially 'engineering' approach, some economists and sociologists highlight the economic and human aspects of a business. The 'humanist' business and work as a social bond, all these questions have reawakened the interest of many authors in the service industries and in client relations [9, 11]. In the same vein, some authors stress the social and collective components of knowledge emergence and learning within working communities [3, 4, 31]. This is generally referred under the name of "communities of practice".

What, on the other hand, appears more relevant to us is another movement, one which tends to turn all types of social exchange, particularly economic exchange, into contracts. By the end of the nineteenth century, both the lawyer Henry Maine [20] and the sociologist Emile Durkheim had become highly aware of this seemingly irreversible historical tendency, the logical conclusion of which has been the reign of the American lawyer. This idea of considering transactions leads to new analyses of the firms [5, 32, 34] and on to the model of a firm as a node of contracts [15].

Starting from this idea of contract, which none – service providers, producers, beneficiaries, clients – can escape from, we will show how this contractualization of relations leads to a structured model that makes it easier to analyze how businesses work and how knowledge is managed. Fusing the notion of contract with the various 'engineering' and sociological approaches will lead us to a methodology that allows us to construct models and information systems which are easy to evaluate, to maintain and to renew. This structuring, based on the idea of the contract, affords an overall framework for business modeling and conception. We have given the methodology the name ABC, for **A**pproach **B**ased on **C**ontract.

Business modeling is in fact inseparable from knowledge modeling, because a model is a representation of the explicit knowledge of the firm. However, to get a

true overall view of knowledge modeling it is important to realize that a lot of the knowledge in question remains unexpressed. The personnel in the company carry around that part of knowledge not contained in the model, and in the control and expression of this knowledge, power is clearly involved [6]. But so is knowledge modeling and management, and this fact has to be understood and included in any method concerning it. We believe that modeling by contracts has three advantages: 1) it allows to make it an explicit the links between business units and facilitate the coordination between them; 2) the modeling process can be progressive and interactive involving the designers as well as the field workers and as such it increases the commitment of people; 3) it facilitates the adaptation of the different business processes.

Coming back to models, we should point out that, most existing methods actually lean toward traditional and electronic document management. Though we would not underestimate the importance of the latter problem, we shall in this paper be concentrating on knowledge modeling and management based on models. Thus, we begin here by establishing the general framework for modeling a business, based on the contract (section 2), and then go on to describe how contract-based modeling is carried out (section 3). Finally we go into the various aspects of modeling, management and of knowledge updating within the ABC method.

2. The P-relation: service provision/ production

At an overall level we can consider any economic relation as an exchange between a service provider and the beneficiary of that service. In certain cases we think in terms of service relations while in others, rather in terms of industrial production. It is sometimes useful to distinguish between the client who choose a service provider and a beneficiary who, as the name indicates, benefits from the service. It is generally the client who pays, although we cannot rule out the possibility in certain cases that a third party who is neither the client nor the beneficiary may pay the service provider. The exchange is material or immaterial whether we consider a service or a product, the differences between the two being more and more tenuous and blurred or even artificial [14]. The main point to grasp is that a **supply relationship** is established, and we propose to call this relationship the **P-relation**. The general situation is shown in figure 1.

In analyzing this P-relation, we shall adopt the provider's point of view. We could equally well have chosen the beneficiary's/client's (BC) point of view. However, we should note that the economic relation in figure 1 is not symmetrical and it does not have the same properties or meaning seen from P as it does seen from BC. Seen from P, the management of numerous relations with several beneficiaries/clients is involved, whereas seen from BC, there is generally only one relation. Then, more importantly perhaps, from P, the nature of the contracts involves responsibility and action since P is making the offer, while BC as the receiver is generally more passive and defensive. As it is almost always companies who are the providers we shall adopt the provider's point of view in all that follows; this is why we introduced the term P-relation. But although we adopt the provider's point of view we should not forget that it is the client who is at the center of the relation. This is a central point and all of the following analyses originate from the position of the client and are directed at the quality of the P-relation as perceived by the client. In [22] a similar approach is adopted for modeling *'workflows'*.

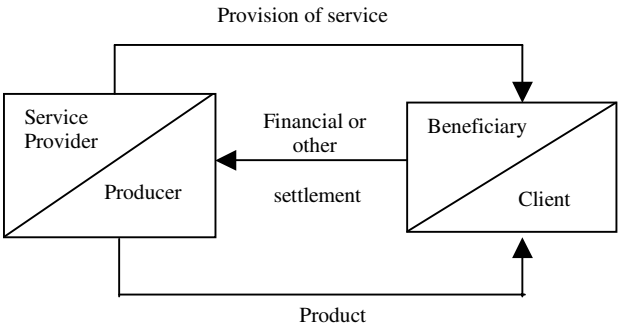

Figure 1. General economic relationship

This P-relation is complex and may be analyzed according to several points of view that we have studied elsewhere [19]. Suffice it to say that it has to be studied in terms of its components in time, in terms of the complexity of the process or facilities for the production and in terms of its distribution in space. In traditional production industries it is these components that are the most important. In addition, there is the uncertainty in the producer-client relation, the diversity among clients and the complexity of human relations, these three components being primordial in the services (figure 2).

The analysis along these components nevertheless remains in the form of general recommendations as long as no attempt is made to identify the P-relation more analytically. Now, within the business, the P-relation(s) is/are (or should be) more or less fixed through the contracts. We shall denote **as P-contract** the implicit and/or explicit contract representing the P-relation. We include the implicit contract because in most cases the explicit (the legal one) contract with the client only represents a small part of the whole contract, many of whose components are in fact implicit as was stressed in

the "transaction cost" analyses [5, 32, 33]. It is this P-contract that we now go on to look at in detail and to use as the guideline in our design method.

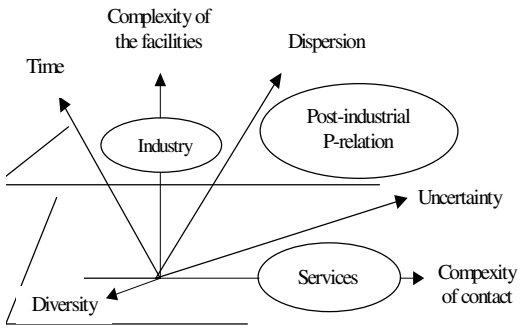

Figure 2 Analysis of the P-relation in six dimensions.

3. The P-contract: modeling and conception

3.1 General modeling principles

In our approach, the P-contract models the P-relation, indicating both the commitments of the service provider and what the beneficiary/client has to do. In principle it is the client who designates the beneficiary and who approves the financial arrangements in the P-contract, *i.e.* who agrees to pay, how much and when. Of course the baker and the physician do not sign contracts with their clients but they implicitly commit themselves to supplying either bread or a medical act having certain qualities (obligation of result or of means), in exchange for which the client pays a sum of money. Although the quality of the baker's bread is no less certain than that of the medical act, the existence of material goods (a loaf of bread in this case) that lends substance to the relation and bestows on it a certain existence in time, is reassuring to the client and lessens the weight of the contractual aspect; in this way many contracts are not personalized and obey general legal rules. Similarly in a firm the cost would be prohibitive to legalize all the exchanges and transactions [5]. On the other hand, the non-material nature of exchanges involved in firms or in 'service' or advisory type P-relations often leads to contractual and legal problems.

The P-contract must be treated as an overall framework within which the P-relation is modeled. For example, in an insurance company where the general P-contract is life insurance, modeling will center firstly on what is common to all life assurance contracts. This high level modeling will then be progressively refined to make apparent the demand for various types of contracts designed for each sector of the market. This top down specification will be subject to sub-contracts, as we shall explain.

Besides the first axis extending from the general to the specific, we also have to consider the time dimension of contracts, the P-contract describing as it does the P relation along its entire lifetime (complexity in time). Even in the case of the virtually instantaneous sale of a finished product, the producer has to manage investments for its facilities, stocks etc., in time. The P-relation therefore exists in time and we then have a **life cycle** of the P-relation. This life cycle recurs in the P-contract. In figure 3 we represent the life cycle of the P-contract on a time axis.

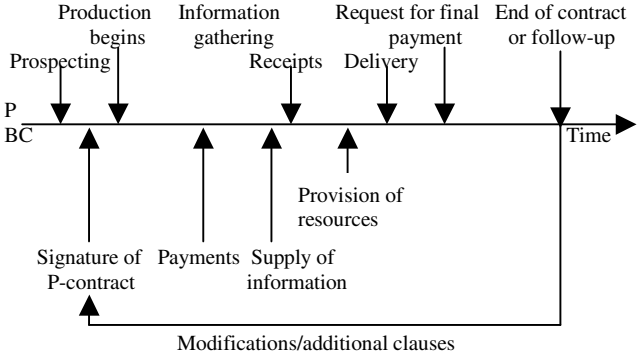

Figure 3 Life cycle of the P-contract

We have included several actions on the part of the producer/provider (P) above the time line and several of the beneficiary/client (BC) below. In addition to these actions, we also have to consider events (in the theoretical sense of decision theory), i.e. unpredictable events that neither P nor BC control, such as a claim in the case of insurance. In what follows we abandon the traditional formalism in decision theory and refer both to unpredictable events and to the actions of BC and P simply as **events**. Every event concerning the P-contract obeys rules which must be mentioned in the contract. In designing the P-contract the first job is therefore to identify all the events that modify what we shall name **the state of the P-relation**. As in the theory of dynamic systems, we call the state of the P-relation the set of all elements describing that relation at a given time in its life cycle (the current state). For example, in a health insurance contract, we have the following simplified and partial table (Table 1). A state corresponds to the state of the relation, essentially a state of one of the main protagonists in the relation. To each state of these persons there will correspond attributes describing the state. These attributes are not detailed in table 1; for example the state of 'subscriber' corresponds to the filling out by the interested party of a request for subscription and its record in a given file.

Actions	States
1 • Signature of the P-contract	• BC becomes a subscriber
2 • BC pays the agreed sum	• BC file is classed in the 'state' of paid-up subscriber
3 • Sickness (possible event) and sending of certificate from BC to P	• BC is classed as a subscriber to be reimbursed
4 • Reimbursement by P	• The 'state' of BC is updated to that of subscriber who has been reimbursed
5 • Canceling of contract	• BC is classed as a former subscriber

Table 1 States in health insurance of current subscribers

As we have already noted, our model has as its starting point the high-level P-contract that defines the P-relation between the service provider and the beneficiary/client. At this level we have a clear view of the P-relation and the needs of clients. When the P-contract is actually applied, however, we clearly have to pass down through several levels to reach the operational level. The initial high-level P-contract forms the contractual core ('**P-contract core**') which is progressively fleshed out by a process of top down and bottom up analysis which we will describe.

The ABC methodology aims not only to model a business according to the P-contract but also to explain how the corresponding modeling can be applied to design and to the management of design teams and subsequently operationally managed (the aspects of control and maintenance of the models of the firm). We shall therefore distinguish all those activities that are to do with design and modeling from those to do with production/service provision. Modeling is handled by working groups that we shall name **'design teams'** or DT. Production/service provision, on the other hand, will be designated by the general term **operational processing** (OP); this can involve production, service, internal equipment and information processing. This difference, at a given time, between DT and OP people is not definitive and, according to the circumstances, people can belong to one or another structure as we will see, unless some mixed time are set up.

Modeling begins with the 'core P-contract' linking P and BC as the starting point. This contractual core gives rise to sub-contracts which in turn can generate sub-sub-contracts (we shall restrict ourselves to the term sub-contract). Every sub-contract represents a specialization and refinement of the next higher-level contract. In general, as we descend the sub-contract tree-diagram we encounter more and more highly specific categories of clientele.

Each contractual level in the contract refinement tree diagram is handled by a design team (DT). Thus the first DT, say DT_0, working at the strategic level, models the core P-contract which he then breaks down into sub-contracts. Each sub-contract will be handed to a DT_i (figure 4). Modeling at a given level can reveal gaps, lack of details or incoherence originating at a higher level. There is then dialog between the DTs at the various levels including operational workers (figure 4).

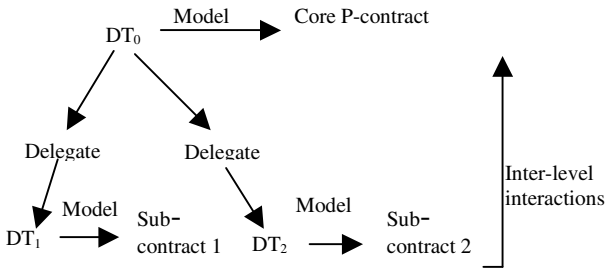

Figure 4 Contract-DT dialogue

As far as knowledge modeling is concerned, it is as if each DT partitions off that part of the contract for which he is responsible. This partitioning takes the form of **sub-contracts** whose meaning must remain intelligible within the overall context of the P-contract linking BC and P. The sub-contract process stops when further partitioning would be irrelevant within the contract. What each DT produces is a **design model** or DM. As quote by Hammer [12]: 'links between sub-processes are essential'.

Although we have already applied our method to various business in health services, public services and software companies, let us merely give a didactic example of the breaking down of a contract for health insurance. In figure 5 we show the DTs that stem directly from the breaking down into sub-contracts. Design teams DT_2 and DT_3 have each decided that the job of setting up the task that has been delegated to each of them can be separated and given to two new design teams for whom they take responsibility: DT_{21}, DT_{22}, DT_{31} and DT_{32}. Through their mother-DT, the latter are directly linked to the contract with the client by the chain of tasks involved in implementing the contract (figure 5).

The advantage of breaking down the design work into DTs is that this confers the responsibility for decisions on experts with a high level of competence and experience of the sub-contracts to be modeled. This experience enables them to take into account the relevant variables to the required degree of detail, without straying on to other levels, and guided throughout by the P-contract. With their knowledge of the tasks they are modeling, the DTs can compare different scenarios and choose the most satisfying one within the prevailing constraints.

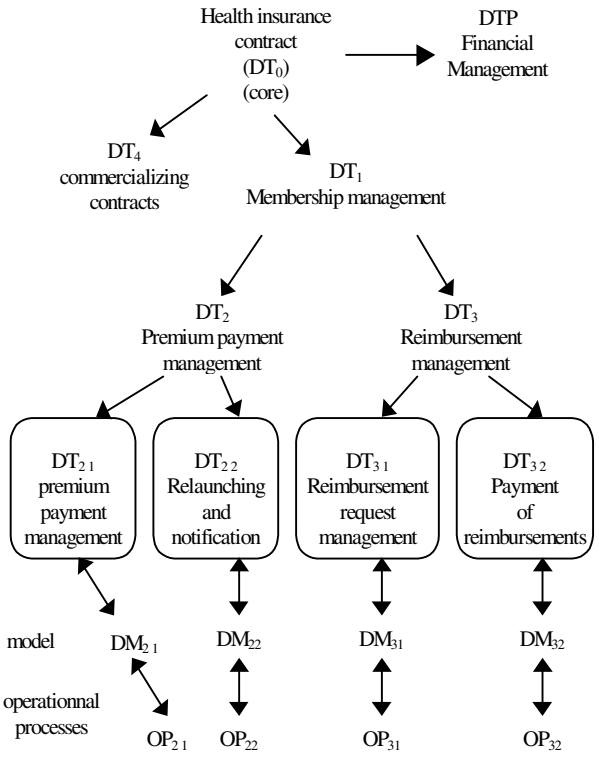

Figure 5. Some of the design teams and models in complementary health insurance

The DTs actually make up the backbone or framework of the organization. Relations between the DTs are made intelligible by the underlying contractual relations. In the low level DTs, the models form procedures that can become operational; at this level the model will be sufficiently detailed. In the case of a computer or automate, the lowest-level model is precisely the computer model that will be coded by a programmer. The job described by this model, whether it be executed by machine or human operator, corresponds to the general term **operational process** (OP) introduced above. Modeling and design (the DTs) should not be confused with the OPs that actually execute the jobs. Clearly, when modeling is sufficiently detailed for the person or program charged with executing the job to be able to do it without needing any other instructions than those in the model, the modeling stops and the job can begin by following the model exactly. Thus, each basic design model in the design tree diagram is reflected by an actual operational process (OP). Note however that DTs that are not situated at the end of a branch of the design tree may also contain parts of the model simple enough to lead to intermediate human or machine jobs. In other words, OPs can be attached to DTs at any level in the DT tree. We could say that 'leaf' DT models correspond to OPs but that the OPs can be attached to intermediate DTs. In every case, the OPs are linked to the P-contract through the modeling. One of the advantages of this approach is that there are direct links through the DTs from contractualization to OPs. This does not *per se* resolve the struggle and tensions between groups but it tends to facilitate resolution by expressing them.

In some cases a different design logic to the breaking down of the core P-contract into sub-contracts has to be used. There are two scenarios for this: when the means of production are to be improved or when design teams charged with transverse contractual functions (or involved in several hierarchical levels in the core P-contract breakdown) are to be created. We shall name 'DTP' for **D**esign **T**eam for better **P**rocessing those design teams who improve efficiency (in the economic sense) of the production process but who are not strictly necessary within the terms of the contract. For example, in the case of health insurance, design team DT_0 who creates design teams DT_i (i = 1, …, 4) also has to launch a DTP for the financial management of individual premium payments (including investments). The client does not care what the insurance company does with the premiums they receive, whereas to the insurer it is vital to make good investments if they are to be able to satisfy claims (figure 5). Another example of such a transverse function is given by human resources management.

Thanks to our descendent modeling, the links between the OP and the P-contract are explicit which paves the way to a better taking into account of the transaction [5]. Each OP functions, or should function, according to the models contained within the lowest-level DTs (figure 6). We give the name **contractual chain** to the chain that begins from the P-contract and ends up at an OP or more generally any DT. If we set out the contractual chains, we obtain a diagram of the exchanges between OPs. Thus in figure 6 the exchanges between OP_{j1} and OP_{k3} require knowledge of the sub-tree with root DT_i. This notion of 'required knowledge' is very important in constructing the system for business knowledge management because it makes it possible to explain to those involved their place in the production process and the purpose of the actions they undertake. The value of the idea of 'required knowledge' has already been pointed out by decision theory specialists, under the name 'requisite decision models' [26].

Modeling through the DTs can result in more than one way of organizing the work. To illustrate this idea, consider again health insurance (figure 5). Taking the example of communication in the case of non-payment of premium, this could equally well come from DT_0, since it may be regarded as a basic client relation, as it could from DT_2 if it is seen as a question of administrative management of premium payments. In many cases there are therefore choices to be made in terms of image and of

relations with the beneficiary, the effect of which on the complexity of the contract deserves some thought. Numerous options have to be raised. Once these choices of modeling are being made, contractual chain diagrams allow the exchanges of information and knowledge between the OPs to be made explicit.

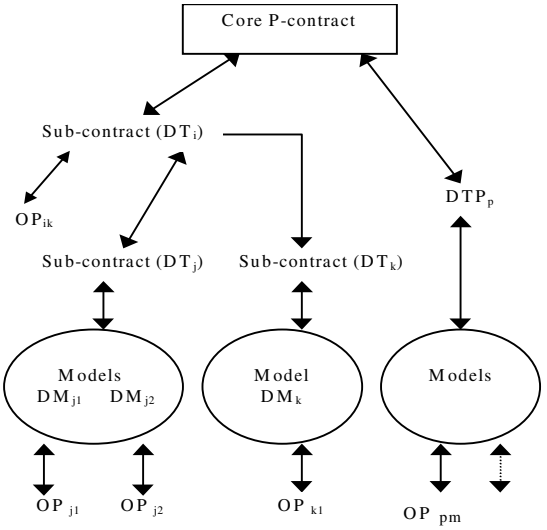

Figure 6. Three contractual chains

To carry out the modeling task, we have designed some representation tools (schemas) that fit to the logic of contract [19].

4. Application of the ABC method to knowledge modeling and management

4.1 The knowledge life cycle

There are numerous reasons for the existence of a very strong link between knowledge modeling and business modeling, as agreed today by many specialists in knowledge management (*e.g.* [10, 27]). The links have also been pointed out between knowledge management and knowledge sharing [7], as too has the importance of problems of knowledge updating [2] and of the social components of knowledge creation [24]. Our view is that all these questions related to capitalization, knowledge updating and the associated tools form part of the management of the models since the models, as we said in the introduction, form the explicit part of the knowledge base of the business. We shall now examine how model management and knowledge modeling and management merge in a global and dynamic vision of capitalization, exploitation and maintenance of knowledge.

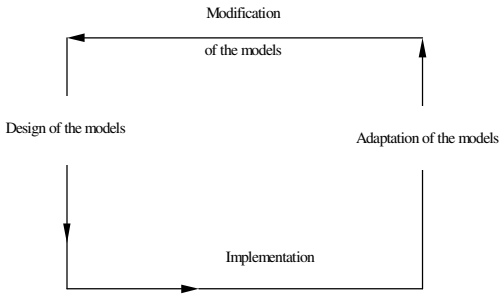

Figure 7. The various phases of model management

By following the natural order in the life of models, we can distinguish three important functions: *the design of the models, then their implementation and finally, adapting the models to deal with modifications to the external environment of the business and with internal problem as such resulting from discrepancies between practice and models*. To each of the three branches of the cycle in figure 7 there correspond activities related to the models and therefore to the knowledge management that we now return to.

We start with the **design of the models**, which is the first phase in setting out the knowledge of the business. When a DT assigns the job of modeling to a DT$_i$ (see figures 4 and 5), he will set out a certain number of methods and principles that he wants DT$_i$ to use. In the language of artificial intelligence, DT possesses **metaknowledge** that enables the DT$_i$ to set out their own knowledge. Metaknowledge thus consists of knowledge transmitted from level n to level n+1 so that n+1 can make his model. After the metaknowledge has been transmitted, DT must check that the resulting modeling fulfils security standards, risk prevention procedures (both financial and physical)[1], client quality requirements, is adapted to workforce skills and that the validity limits of the model have been set out. This checking is very important since we know that there are several ways of modeling the operations. The checks will in particular verify quality and security and will ensure that redundancies and tests at carefully chosen points and times in the production process, together with incentives to respect standards and to satisfy clients, have been provided. For example, feedback such as client satisfaction questionnaires, or security bonuses could be introduced. The quality control of a model brings a critical judgement to the quality of the model and is therefore a type of 'metamodeling'; this is a very important part of knowledge management in a business.

[1] These checks are generally all gathered under the name 'internal controls'

The design of models is also concerned with the efficiency of the model through which the P-contract is implemented. One of the great spin-offs of older organizations is the accumulation of more or less necessary tasks whose utility is no longer apparent. Chains of sub-contracts enable this process to be checked. Each DT must set out these exchanges with the other DTs and show their relevance within the P-contract ('requisite modeling'). This facilitates the economic analysis of the process by making it possible to introduce the transaction costs [5, 32]. Moreover, contractual representation makes it easier to carry out tests and functional simulations to check that in each DT:

- all the information and know-how required for the sub-contract in question are available in one of the sub-contracts either already modeled or to be modeled (integration test)
- each output corresponds to an actual BC requirement or that of another DT within the contract
- each occurrence of an event or a BC intervention triggers a suitable reaction.

We now come to the second of the branches in figure 7, involving the way in which the knowledge is put to use, i.e. '**implementation**'. The role of the DTs is, as we have seen, to use successive refinements to construct a model of the operations that each OP has to carry out. The actions of the OPs are monitored by checking that the production or service operations actually obey the said OP model. As we have just seen in the case of quality control of the models, questions of quality and safety are among the concerns of the design teams. The hierarchy involved in the monitoring of the implementation is often merged with the operational hierarchy involved in manufacture and representing the traditional business hierarchy. Thus we cannot avoid the question of the role of the hierarchy in the business and its evolution, which we shall examine in the next section.

By monitoring the implementation we check that the operations are carried out in conformity with the models. This can result in the appearance of discrepancies leading on to two types of remedial action belonging to the third branch in our scheme, *viz.* **model adaptation**. If on the one hand the models seem to be suitable the operations will be modified, for example by setting up adapted training procedures for personnel, or by introducing incentives. From this point of view, adapting the models involves questions of personnel management. On the other hand, when ideas and practices emerging from ‘communities of practice” [3, 31] are suitable, we enter into a phase of new knowledge production since in our approach the knowledge used by the POs must be modeled by a DT, even if it remains a non-automated task. It may be that people in the company have developed satisfactory operating methods that have never been modeled. This difference between a model and an operating method is frequently mentioned in the context of the sociology of work [3, 23]. This discrepancy between what is prescribed (i.e. our 'model') and the actual way of doing things should not necessarily be reduced by a return to the model, but it must be identified for evaluation purposes. The phase of model adaptation is triggered by the task of implementation monitoring. Here is where we have to think about the value of any modifications introduced by the operators. Here too we must be able to make decisions on the non-modeled knowledge of the operators (see section 4.3). Finally, the proposed adaptation must be integrated within the models by the design team, branch 1 in our scheme, and the loop is then closed.

The role of operators in innovation in Japan has received a lot of media attention and some academic work [24], the DT organization that we suggest provides a structure that helps to understand and exploit these root initiatives. This bottom up process is one of the sources of the 'contract innovation'. The other sources of innovation flow in the opposite direction, from the client or from the environment; some innovations are triggered by client demand and have to be processed in top down fashion by the DTs within the contract; other innovations stem from environmental pressures and from imitation of competitors. These too will be controlled by the DTs, the difference between them and innovations linked to the contract or the client being that certain of the former may remain local within the DT.

It can also happen that after analysis of information on the validity of a model that a DT is responsible for, it transpires that the model no longer fits the situation or presents deficiencies. In this case, which corresponds to the classical notion of monitoring, the DTs must modify their model. The method usually used to locate dis-functioning in models is through permanent monitoring of certain parameters, and it is the role of data storage and computer decision support systems (see 4.3) to enable modifications of parameters to be observed and to facilitate their control. Thus our methodology enables several types of process management to be distinguished and to be inter-related. The quality control of models, of operations and the adaptation of the models are inseparable processes that feed into each other within the process of knowledge modeling and management.

4.2 A variety of hierarchies within the firms?

Suppose the models designed by the DTs actually exist, so that the DTs have more or less finished their initial task. At this time, their work diversifies, some of the members of the DT assuming the tasks of monitoring the quality of the models, others dealing with

implementation. The corresponding hierarchy is divided between operational hierarchy, coordinating and organizing the actual operations (OP), and implementation control as we have seen. We can observe that at the present time the organizations of the two tasks are in practice merged; this is wrong, and in fact the implementation control is not in general sufficiently identified.

Furthermore, the quality control of models which, as we have seen, ensures the quality, follow-up and 'maintenance' of the models, very often plays a considerable role in modern businesses. For certain DTs facing highly evolving environments or a rapid pace of technological or contractual innovation, it is vital that they keep up their activity and not disappear completely in implementation monitoring. The personnel who remain in DTs will play a 'surveillance' role of 'economic intelligence' and knowledge manager so as to be able to adapt the models swiftly as the need arises. The perpetuation of DTs for knowledge management and quality control of models engenders a *de facto* hierarchy within the business; there comes about a sort of design hierarchy that has two aspects: management monitoring, which exists in most companies, and quality control which very often remains to be constructed. This hierarchy which is very close to the modeling and design of the business, carries with it the values of quality, safety and innovation. After having been involved in the modeling, this hierarchy crosses straight over into the monitoring tasks as we have described. Some supernumerary members of the DTs will join the OPs that were at the ends of the contractual chains to which their DT belonged or become involved in the implementation control. In particular, one of the advantages of the shift from designer to executive staff is that the latter will then have an intimate knowledge of the models for whose correct operating they are responsible. Furthermore, it is desirable that passing from one hierarchy to another be a two-way process. The resulting dialog between operational hierarchy and design hierarchy is, in our opinion, central to the improvement of the models and process innovations.

It is also of interest to note that our approach allows an interpretation of the phenomenon of the shrinking of production hierarchies. This phenomenon, which has been observed for the last decade, has not up to now received a convincing explanation [28]. In particular, the role of new technologies is not clear. Our explanation relies rather on the idea of progress in business modeling and a greater structuring of tasks; responsibility for, and implementation of the production model of each OP can be at 'ground level' since relatively elementary procedures will be clearly set out in the model and there is hardly any need for an operational hierarchy to coordinate them and have them carried out, see also [21]. When knowledge is well modeled and adequately related to human knowledge, it is easier to recruit the personnel suitable for a given job, and this fact will further weaken the operational hierarchy. We are witnessing a sea change in the profession of executive, which is shifting from the management of the operations themselves to design, modeling and innovation. The qualities required – such as imagination rather than authority – are not the same and the change from one kind of world to the other is likely to pose problems for companies who do not have the necessary concepts to instigate and follow through this mutation.

Related to these ideas are certain management experiments receiving a lot of attention at the moment that owe their success to 'management by project' which is not far from the idea of self-organization [4, 24, 31]. This type of management relies on a 'project team' being responsible for the totality of activities, from client relations to fabrication and delivery. The term 'project management' is actually ambiguous since many authors confuse the steps of initial conception and setting up of the project, which corresponds to the hierarchy of our DTs, with the projection on to the operational level (our OPs). As we have just pointed out, this 'projection' can also occur within the ABC methodology once the initial modeling phase has been accomplished. One of the features of management by project is the absence of any long-standing executive functions: a given individual may be the driving force behind one project yet have few responsibilities in a subsequent one [8]. The hierarchy lasts no longer than the project. This type of management is supposed to be much more reactive and motivating than traditional management. Within the ABC methodology, the notion of management by project corresponds naturally to the entrusting of a sub-contract to the DTs right up to operational level (OP). It is then hardly surprising that the two approaches have numerous points in common, especially those concerning the executive's role. Prior modeling allows increased autonomy of implementation and flattening out of the implementation hierarchy. The advantage from a contract point of view is that this gives a precise meaning to the notion of project.

4.3 Articulation between human knowledge and coded knowledge

In all of the functions and means in a business, there is manipulation of information, knowledge and often, metaknowledge. We should however distinguish automatons or completely programmed devices from the rest. We consider that the programmed functions, whether they use computers or any other physical device, are production means. Consider on the other hand those functions that assume human intervention. They are of

two types, those related to the OPs and those related to the models. The relations between humans and systems are surfaces of adjustment or degrees of freedom for the organization, for both production and modeling. We shall meet this dichotomy again in the next part of the section. *These degrees of freedom always imply a decision and a responsibility on the part of the human concerned*. These two inseparable notions are fundamental. They have to be understood because they are basic to the success of all organizations. Thus unlike many computer professionals, we do not evade that other knowledge management method that we referred to in the introduction: we mean the knowledge contained in the minds of the personnel in the business. In other words, to use the expression of Hansen *et al*. [13], we have a choice between managing knowledge by coding or by personalization. Actually the one does not exclude the other and we side with Abecker *et al*. [1] in considering that a cohabitation of the two modes is necessary.

The fundamental distinction between knowledge linked to the OPs and knowledge linked to the DTs is a result of the dual function of any business: on the one hand, the production of the goods and/or services according to contract and, on the other hand, its permanent adaptation to modifications in the environment which we denote by the generic term **adaptation**. Each of these two functions is based on information processing but leads to two types of means of different natures. The function of production comes under the operational means and is part of the operating system. Adaptation to the environment, on the other hand, concerns the design of models and what we have named the quality control of the models associated with Decision Support Systems (DSS).

We have seen that the OPs represent the operational implementation of the lowest degree of modeling. However, even at this level, the operator still the responsibility of his/her work: he/she takes operational decisions. It is necessary to be aware of the field of freedom left to each participant and to model it well, firstly because this is an important part of the personalization of the service and secondly because we have to know whereabouts implementation monitoring must be carried out to maintain the quality of production or of service. The second level at which freedom is exercised is with the metaknowledge relating to the design and monitoring of the models. As we have just indicated, in the case of models, it is a question of permanent adaptation for organizations. In fact, right from conception, modeling and decision cannot be separated inasmuch as all modeling is a choice: there are many degrees of freedom at this level. The computer aid for adaptation is that of decision support systems or Executive Information Systems (EIS). These computer systems, involving models, are of a different nature from computer production systems. This use of computer aid for the adaptation and monitoring of models has cropped up in various forms in the literature: strategic decision support [30] and DSSs [16, 18, 29]. But in any case, DSSs are concerned with choice or decision in which the models to be applied are incomplete and the human role is fundamental. Seen alongside the ABC methodology, the interpretation of the DSSs as support systems for model management [18, 29] makes complete sense. Similarly, the EIS and other more recent tools for on-line analysis (OLAP) and data mining, are becoming the preferred way of monitoring the models through their ability to locate discrepancies between the model and the current environment.

At the present time many ideas are appearing about the cooperating business or the networking business (*e.g*. [25]), because it is a dual cooperation-complementarity that business needs: cooperation between coded knowledge (shared) and personal knowledge, and also inter-personal knowledge. The ABC methodology offers a framework for these cooperation, since the contractual chains that contain the whole of the coded knowledge validated for use in them at the right level and at the right time, enable the coded knowledge to be shared between the operatives and furthermore facilitates and gives a framework non-coded knowledge exchange and sharing through the DT dialog. On the other hand, setting out of the field and *modus operandi* in the OPs defines the margin of freedom left to that personal initiative which is vital to 'personalization' (especially in services). Through the modeling and monitoring of the models there can be a structured design/implementation dialog with the adaptation of the models in view. Finally, note that the distinction between coded and personal knowledge is re-evaluated in permanence within the life cycle of model management through their monitoring.

5. Conclusion

Very few authors have managed to link knowledge management, business modeling and decision. Many have restricted knowledge management simply to document management. To get beyond this we propose relating knowledge management to the global modeling of a business. We model a business using the contract to guide our way; this offers the advantage of starting off from the position of the client and of having a beneficial knock-on effect on the whole business. The extra originality of our approach is, through the notion of the P-contract, to provide a support that is both conceptual and implementable within modeling. Our modeling enables us to construct a global, modular and coherent model of a business. The unified view of the business based on the contract as the key design factor of operational exchanges

is a powerful tool for the systematic modeling of the firm, enabling the complexity of the relations and the process to be mastered with the satisfaction of the client constantly in mind. The modeling method based on design teams and the contract is dynamic and easy to use; it shows up choices that are often implicit and thus leads to a strategic overall reflection on the business activity.

The life cycle of knowledge modeling and management and the organization of the monitoring of the models provides numerous prospects both for innovation and decision support. In particular, the creation of a design and model implementation hierarchy in a business enables both explicit knowledge and metaknowledge to be capitalized and managed. Because it does not reduce modeling to a mere computerizing of knowledge, but takes into account personal knowledge, the ABC methodology does not stifle the initiative and adaptability of the personnel; on the contrary, it inventories the degrees of freedom, frees initiatives through the notion of responsibility included in the contract and allows the initiative to be shared through the DTs. Thus the modeling of coded knowledge links up naturally with human resource management, which is also an essential aspect of the knowledge management in a firm.

References

[1] **Abecker A., Bernardi A., Hinkelmann K., Sintek M**., "Toward a Technology for Organizational Memories", *IEEE Intelligent Systems 19 n°2*, 1998, pp. 40-48.

[2] **Barthelemé F., Ermine J.-L., Rosenthal-Sabroux C**., "An architecture for knowledge evolution in organisations", *European Journal of Operational Research 109*, 1998, 414-427.

[3] **Brown J.S. and Duguid P.**, Organizational learning and communities of practice : towards a unified view of working, learning and and organization, *Organization Science 2 (1)*, 1991, 40-57.

[4] **Brown J.S. and Duguid P.,** *The social life of information*, Harvard Business School Press, 2000.

[5] **Coase R**., *The Firm, the Market and the Law*, Chicago University Press, London, 1988.

[6] **Crozier M. and Friedberg E**., *L'acteur et le Système*, Editions du Seuil, Paris, 1977.

[7] **Ermine J.-L**., *Les systèmes de connaissan*ces, Hermès, Paris, 1996.

[8] **Eustache D. et Jolivet T**., "Créer des produits et inventer des règles, la nouvelle G.R.H. d'une entreprise d'assurance", *Gérer et Comprendre n° 58*, 1999, 13-23.

[9] **de Foucauld J.-B. et Piveteau J**., *Une société en quête de sens,* Éditions Odile Jacob, 1995.

[10] **Fox M.S., Gruninger M**., "Entreprise Modeling", *Artificial Intelligence Magazine 19 n°4,* 1998, 109-121.

[11] **Gadrey J.,** *L'économie des services*, Editions La Découverte, 1992.

[12] **Hammer M.**, Process makes practice better, CIO Magazine 1, 2000, http://www.cio.com.

[13] **Hansen M.T., Nohria N. et Tierney T**., "What's your strategy for managing knowledge ? ", *Havard Business Review*, March-April 1999, 106-116.

[14] **Hatchuel A**., "Modèles de service et activité industrielle : la place de la prescription", in *Relations de Service, marchés de services*, De Bandt J. et Gadrey J. Eds., 1994, CNRS, 63-84.

[15] **Jensen M. C. et Meckling W. H**., "Theory of the firm : managerial behavior, agency costs and ownership structure", *Journal of Financial Economics, 3*, 1976, pp. 305-360.

[16] **Keen P. G. W. and Scott Morton M. S***., Decision Support Systems*, Addison Wesley, Reading, 1978.

[17] **Kettani N., Mignet D., Paré P. et Rosenthal-Sabroux C**., *De Merise à UML*, Eyrolles, Paris, 1998.

[18] **Lévine P. et Pomerol J.-Ch**., *Systèmes Interactifs d'Aide à la Décision et Systèmes Experts*, Hermès, Paris, 1989.

[19] **Lévine P. et Pomerol J.-Ch.,** Pour une stratégie globale de conception de l'entreprise : l'approche basée sur le contrat (ABC), Working Paper, 1999.

[20] **Maine H. S**., *Ancient Law*, Londres, 1861.

[21] **March J.G**., Mundane Organizations and Heroic Leaders, in *Seminarios Sobre Administracion Universitaria*, Mayhew L. B. and Leon-Garcia F. Eds., Mexicali, 1988.

[22] **Medina-Mora R., Winograd T., Flores R. et Flores F**., "The Action Workflow Approach to Workflow Management Technology", *The Information Society, 9*, 1996, 391-404.

[23] **de Montmollin M**., "What is intention ?" in *Intentions in communications,* P.R. Cohen, J. L. Morgan and M. E. Pollack Eds., MIT Press, Cambridge, MA., USA, 1995.

[24] **Nonaka I.**, A dynamic theory of organizational knowledge creation*, Organization Science 5*, 1994, 14-37.

[25] **O'Leary D.E**., "Knowledge-Management Systems : Converting and Connecting", *IEEE Intelligent Systems 19 n°2*, 1998, 30-33.

[26] **Phillips L. D**., "A theory of requisite Decision Models", *Acta Psychologica 56*, 1984, 29-48.

[27] **Post W., Wielinga B., de Hoog R. and Schreiber G.,** "Organizational Modeling in Common KADS : The Emergency Medical Service", *IEEE Intelligent Systems 12 n°4*, 1997, 46-52.

[28] **Reix R**., "L'impact organisationnel des nouvelles technologies de l'information", *Revue française de gestion n° 84* janvier-février, 1990, 100-106.

[29] **Sprague R. H. Jr. And Carlson E. D***., Building Effective Decision Support Systems*, Prentice Hall, New Jersey, 1982.

[30] **Tardieu H**., Système d'information-stratégique et système-d'information stratégique, in Autour et à l'entour de Merise, colloque AFCET, 1991, 43-64.

[31] **Wenger E**., *Communities of Practice: Learning, Meaning and Identity,* Cambridge University Press, Cambridge, UK, 1998.

[32] **Williamson O. E**., Transactions Cost Economics, in *Handbook of Industrial Organization*, Schmalensee R. and Willig R. D. Eds., Elsevier, Amsterdam,1989.

[33] **Williamson O. E**, the firm as a nexus of treaties: an introduction in *The Firm as a Nexus of Traities*, Aoki M., Gustafsson B. and Williamson O. E Eds., Sage Pub., London, 1990.

[34] **Williamson O. E**, The logic of economic organization, in *The Nature of Firm*, Williamson O. E and Winter S.G. Eds, Oxford university press, Oxford, 1991.