LEARNING IMPACTS OF THE ALPIN EXPERT SYSTEM ON ITS USERS

Eric Brangier[1], Kent Hudson[2] and Hélène Parmentier[1+2]

1. Université de Metz, Faculté des Lettres et des Sciences Humaines, Département de Psychologie.
7, rue Marconi, 57070 Metz (Technopôle Metz 2000), France
2. Informatique CDC, 4, rue Berthollet, B.P. 16, 94110 Arcueil, France

Abstract: The introduction of expert systems into the workplace has generally been studied from a technical point of view while the influence of such systems on human work environments remains poorly explored. In this paper we show that the introduction of an expert system implies new professional, organizational and cultural learning for operators. Employees attempt to restructure their previous professional skills according to their representation of the new tasks. This restructuring implies the rethinking of their decision making processes and how their work is organized. Expert systems contribute in this fashion to change in corporate culture.

Keywords: Expert system, organizational impacts, psychology of learning, psychology of work, organizational culture.

Introduction

The introduction of an expert system into the workplace is an ideal occasion to study the effects of intelligent technology on the learning carried out by operators. Our research covers the introduction of the Alpin expert system in a company specialized in pension awards management. Alpin is designed to help 183 agents located in 29 different offices at a work site in Bordeaux, France, in their full or part time responsabilities in awarding medical disability claims. Its purpose is to enable non-expert agents uniformly to achieve claims award decision standards equivalent to those of the company's best experts [14]. For these employees the arrival of Alpin introduced significant change in work methods, content and relations, a change too great to be effortlessly adopted in daily behavior. This dynamic created a moment in workplace life where individuals needed to redefine their previous skills.

This study of learning in relation to Alpin seeks to understand the articulation between cognitive processes and the social conditions in which they are worked out.

In the following pages we first present a rapid sketch of some pertinant prior research, followed by the questions around which our study is framed and its methodology. In our analysis of the results we show that the first 18 months of use of the expert system were accompanied by three types of learning by operators.

Relevant prior research

Studies of the social aspects of artificial intelligence have focused on the formalization of know-how and knowledge and their learning. We first summarize research which has identified these aspects. Then we will show that learning results from the workplace impact of the expert system: It produces various forms of disturbances in work life which users seek to control through new learning.

Learning and the socio-organizational impacts of expert systems

Research dealing with the social aspects of expert systems has identified several different and complementary levels of impact on organizations described below: Impact on skills, on performance, on the organization of work, on attitudes towards the new technologies and on company culture.

Skills and organizational behavior: Several researchers have noted that the technologies of artificial intelligence limit the possibility of operator learning.

Bainbridge's work [2] stresses that intelligent systems designed to aid process control reduce the possibilities for operator learning. Indeed, these systems tend to:

- Reduce the capacity of operators to remember essential information quickly;
- Reduce operators' aptitudes for reflection;
- Weaken the ability of operators to measure the consequences of their actions;
- Create a climate of overconfidence in the operator who then becomes less likely to verify the completeness and relevance of information;
- Restrict the operators' ability to anticipate and more generally to manage situations not foreseen by the system;
- Make it difficult or even impossible for an operator to achieve an overall vision of the operating process;
- Create the illusion of transfer of responsibility to the intelligent system, thus confusing responsability in case of incidents;
- Increase the number of entirely automated work sequences, thus reducing operators' opportunity to practise and leading to a decrease their skills levels.

These problems generally have their origin in that automation, including expert systems, is designed to have the machine replace human intervention. In such cases, operators' work time is generally characterised by boredom punctuated by occasional excessive pressure.

Woherem [23] confirms and explains such dequalification as follows: (a) The paradigm of today's expert system design involves a simplistic definitions of skills, linking them to work assignments, and thus eliminates many possibilities for user learning; (b) expert systems include only small parts of the total field of expertise, this discourages overall learning of the field; and (c) operators see success and rewards as being due not to their input, but to that of the intelligent system. Freyssenet [7] concurs that current expert systems manage poorly or not at all to be teaching tools of domain knowledge. The principal reason for this comes from the nature of collected and formalized knowledge: It is surface and not deep knowledge. Thus the knowledge generally implemented in the system makes it possible to solve various individual problems, but does not enable users to integrate underlying knowledge necessary to invention of unforseen solutions. Yet deep knowledge is fundamental to learning. Consequently, in order to encourage operators' learning of professional skills, expert systems should:

- Store deep knowledge, in addition to that used to solve operational problems;
- Not directly give the solution to the user, but rather help him find the solution by himself by providing needed deep knowledge, empowering operators thereby to identify and solve the cases not envisaged beforehand by the system.

Pomerol [19] also stresses that complete expertise is rarely included in expert systems, so that the expert model is not in fact high-level expertise, but only "average expertise" [18]. He notes as a result that as expert systems are often limited to use by those semi-expert operators who do not already have access to modelled knowledge, the expert system can be experienced by them as job enrichment [6].

A distinction can thus be made between two types of expertise. When expertise is complex, open-ended and contains play, or grey areas requiring initiative, expert system operators use the system to avoid routine [19] and acquire new knowledge. Conversely, as Bainbridge observes, when the systems are “complete”, they create routine and reduce the likelihood of learning [2]. As a result those organizations choosing to use expert systems are confronted with significant problems in maintaining the training level of their personnel. A possible solution consists in treating the “upper end” of the problem [19], by training users to handle those cases rejected by the system, and in cases of moderate complexity by developing forms of collective work which enable operators with different [3] skill levels to interact.

User performance : Nii [16] points out that operator training time is decreased with expert systems. Similarly, a study of four companies [23] notes that the systems increase performance especially for those new operators who interpret their increased productivity as an indication that they have increased their skill levels. Seen thus expert systems do increase performance by reducing learning time. This contradicts traditional approaches to qualification which explicitly consider learning time as a criterion of qualification.

Coll [5] seeks to measure the effects of computer-assisted decisions in relation to the decision-making time required and decision quality. His results seem to show that the data-processing support of decision-making aid neither reduce the required time for decision nor do they improve the quality of decisions. The authors explain these results as resistance to data processing on the part of the work team using the system. If we accept these results then work teams, and by inference management quality, must be seen as important to the impact of expert systems on user performance.

Work organization: A number of authors show that the introduction of knowlege-based systems modifies work organization [4,6,22], by changing the division of labor. In this sense technological innovation is not merely introduced into the workplace, but contributes to the transformation of the workplace. Senker [21] notes that the impact of expert systems is a function of the organizational and social aspects of their introduction. Alter [1] remarks that individuals and groups adopt new technology to the extent that it empowers strategies leading either to greater workplace autonomy or social innovation, for example by the creation of “grey zones” of power between technicians and managers.

Expert systems thus appear to reduce the usefulness of an organization structured to distinguish between operators and manager/experts, and its counterpart in hierarchical status. The justification of middle management’s status is called into question by the new relation to decision-making created by the expert system. More generally, the introduction of expert systems leads to a rethinking of the organization of work and of expertise. Through these it leads to new poles of conflict between experts, middle management and operators, each aspiring to greater social status but differently empowered to do so by the introduction of the expert technology.

We see that expert systems thus acquire their meaningfulness to operators and management in the social context of their use.

Attitude to new technology: The general attitude of expert system users seems positive [23]. They particularly appreciate its precision, accuracy and speed, as well as the initial reduction of routine in their work. However these initial favorable opinions tend in the long run towards the negative, especially as the system replaces human operators.

Corporate culture: Prior research has demonstrated the importance of culture to the analysis of workplace situations [20]. This approach analyses speech, symbols, rituals and habits of social groups as indicators of behavioral meaning. Using a cultural approach to study organizational life, various researchers [8] have tried to understand the significance of the techniques which surround us and to which we grant increasing credence. Culture affects the judgements operators make about their own work. The introduction, for example, of an expert system into a life insurance company one of us studied projected new values [3]. Whereas medical reviews of claimants have traditionally had a negative connotation among operators and clients, the company sought more or less consciously to transform such perception of its medical claims review procedure by publicizing its “infallible” expert system. The expert system thus symbolized the implementation of technically just norms for these life-and-death questions. Seen in this way, the expert system accompanied and induced a change in organizational culture: This also constitutes learning.

Studies seeking to understand how technology modifies the values and norms of social groups have generally found that they link values such as modernity, innovation to the public image of the company using the technology. Habermas [11] notes that the spreading of the illusion that knowledge can be made available through technology can be correlated to the growth of information technology.

Learning and the regulation of the socio-organizational impacts of expert systems

The sum of these impacts can be considerable social destabilization within a work environment. This in turn leads to social regulation.

Apart from the work directly dealing with the impact of expert systems, our study takes into account widely known research [13] concerned with operator learning strategies. Researchers here noted that operators learn while observing others as well as through the work process. They acquire transmissable skills from work-site acquired know-how. Other studies consider cognitive aspects involved in transmitting knowledge to another person.

We accept as a working hypothesis the research indicating that operational strategies developed by individuals in the adoption of new technology rely on their representations of that technology [12,15]. These representations are structured as mental models [17].

The work of Greenfield and Lave [9] indicates that skills acquired in a given situation can be formalized as mental models and thus translated into new skills. These skills can be characterized by their degree of interiorization and in terms of implementation level: Single or multi-context. Leplat [12] considers operational strategies as modifications of cognitive representations, resulting in mental reconstruction of the work process. Another research perspective proposes mechanisms for the appropriation of new tools [10]. It defines skill acquisition as a process chosen by operators for resolving disturbances in their work process provoked by the installation of a new tool.

Fischer and Brangier [6] stress the fact that while seeking to acquire new skills, operators act on the designed work process, trying to change its design from one of replacing man by the machine to one of man-machine collaboration. The introduction of an expert system provokes learning and appropriation of the system, which they define as "heuristic operational strategies". These strategies simultaneously seek to incorporate the new work methods and to change them. These are cognitive strategies insofar as they are connected with acquiring new mental models for picturing man-system interactions. These appropriation strategies are also heuristic, in that they express the way in which each individual comes to terms with the expert system, by individually “playing” with the system and by reshuffling know-how between the various agents (users and experts) and the system.

To summarize, prior research shows that the installation of a knowledge-based system creates a learning situation resulting from several factors: The technological determinism of the new system, acquired professional experience, the context of the system's use, individual and collective operator strategies for adaption and operators' operational strategies founded in how they visualize what they make and do in the work process. Thus our study of learning in relation to Alpin is relevant to understanding the articulation between cognitive processes and the social conditions in which they are worked out.

The focus of our study

Our understanding of prior research leads us to retain three categories of socio-organizational impact as defined above: The *individual*, regrouping skill and performance, the *organizational* and the *cultural*, regrouping user attitudes toward technology and company culture.

The focus of our study is the way in which the individuals confronted by the Alpin system learn by using it. We decline this general question in the following hypotheses.

Hypothesis 1The establishment of an expert system involves three types of learning:

1.1. Individual learning of new skills and performance;
1.2. Organizational learning and associated forms of social innovation;
1.3. Cultural learning, i.e. norms and values acquired by operators in the course of using Alpin.

Hypothesis 2The purpose of operator learning is to work differently, i.e. to:

2.1. Adapt the expert system in order to work more comfortably and flexibly;
2.2. Change work organization by reducing system-induced "Taylorization" of their tasks;
2.3. Participate in company culture by integrating hitherto absent economic priorities into the claims handling process.

Hypothesis 3The mental processes producing learning are founded on:

3.1. Operational strategies aiming at optimum use of the system;
3.2. Heuristic strategies representing forms of appropriation of knowledge of and from the expert system, as well as new knowledge acquired from use of the expert system.

Methodology

General characteristics of the company and of the operators

The CNRACL (Caisse Nationale de Retraite des Agents de Collectivités Locales) is a medical disability claims management facility, administered by the Caisse des dépôts et consignations, a French public financial services holding company. CNRACL administers old age and medical insurance for local and regional civil servants. Its personnel is composed of more than 500 civil servants, trained primarily in administrative skills and procedures.

Alpin's operators decide whether or not to award medical disability pensions to claimants. The pension award decision is made on the basis of a file submitted by either the claimant or his employer. The operators study the claimant's file to determine its conformity with rules which permit decision using criteria based on both its legal and its medical aspects. Claims processors are recruited with high-school degrees, are trained on the job then charged with the implementation of this process. The Alpin expert system project began in September 1988. In 1989 the “claims committee” of operator experts was established to review decisions made on both borderline claims and on those rejected by Alpin. In January, 1991, after a 6-month trial period by 10 employees, the use of the Alpin expert system became obligatory.

The study

The essential methodology of the study was observation in the complex, real situation of the enterprize. Various survey techniques were used:

1. Observation at work sites (4 months);
2. 21 non-directive interviews with operators;
3. 3 interviews with the Alpin system I.S.team;
4. 4 interviews with awards committee experts;
5. A control test of manual claims procedures and criteria involving 5 operators;
6. Access to avaible documents and statistics: Alpin specifications, production, quality and awards committee records.

Table 1*Relation between survey methods and hypothesis*

Hypothesis	Techniques for survey and analysis
Hypothesis 1: Three types of learning	1. Observations of claims process: Patterns and time 2. Results of Alpin quality tests at installation 3. Control test of manual claims procedures and criteria involving 5 experienced and beginner operators 4. Content analysis of interviews with management 5. Observation of awards committee procedings 6. Content analysis of interviews: Work methods,values and norms 7. Analysis of claims commission records
Hypothesis 2: The purpose of operators learning	1. Analysis of operator interviews recounting the installation and first months of Alpin. 2. Comparison of values and norms present and absent from interviews of various operator
Hypothesis 3: Mental processes producing learning	1. Observation and analysis of operators' relation to Alpin 2. Comparison of operator discourse dealing with work before and after Alpin 3. Observation of game behavior and discourse

Our comprehension was enriched by frequent discussion and collaboration with IS and operator teams, responsable for the maintenance and utilisation of Alpin, and with executives from both CNRACL and its IS service, the GIRET B unit of Informatique CDC.

A certain number of limits placed on the study by the enterprize limit our ability to generalize on the basis of our results: These include limited public use of data. These public limits are coupled to significant changes in available data definitions just prior the period studied, making available information difficult to compare and interpret. At this stage our results must therefore be considered exploratory and qualitative.

Analysis of the results

The analysis of the results leads us to confirm our caracterization of the learning due to the introduction of Alpin as individual, organizational and cultural learning. We have chosen to separate thus the narration of these results, which in fact are interdependent and occur simultaneously.

Individual learning

The use of Alpin creates new constraints and work procedures. Individual learning can be observed in terms of operators' knowledge and performance.

Domain-related learning: Have Alpin operators have increased their knowledge in the domain of medical disability claims?

A number of elements lead to the conclusion that Alpin has not led operators to acquire significant domain-related knowledge. Note first that the domain concepts in Alpin are fragmentary and that the operators statements reflect only those concepts regularly required in the system's use. Several operators successfully using Alpin but having never handled claims previously were unable to answer relatively simple questions in the domain of medical claims. We observed that operators express a conceptual organization of domain knowledge structured not through a representation of the domain concerned, but rather through their grasp of how best to use Alpin. That is, the operators present the domain of claims processing through its relation to the use of the tool Alpin, and not in terms of typical pension claims categories, such as medical limits, rules and definitions, and administrative procedures. The domain knowledge expressed by the operators is principally centered around administrative facts. Previously non-expert operators do not now demonstrate significant knowledge of types of sickness and injury, nor degrees of invalidity. These operators thus seem to retain those elements relevant to the use of the system, without having acquired at this time a more general knowledge of the field.

This operational learning enables operators to create heuristics aimed at simplifying their work. Certain users can correctly second-guess Alpin's decisions on most simple claims (invalidity demonstrated, no accident as the cause). This is a case of experienced operators transfering prior knowledge to a new situation. Take the following example: Municipal employees are not allowed more than a given number of holidays. If they have overrun their limit their medical claim will be blocked by Alpin, pending a lengthy review by their city attorney. The operator thus notes the overrun, decides that a few days' overrun is inconsequential, and modifies the dates entered into Alpin to correspond to the "correct" number of holidays. Alpin accepts the claim and the process is expedited to the satisfaction of the adjuster. In this case, the operator has modified data in order to optimize work time.

"I can make Alpin say whatever I want".

The operator has thus found an heuristic seeming to enable him to work more comfortably without endangering the awards process. Such strategies are based on operator understanding about how Alpin functions, hypotheses worked out in their use of the system. The behavior is play: To trick the system and beat it, to anticipate its errors, to process claims more quickly.

"With other systems you win every time, but when you play around with Alpin you never know where you're going to end up....You don't do your work just to get some citizen his pension, you do it in order to beat Alpin and to get your idea through. Its just a game.".

These operators have found games, tricks and routines which accelerate processing time. To do this they have had to learn from Alpin to recognise a certain quantity of domain-related information such as process rules, administrative regulations, the names of certain sicknesses, and thresholds of claims award amounts.

Performance and quality: All operators agree that the length of time necessary to complete the full sequence of the pension award process has increased as a result of Alpin. This is due to a new step in the processing sequence added by the expert system. Thus a number of operator heuristics are intended to increase operators' individual productivity by shortening the time required by the Alpin-based processing sequence. The limits to data on claims processing quality make it impossible to for us to corroborate our hypothesis regarding the quality of decision making statistically since the beginning of utilisation of Alpin in production. However 200 sample claims were the basis of CNRACL's 4-month inital quality test. Overall, Alpin quality norms are considered excellent by management.

Conclusion: The learning function as operational and play

Two functions of learning appear: Operational, rather than cognitive learning of the system facilitates its use for the operator. Secondly the acquisition of certain domain information and rules tied to heuristic strategies enables some operators to play with Alpin, enabling them to undo its fastidious procedures. Learning thus relates to the tool, not to the domain, and its purpose is to increase operators' perception of their own work efficiency and their control of their part of the work process.

What learning	How learned	Why
Use of Alpin.	Trial and error	Work.
Operational and game heuristics, including prior analysis of claims.	Play. Invention.	Shorten work time and load. Change award decision. Avoid supervision Demonstrate innovative behavior.
Acquire new performance-structured domain data.	Using Alpin. Play.	Improve game heuristics.

Figure 1. Individual learning

Organizational learning

By introducing the expert system, the enterprize sought to extend a knowledge-based production system beyond a small number of domain experts. This implies organizational change, and creates a larger space of interplay both among operators and between operators and management.

Learning to decide with Alpin: Alpin changes the decision-making steps of the claims award process by increasing scope, it also tends to standardize the work of each operator in terms of process, decision criteria and results. Each operator decides more frequently and with less risk. Alpin proposes a *conclusion* to each claims process which operator discourse generally assimilates with a *decision*. Operators thus feel relieved of the responsability of decision.

> *"It is easier to do what Alpin says, it tells us what to do."*

Transfer of know-how: Previously transmitted orally, informally and by one individual, claims domain know-how is now transfered to Alpin which diffuses it to operators. The expert system appears to operators as a vehicle for this transfer, though the system is not designed for this purpose.

> *"It's a big help to make sure nothing has been forgotten"*

Alpin also changes work relations among operators. Some claims processors evoke the fact that the system has replaced the discussions that previously occured between colleagues.

> *"Alpin gives advice just like a colleague. You enter the information.... [I]t's like there are still two of you working on the claim. That replaces what used to happen, one person studied the claim and then gave an opinion, while the other reread the claim file for a final opinion".*

Managing expertise: The creation of a formal expert group responsable for expertise has modified the role of management. This began with a task-force composed of operators recognized as domain experts who participated with the IS team during the creation of Alpin, and exists currently as the "claims committee". The committee decides in all borderline cases and reviews Alpin's decisions when negative. The committee also updates Alpin's criteria and recommends modifications of various sorts, including the presentation of information by Alpin. This operator experts group exists alongside the management structure, and to a certain extent is in competition with it. Note however that the committee does not seem to be used as a means of training or other circulation of information. Operators bring claims to committee passively and do not participate in its deliberations. Some of them criticize the committee for this aloofness from other operators and for not teaching domain knowledge.

Changing the role of middle management: The supervisory role of middle management is reduced by Alpin. Since non-expert middle managers can neither supervise nor review expert decisions made through Alpin, their continuing role in the authorization process serves only to confirm its conclusions. Interviewed operators criticise their managers for not mastering Alpin and for not being able to supervise the claims process. Middle management has thus seen its expert supervisory role in claims processing transfered to Alpin and to the committee. As an example, only one of the 150 claims reviewed by the committee had been referred to it by a member of middle management. Interviewed middle managers uniformly criticize the expert system, mentioning the claims processing time loss generated by the system.

Conclusion : learning new work roles

Our observations tend to show that operator's learning strategies in the conditions of this expert system orient the system and induce certain changes. They induce claims processing circuits which influence expert system results and modify older institutional processes for handling claims. Alpin enables the claims processor to immediately access domain knowledge produced by others (within the limits described) through the constant update of Alpin managed by the claims committee. The overall claims process is standardized, with each operator acquiring greater autonomy from management while accepting the new constraints connected with process standardization.

In its wake Alpin has restructured the roles and organization of work within the service: It redistributes skills among the operators and middle management, empowering the former and reducing the role in the work process of the latter. Among operators Alpin diffuses knowledge and thus modifies the division of labor in the unit, notably increasing the number of operators by allowing non-experts to process claims. The system has had the effect of placing in parallel and perhaps in competition the authority of domain and procedural expertise with that of middle management. Operators have become relevant interlocutors for the experts of the claims committee, and thus of the decision-making process in claims awards.

What learning	How learned	Why
Decision without referral to management.	Referral to Alpin. Obeying Alpin.	Perceived reduction of risk. Perceived replacement by Alpin as decision-maker.
Reference to Alpin knowledge base intead of discussion.	Alpin design. Availabililty.	Induce a decision by Alpin.
Consider middle management as not expert.	Middle management excluded from Alpin decision loop.	Work professionally and differently.
Orient awards before analysis.	Play.	Acquire expertise based authority Organize work differently.

Figure 2 Organizational learning

Cultural learning

This study observed a number of indications relating Alpin to operator acquisition of new values and norms. Note first of all that the management of CNRACL seems rather than to have sought economic results, to have sought "cultural" benefits from Alpin, including its public and internal image. Possible productivity increases through Alpin were not tracked by the company during the start-up period.

For a number of operators the expert system seems to have sparked an idealized admiration of Alpin's high technology, in a low-tech industry. This idealization underlies three observed values which seem to confirm our hypothesis of cultural learning through Alpin: equality through standardized decision criteria, justice in award amounts and economic viability for the insuring company.

Standardized decisions and the relearning of the principle of equality: Operators unanimously claim that Alpin increases uniformity in claims processing. Claims decisions, criteria and process are standardized. They recognize that Alpin almost invariably makes the correct decision, doubting their own judgement in cases of disagreement with the system.

"Alpin can't make a mistake. I can, but not Alpin."

The cultural value of uniformity is equality of treatment, that is impartial justice for claimants. This invariable fairness of Alpin contrasts with the fluctuations, partiality and possibility of error in human judgement. The idealized, machinal perfection of Alpin garantees impartial, error-free decisions.

Just awards and learning to redefine equity: The award amount determined by Alpin is considered just in that it is calculated individually according to the facts of the claimant's case, using uniform criteria and without error. The amount of the award cannot be justly contested, whether or not it corresponds to the need of the claimant. We observe here the idea of *fair intercourse* between insurer and claimant, closer to legal values than the values of social justice. This is close to the value of *fair exchange* found in mercantile cultures.

Institutional viability and learning economic values: The greatest value change observable in Alpin operators is their integration of the notion of the financial impact of the award (award amount) as a legitimate concern within the awards decision process. This criteria is displayed for the operator to see in every use of Alpin; it determines whether CNRACL will request a second medical opinion on the merits of the claim. Alpin's proposed conclusions make specific mention of this criteria. Every operator interviewed stressed the fact that awarding a pension costs the company heavily, some recognizing that this preoccupation is new and not shared by all claims adjusters.

"People who refuse to use Alpin see themselves as do-gooders, not claims adjusters".

Others however complained that small pension claims were processed without close inspection, while larger claims were more closely scrutinized.

Conclusion : integrating economics and justice

Justice according to Alpin is calculated rationally, carefully and antiseptically, as each claim is judged on its merits under precisely the same criteria. Alpin is just, in that its program does not permit it to be partial. Its systematized knowledge permits Alpin to judge more correctly than an operator, replacing him in the difficult role of judging just how great should be a medical claim award. It is as if the operator's moral problem of refusing an injured client's claim were transfered to an idealized, perfectly intelligent machine. Alpin represents legitimate refusal (or acceptance) of an award, and renders the operator non-responsable.

This is what gives Alpin the weight of a value statement in the current context of this enterprize. Alpin intervenes culturally at the moment that public administrations move from the socially just to the economically just. It is a successful cultural vector, adding economic criteria to an arena previously ruled exclusively by social and legal criteria.

What learning	How learned	Why
Idealization of Alpin as perfect.	Correct decisions by Alpin, errors by operators	Reduce error, reduce personnal responsability.
Standardized decisions and process.	Using Alpin	Ditto.
Standardized award amounts, seeing awards as independant of need.	Using Alpin	Ditto.
Economy : concern for institutional viability.	Alpin display of awards amount criteria. Automatic request for second medical expertise linked to award amount.	Belief in Alpin. Belonging to professional community.

Figure 3 Cultural learning

Conclusion

The arrival of Alpin represented more than passage from one technical system to another; it was a small but significant industrial change. Its stakes included the redefinition of the apparent value to operators of domain and IS knowledge, through learning behaviors including games and social innovation. It was a relatively brief phase in the life of the company which introduced certain changes which may prove persistant.

Our observations show that operators demonstrated forms of learning which provided them satisfactory means to adapt to the changes brought about by the installation of Alpin. The learning processes can be described as operators' heuristic operational strategies. The operators designed strategies enabling them both to learn new knowledge and to influence their work methods and organization.

These are cognitive strategies in that they are based on the acquisition of new mental models, notably in terms of operator relationship to the new expert system. The strategies are also heuristic: The operators both work and play with the expert system and in so doing discover knowledge and know-how pertinent to their games. These are in some sense cognitive games whose pawns are the concepts, rules and terms of the domain knowledge, structured by the reasoning chains of Alpin. Their heuristic strategies are also associated to looseness or play in organizational roles. They serve to “correct” certain aspects of Alpin, modifying the expert system’s procedures in some cases, discovering grey areas in Alpin which allow them to master aspects of the work process. Operator’s heuristic operational strategies are methods for exploring the new knowlege areas made available by the expert system. Through these operators acquire new ways of working which enable them to adapt and to learn new individual, organizational and cultural behavior. Such strategies represent an expression of the relation between the operators, the intelligent system and the social context in which the operators work.

To review some of these strategies: Individual operators were obliged by Alpin to rethink their work process, and in so doing they learned to master Alpin and invent new ways to work. They redefined part of their work, finding or creating useful zones of uncertainty or play. Power comes from manipulating such zones of freedom, but it is also a learning adaptation to the system. Secondly, the operators discovered that the use of the tool could be true play: To anticipate the decisions of Alpin, to short-circuit it and so make it do what the operator wished. The dialogue with an interactive tool creates zones of freedom in which the system’s rules, but also domain concepts, knowledge and rules are pawns. To play with an expert system is to enter into an intelligent, learning dialogue with it. Thirdly, the creation of the claims committee is an example of a learning strategy. This new organizational structure, parallel to management, reinforces the authority of human experts and weakens non-expert managerial authority. This is organizational learning, affecting the decision-making system in the enterprize.

Research on workplace learning remains modest, and is insufficient in its current state to permit a general theory. The results presented in this paper, while fragmentary, may serve as a basis for further work.

References

1. Alter, N.: La bureautique dans l’entreprise. Paris, Editions ouvrières, 1986
2. Bainbridge, L.: Will expert systems solve the operator’s problems? Les systèmes experts peuvent-ils aider les opérateurs à résoudre des problèmes? Actes du colloque “Les facteurs humains de la fiabilité et de la sécurité des systèmes complexes”. Neboit, M., Fadier, E., [Eds]. Nancy, INRS. 17-25, 1991
3. Brangier, E.: La dimension imaginaire de l’implantation d’un système expert dans une entreprise. Technologies, Idéologies, Pratiques. Volume X, n°2-4, 369-386 (1992)
4. Brangier, E., Prez, P.: Quelques aspects sociaux de l’implantation d’un SE dans une entreprise. Le Journal de l’intelligence artificielle, 3-7, December (1988)
5. Coll, R., Coll, J. H., & Rein, D.: The effect of computerized decision aids on decision time and decision quality. Information & Management, 20, 75-81 (1991)
6. Fischer, G.N., Brangier, E.: Implantation d’un système expert : stratégie d’appropriation et changement organisationnel. Actes du colloque L’économique et l’intelligence artificielle. CECOIA2, Paris, AFCET. 89-94, 1990
7. Freyssenet, M.: Systèmes experts et division du travail. Technologies, Idéologies, Pratiques, Volume X, n°2-4, 105-111 (1992)
8. Gras, A., Poirot-Delpech, S.: L’imaginaire des techniques de pointe. Paris, l’Harmattan, 1989
9. Greenfield, P. M., Lave, J.: Cognitive aspects of informal education. In: Wagner D.A., and Stevenson, H. [Eds]: Child development in cross cultural perspectives. San Francisco, W.H. Freeman, 1982
10. Guillevic, C., : Transfert de technologies et psychologie du travail: L’appropriation de l’outil. Université de Toulouse, Le Mirail. Laboratoire Personnalisation et changements sociaux, 1988

11. Habermas, J.: Technik und Wissenschaft als Ideologie. Frankfurt am Main, Suhrkamp Verlag, 1968
12. Leplat, J.: Les représentations fonctionnelles dans le travail. Psychologie Française, 30, 3-4, 269-275 (1985)
13. Leplat, J., Enard, C., Weil-Fassina, A.: La formation par l'apprentissage. Paris, P.U.F 1970
14. Lesaffre, F-M., Brunessaux, L., Oggioni, C., & Zuck, J.: Un système expert réglementaire: Alpin, aide à la liquidation de pensions d'invalidité. Les systèmes experts et leurs applications. Avignon, EC2, May, 1990
15. Montmollin, M. de: L'intelligence de la tâche: Eléments d'ergonomie cognitive. Berne, Peter Lang, 1984
16. Nii, P.: Impact of expert sytems: Some observations. In: 1987, Expert systems in production and services: Impact on qualification and working life. Bernold, T., & Hillenkamp, U. [Eds], Amsterdam, North-Holland, 47-54, 1988
17. Norman, D.A.: Some observations on mental models. In: Gentner, D. and Stevens, A.L. Mental models. London, Laurence Erlbaum, 7-14, 1983
18. Pomerol, J-C. : Les systèmes experts. Paris, Hermès, 1988
19. Pomerol, J-C.: Systèmes experts et SIAD: Enjeux et conséquences pour les organisations. TIS, vol 3, n°1, 37-64 (1990)
20. Schein, E.H.: Organizational culture and leadership. San Francisco, Jossey-Bass Publishers, 1985
21. Senker, P., Townsend, J., and Buckingham, J.: Working with expert systems: Three case studies. A.I. & Society. 3, 103-116 (1989)
22. Tersac, G., de, Soubie, J-L., et Neveu J-P.: Systèmes experts et transferts d'expertise. Sociologie du travail, n°3, 461-476 (1988)
23 Woherem, E., E.: Human factors in information technology: The socio-organisational aspects of expert systems design. AI & Society, 5, 18-33 (1991)