

A survey of French developments in knowledge-based systems

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Abstract

Like other industrialized countries, France is currently enjoying a vogue for artificial intelligence and, generally, for hardware and software components and structures which will be needed for the design and implementation of the computer applications of the 1990s.

Since public announcement of MITI's Fifth Generation Project in October 1981, the French scientific and industrial communications have exhibited increasing enthusiasm for AI languages, expert systems, man-computer interaction, novel computer architectures, and knowledge-based computer systems as a whole. The choice of the Prolog language for the Japanese project has stimulated many French industrialists to be aware of the existence of a basic AI tool designed mainly in France.

In spite of the present fashion, often maintained by the journalistic milieu, it would be inaccurate to say that the French fifth generation project goes back to the Japanese announcement. The MITI project has certainly been a catalyst of ministerial and industrial awareness, but the bulk of ongoing projects stem from earlier work most often funded by government agencies.

In spite of the current thrust in AI and the centralizing habit in France, a "flagship" AI project cannot be identified. French Research and Development initiatives in artificial intelligence in general, and expert systems in particular, correspond more to a set of distinct projects. These frequently complement each other in technical scope and in their scientific and industrial objectives.

1 The pattern of developments in France

Roughly speaking, developments in France are currently carried out in two general contexts which are funded, totally or in part, through governmental initiatives and industrial and commercial projects. While the first mode has prevailed in past years, the second is developing rapidly. The reasons for this are twofold. First, a growing awareness of the potential of knowledge-based systems technology, particularly in industries not accustomed to exploiting public funding for building their tools. Second, governmental research and development funding sources have declined somewhat during the past two years. The next two sections discuss these developments.

1.1 French government initiatives

Many ministries and government agencies are currently actively engaged in research and development on knowledge-based systems technology. Generally, two processes occur; either government agencies subsidize public research laboratories and industry on specific projects, or they award contracts for acquisition of specific products. As of today, the first pattern is most prominent.

The ministries of Industry, Research and Higher Education, Defence, Agriculture, Urban Planning and Construction, Health, and Telecommunications are among others active in the field. (Note that we refer here to the present structures and bailiffs of French ministries. Documents dated before March 1986 might describe a slightly different situation).

1.a.1 Ministry of Industry

The general role of this ministry is to aid companies under its bailiff to expand. One ministry department (SERICS) and one agency, ANVAR (Agence Nationale de la Valorisation de la Recherche), play the main part in knowledge-based systems. SERICS and ANVAR are very new to the knowledge-based systems area (January 1987). Their contribution is in providing loans to companies to help their commercial and industrial growth. For example, ANVAR recently helped Cognitech to raise its capital, and Amaia to expand its range of dedicated machines and accompanying software.

Until the end of 1986, most initiatives of the Ministry of Industry corresponded to the actions of ADI (Agence de l'Informatique). ADI has included expert systems tools and applications since 1980 when it was instituted with a national responsibility to monitor software technology. ADI was closed in early 1987 following a ministerial reshuffle. During its existence, over nearly a decade, ADI was instrumental in supporting technology transfer projects for knowledge-based systems. Its contracts were aimed mainly at industrial companies or consortia including industry and public research laboratories; these contracts have helped many research prototypes to reach the state of fully-fledged commercial products as well as small companies to start up.

1.a.2 Ministry of Research and Higher Level Education

The main initiative of this ministry is conducted within the context of the PRC IA program (Programme de Recherche Concertée en Intelligence Artificielle; Coordinated Research Program in Artificial Intelligence). This is a co-operative programme monitored by CNRS (National Center for Scientific Research), which is a "club" of public research laboratories whose aim is federating public research laboratories, favouring software tools for sharing and disseminating technical information within the research community and industry.

As of today 23 groups from 18 organizations are members of the PRC-IA club:

CERT	Toulouse
CNET	Lannion
CRIM	Montpellier
CRIN	University of Nancy
ERIC	University of Paris Nord
GIA	University of Aix-Marseilles
GRTC	CNRS-Marseilles
INRIA	Ministry of Industry-Rocquencourt
INSERM-UA 19 4	Paris
IRISA	Rennes
LAAS	CNRS-Toulouse
LAFORIA	Paris
LI	Caen
LIA	University of Chambéry
LIAPS	Paris
LIFIA	CNRS-Grenoble
LRI	University of Paris-Sud—Orsay
LSI	University of Paul Sabatier—Toulouse

In all, these 23 groups involve about 300 people of which 90 are directly involved in the PRC-IA. The scientific programme of PRC-IA consists of four main chapters:

- Knowledge and reasoning
- Analogy and learning
- Inference and control
- Applications development methodologies

Descriptions of the projects conducted by the members of PRC-IA can be found in [8].

1.a.3 Ministry of Defence

The main initiatives of this ministry are conducted by Direction des Recherches, Etudes et Techniques (DRET) of Délégation Générale pour l'Armement (DGA), the government agency in charge of industrial and commercial affairs concerning weapons. DRET is similar in scope to DARPA in the USA. Knowledge-based systems are well established in the DRET's programmes. Among others, one can note:

- Fault diagnosis for airborne equipment
- Sonar signal interpretation
- Battle management
- Fire risk assessment aboard a ship
- Air flight simulation
- Mission planning

1.a.4 Ministry of Agriculture

The main initiative of this ministry is the INRA (Institut National de la Recherche Agronomique) plant pathology project, the SEPV project which is attempting to develop a score of expert systems for diagnosing plant diseases affecting the major crops farmed in France.

An early expert system, widely reported in the literature, is TOM which deals with tomatoes. This expert system is complemented by an image base stored on optical disks. It is expected that TOM and other expert systems to come will eventually be accessed via the MINITEL system.

1.a.5 Ministry of Urban Planning and Construction

In 1985, this ministry started to fund research and development projects in the field of CAD/CAM and project planning tools for trades and professions relating to architecture, building, construction and urban planning. In the first half of 1986, the Ministry issued a call for proposals dedicated to expert systems [7]. Three projects have been retained for a total budget in the range of 3M FF. The projects deal with CAD for central heating, work-site planning, and the design of steel grids for reinforced concrete structures.

1.b Industrial developments

Although still unusual a short while ago, commercial products and fully-fledged applications are now appearing rapidly in France. In the following section we focus on developments originating in France; products available in France which are imported from other countries will not be discussed.

At the present time there is quite a large range of offerings in the area of software tools. About 80 French companies (excluding American and other European companies operating in France) offer tools ranging from integrated environments to specialized languages. Table 1 gives a partial list of these companies.

The list consists of two main categories:

- (a) Traditional software houses and computer manufacturers which have establishing distribution agreements with other vendors (mainly from the USA and to a small extent from the UK) or by developing advanced prototypes developed within public research organizations or other industrial companies for their own internal use.
- (b) Small companies, most of them started during the past five years. As a rule, their products are based on developments created within public research organizations or with funding from the various governmental organizations mentioned above.

Below are some of the products they develop and which have achieved a significant distribution.

Table 1 A sample of French companies

AAF	Inforama
Acaste	Infosys
Ackia	Intellia
Act Informatique	Intellisys
Amaïa	Intellitec
Applia	Intelsys
Apside Technologies	Ise-Cegos
Aquitaine Systèmes	Itmi
Bull	Joy Informatique
Cap Sogeti Innovation	Lidia
Cep	Métrologie
Cisi-Ingenierie	Microformatic
Cognitech	Mind Soft
Cora	Neuron Data
Cril	NSL
CR2A	Progilog
C2M Informatique	Prolog IA
Delphia	Saia
Diredia	S20 Développement
Edia	Secia
Electronique Serge Dassault	Selisa
Elsa Software	Sema-Metra
Erli	Sig
Eurequip	Siria
Euristic Systèmes	Soft Computing
Framentec	Softmax
Galilee Informatique	Steria
G-Line	Syseca
Graphaël	Syspertec
GSI	TNI
GSI-Tecsi Software	Vecteur
2H+	
Iams	
I-Best	
Ilog	

1.b.1 LISP tools

Started at INRIA as a software component in a CAD system for VLSI design, Le-Lisp is a French variant of Lisp, and has now become a well developed product environment which is distributed by several software houses. The INRIA design team has now started a company to continue the industrial development of this tool, particularly in the context of a Eureka project in co-operation with several European organizations. The aim of this project is to develop a complete product able to contend with Common Lisp as an international standard. The main characteristics of Le-Lisp are its design consistency (it was designed by a small group and not by a committee), its efficiency, and its portability.

1.b.2 Prolog tools

Development of Prolog interpreters has been popular among French organizations during the last decade. Four developments have led to commercial products.

- (1) Prolog-P, designed by CNET (National Center for Telecommunications Studies), distributed by CRIL
- (2) Prolog 2 initially developed in Marseilles by Colmerauer’s group and now sold by Prolog IA

Table 2 A sample of knowledge engineering tools developed and available in France

Argone	Cognitech
Cognitif [12]	Cognitech
Diagnex	Itmi
Emicat [25]	Electronique Serge Dassault & IBM
L'Expert Kit [18]	Act informatique
Genesis	Edf & Steria
I	Cisi-Ingenierie
Intelligence Service [14]	GSI-Tecsi
Kool	Bull
Lap	Iriam and Selisa
Nemo	S20 Développement
Nexus [22]	Mind Soft
Ourse [11]	Prolog IA
Parsec	Aquitaine Systèmes
Plaisir d'Expert	Joy Informatique
Se-D-Pan	Vecteur
Tess	Cril
X-SYS [15]	Saia
Taiger	Siria

- (3) Delphia Prolog sold by Delphia a small firm founded by former researchers at the University of Grenoble
- (4) Xilog a Prolog interpreter designed by the AI corporate group of Bull; this interpreter is particularly known for its efficiency

These products enjoy a fair level of commercial distribution, but wider acceptance seems to be hindered by lack of an international standard and, to a certain extent, by relative isolation from mainstream computer environments. It is fair to state that Prolog is mainly used for prototyping purposes.

Besides interpreters for the Prolog language, other tools were developed or are under development. In this respect, one should mention LISLOG [16], a Prolog interpreter embedded in a LISP environment; initially designed by CNET, it is now distributed by Amaïa; Adlog [23] a tool for logic programming accessed from an Ada environment recently released by CR2A. A review of French Prolog developments can be found in [20, 21].

1.b.3 AI environments

French research organisations have developed a range of inference engines and AI programming environments in the last few years. Several of them have been taken over by industrial organizations to provide a basis for commercial products [1, 19]. A sample of software tools developed and available in France is given in Table 2.

1.c Applications (at end 1987).

Space here does not permit an exhaustive presentation of the variety of applications which have been developed, or are under development by French industrial or service organizations. Data from conference participant lists, such as the yearly Avignon workshop and technical papers published in the open literature, suggests that perhaps 1000 French companies are significantly sensitized to expert systems technology. A questionnaire mailed during the last quarter of 1987 to 1000 different companies produced 200 answers from users (software houses were not considered). Table 3 illustrates a range of expert system applications which have been or are under development in

Table 3 Expert systems applications in France

Expert system	Function	Company
AIDE	Business auditing	Banque de France
APEX	Technical diagnosis	Apside Technologies
BEST	A tool for implementing credit risk assessment expert systems	Prolog IA
CESSOL	Analysis of geotechnical soil surveys	CRIL
CHARIS	Financial analysis	Acaste
CORSER	Corrosion	CEA
CREDIT MANAGER	Credit risk assessment	Soft Computing
CUVEX	Specifications of the components of a casing column	Elf Aquitaine
DEDALE	Analog circuit diagnosis	ESD
DEESSE	Design of gas stations	Soft Computing & Total
DIAGNEX	Technical diagnosis	ITMI
DIAPASON	Marine seismic data acquisition	Elf Aquitaine
ENCHERES DU BRIDGE	Teaching bidding in bridge	Syllog
EVENT	Credit risk assessment	Evalog
EXPAT	Personnel expatriation	Saia
EXPRESS	Computer-aided reliability control	EdF
EXTASE	Alarm processing in the vacuum distillation tower of a refinery	CGE
EXTHER	Thermal diagnosis	Bertin
EXTRA	Alarm processing of 900 W pressurized water reactors	EdF
FIABEX	Assessing reliability of complex equipment	CEP
FINEXPERT	Financial analysis	Experteam
FINSIM-EXPERT	Financial analysis	Sig
GRUYEX	Process control in Emmental factory	Institut Français du Gruyère & CAP SOGETI
JOSEPHINE	Investment advisor	Banque de Bretagne
MABEL	Marketing of heavy equipment	Framentec
MADIA	Fault-tree construction	Bertin
MAINTEX	Technical diagnosis	Framentec
MIRIAM	Personnel management	EdF
NORMES	Analysis of the impact of security standards in engineering contracts	SGTE
OPACS	Piping support design	Framentec
OPERA	Scheduling thermal treatments in steel works	CRIL
OPHELIE	Urban water network control	Compagnie des Eaux
ORDDF	Resource scheduling on building sites	CRIL
PATRILOG	Investment advisor	Crédit Agricole
PEGASE	Structural design	Aérospatiale
PENELOPE	Site planning for large construction projects	Dumez
PILOTEX	Process Control	ITMI
PLANEX	Factory planning	ITMI
PREFACE EXPERT	Financial analysis	Ordimega
	Investment advisor	Scalbert Dupont
PREFASE	Family allowance calculations	EdF
RUFUS	Fault, diagnosis and prescription for motors, doors and brakes on the RER railway	RATP
SADE	Insurance underwriting	Framentec
SAOR	Administrative document processing	Cognitech/IGIRS
SERUS	Seal weld inspection	CEA
SEXS	Technical diagnosis & repair for compact disk recorders	Phillips
SIMPLOP		CR2A

Table 3 (cont.)

Expert system	Function	Company
SIRACUS	Ultrasonic non-destructive control	Framentec
SNIF	Training gas emergency teams	Framentec
SYMA	Pension liquidation	Cognitech/Ministry of Defense
TIPI	Real estate loans	Caisse d'Epargne
VULCAIN	Fire risk analysis	Bertin
—		Crédit du Nord
—	Credit risk assessment	Banque Hervet
—	Insurance underwriting	CCMA
—	Investment advisor	Banque Populaire de Lorraine
—	Leasing contract analysis	Bail Geston
—	Loans	SOREFI
—	Portfolio management	SNVB
—	Public contracts	French PTT
—	Real estate loans	Crédit du Nord

France: 30% of them have developed already or are still developing expert systems; 20% are investigating the use of expert systems; 25% are considering developing a prototype during the next six months.

The survey also brought to light the following fact

- There is no correlation between the size of companies and their involvement in expert systems; small or medium sized firms invest in expert systems at the same level as that of large companies.
- More than 80% of the companies developing expert systems belong to the category of technologically-advanced companies (electronic and computer industry, avionics and space industry).
- More than 50% of the companies currently involved in expert systems consider that they are currently growing; this proportion is much larger than the national average.

The distribution of application areas is approximately as follows

Engineering	22%
Production management	17%
Technical diagnosis and maintenance	13%
Finance and Business Administration	13%
Sales and Marketing	6.5%
Human resources management	6.5%
CAI and Training	4%
Computer engineering	4%

In addition we note that

- Expert systems have been developed mainly in technical contexts
- Finance and banking applications remain scarce
- Use of expert systems by data processing companies for their own operation is low

Another survey [13] dedicated to the banking and finance world (banks, traders, insurance companies) conducted during the second half of 1987 supports the above observation: only 7% of the banking and financial establishments surveyed have developed an expert system.

Application areas considered by companies just starting in the expert systems technology show slightly different “rates of popularity”.

Technical diagnosis and maintenance	17%
Finance and business administration	14%
Engineering	12%
Regulation analysis	10%
CAI and training	9%
Computer engineering	8%
Production management	8%
Risk assessment	6.5%
Planning	6.5%
Sales and marketing	5%

Here finance and business administration applications are in demand.

We should also mention medical expert systems. This application area is well developed in France. However, although many current projects have led to prototypes for evaluation, and a few have entered the commercial arena recently, it is too soon to assess their success. Good surveys of French developments may be found in [4, 9].

Tools used by expert system developers are by and large shells on micro-computers and workstations. Shells on mainframes are still scarce and dedicated machines are restricted to only a few industrial laboratories; this situation is not unique to France. However, regarding tools used by French developers, one should note the use of the Videotex environment for distributing expert systems; this is due to the wide distribution of Minitel sets in French homes and offices. This opportunity is currently attracting the interest of expert systems providers and, of course, France Telecom. However, technical problems of performances and acceptability remain to be solved [6]. In this respect, one manufacturer has just announced a Lisp machine to be used as a videotex server and, more generally, as a transaction server [6].

2 Conclusions

According to most technico-economic studies the French software industry ranks second or third in the world. It is no surprise therefore that activities relating to knowledge-based systems started relatively early in France and have achieved considerable strength compared to other industrialized countries. However, the current product range is still unstable and fragile; to a certain extent it might be considered to be too rich with respect to the available market. Several mergers have already occurred and more are expected.

The tools available today exhibit signs of greater maturity as they have wider scope and are increasingly linked to mainstream computer environments.

As far as applications are concerned, most professions are now aware of knowledge-based systems technology; this is evident by the proliferation of seminars aimed at specific application areas like banking and finance; marketing; mechanical engineering; business administration; maintenance; medicine and law. Moreover, many knowledge-based systems projects or exploratory studies can be found in French industrial and commercial organizations; it is significant that a large proportion of these organizations is not traditionally associated with computer technology. Most observers agree that knowledge-based systems have taken off in France.

As knowledge-based systems technology has been partly transfered to industry, through prototypes and personnel, research groups need to focus their effort in other areas. A degree of indecisiveness can, however, be perceived in the research community about the major research areas to pursue but, generally speaking, new research issues which are popular today relate to learning techniques, knowledge acquisition, non-standard logics, knowledge-base management and validation, and new programming paradigms to aid knowledge representation [8].

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