MISA: Management of Information Sharing based Agents

Samira Bourouina-Meftah [1], Fatima Bendella [2]

[1] *SIMPA Laboratory, Université des Sciences et de la Technologie d'Oran Mohamed Boudiaf USTO-MB, Oran, Algeria*

[2]*SIMPA Laboratory, Université des Sciences et de la Technologie d'Oran Mohamed Boudiaf USTO-MB, Oran, Algeria*

E-mail address: samira.bourouina@univ-usto.dz, fatima.bendella@univ-usto.dz

Abstract: This work aims to create an information sharing system called MISA (Management of Information Sharing Based Agents) based on two approaches: multi-agent systems and decision support (method Electre1 and Promethee2) to facilitate the sharing of information in the University community. MISA must allow a user to query for a given resource while respecting the access rights assigned to other actors.
Due to the results obtained, we were able to optimize internal communication (cost and time of information sharing) and enrich existing collaborative systems.
This work is implemented to demonstrate the validity of an innovative information sharing approach, using at the same time multi agent systems and decision support methods applied to a practical case: university. MISA is intended for both administrative and teaching staff (intra-university).
The results of a simulation study is represented in this paper using the JADE platform of the multi-agent system of data sharing and management of (Faculty, department, institutes, division, corporate services & others) with other actors of the university. The system must allow a user to query for a given resource while respecting the access rights assigned to other actors.

Keywords: Information Sharing (I.S), Information Management (I.M), University, Multi-Agent System (MAS), decision support.

1. INTRODUCTION

Considered as an absolute necessity for the University, whose very foundations are based on knowledge, the information sharing (I.S) is of strategic importance and has become an essential vector of development.
Information sharing I.S is an important part of any association, so the main question for associations is to process this information. The difficulties related to manager data can be classified into three general classes: attainment (which represents the deletion of data from data sets, printed resources), arrangement (addressing the issue of data storage) and handing out (dealing with the issue of separating the correct data at the ideal place and time).
The necessities and aims of an association have both unequivocally and verifiably affected the plan and parts of complex information system. So such these requirements are considered to be generally stable, this is a feasible way to deal with the system design, as changes only occur here and there and can therefore be explained by reengineering processes.
The university is well supplied daily to manage an accumulated and though dispersed amount of information in a multitude of documents through number of faculties, departments and services ranging from collection to dissemination, and the advent of Information and Communication Technologies (ICT) such as social networks, collaborative digital work spaces and other collaborative tools based on Web, offer new opportunities and foster collective intelligence.
Thus, the call for information sharing makes it possible to avoid wasting time and resources in search of knowledge already available.

Mastery in the management of the flow of information, by sharing, between the different actors of the university, facilitates teamwork and constitutes the basis of the new ways of functioning in the university.

Fostering communication, sharing and exchange requires the interconnection of microcomputers, and in this way enables individualist office automation to become "collectivized" towards sharing data and working on common projects.

The I.S is managed and controlled by several university's actors, working between them closely and collaborate in order to achieved better information sharing [5].

To illustrate the necessary collaborations (intra-university) and identify bottlenecks in the Information Sharing application (I.S) by one of the actors (faculties, departments or services), we got interested in the study of solving a problem of information sharing through a new approach called the " multi-agent systems approach " [11][13].

This approach is advantageous because while eliminating the prior recognition between agents it avoids the many interactions between agents not concerned by the I.S.

The architectural objective proposed in this study is to provide a platform that helps the actors (administrator or teacher) in the university community to work in a distributed system while providing them with shareable files, so in order to do this; our reflection took as a starting point the following questions:

What are the process and (I.S) tools used traditionally?

How can we improve the (I.S) already existing?

Which (I.S) services would be best suited for our University?

2. INFORMATION SHARING USING MULTI-AGENT SYSTEMS APPROACH AND THE DIFFERENTS (I.S) MODELS

A representation of the Multi-Agent Systems (MAS) design is introduced by [7]. The primary focal point of this paper is on the knowledge management details utilizing the new guidelines, specifically on the Virtual Organization. The MAS design gives an agent structure and brings interoperability inside and across agent based applications. The new executions of MAS depend on Java and Internet important innovations (JADE, JACK, XML, SMTP Active Objects, and so on) The interoperability includes connections among agents and stages and platforms between executions of agent administrations.

The collaborative agents (MAS) can achieve competitiveness by constantly improving the cooperative virtual association with the most extreme collaboration as a model. In the event that a partner does not perform according to the assumptions, for example if it does not meet the schedule or if it does not offer the opportunity to compete with its competitors, it will be replaced by a suitable partner. This exchange of choice and adaptation will be carried out by multi-specialist platforms according to [1] [16].

Multiple organizations offer Document sharing platforms for the sharing of electronic files, which often allows multiple team members to save time.

On the ground and the nature of work, its situation or its objective, information sharing comes in different shapes and/or methods (written / oral, formal/informal, direct/indirect, in real time or delayed).

Among others, models of I.S proposed to organizations (university or enterprise), we will quote:

2.1 Intranet (Development of an internal network)

This is an information system specific to the organization (University or Company), adjusted to the needs of employees and allowing effective communication. The solution is to set up a collaborative platform offering means of communication linking all the members of a given organization to each other and ensuring both horizontal and vertical exchanges (information circulates between all hierarchical levels).

However, this solution reveals some functional limitations, such as the choice of who has access to what (security), or the warning of collaborators when information is modified or when the volume of information and the multiplication of files and information. Directories get too high, making the search for information time-consuming and slowing the performance of the entire system. These uncertainties make it necessary to set up tools dedicated to data management and sharing and detailed expertise of the Information System, its architecture and its flows.

2.2 The Collecticiel (also called Groupware)

The groupware is à software that allows you to work in a team. This tool allows users to share their work and Files remotely : Like communication, the ability to share files, documents, data and all other forms of media, and to do Speed Search - Search old files, previous conversations or past blog posts is facilitated by the function of research collaboration software[4][8] .

Regardless of distances or time (real or synchronous), users interact through applications, also known as collaborative software, that allow them to communicate, cooperate, share, coordinate, discuss and even compete for a common job.

Group work tools have been found to be the ideal way to help develop these applications. Also, data sharing between sites requires a number of abstractions commonly called building blocks.

However, data sharing can be done in a variety of ways by using a variety of tools, because the data can be stored on a primary site or replicated to all sites. Thus, depending on the chosen policy path, results and data consistency may be affected differently.

We can find several components in the groupware such as:

- Shared calendar (calendar sharing via Outlook)

- Document sharing (via the organization's computer network or intranet)
- Newsletter (allows, for example, communicating the essential information of the organization to the employees).

Groupware is developing more and more in large companies, some of which have set up a professional chat (Communicator) to see if the user is available, busy or in a meeting in order to communicate with him. This system also makes it possible to see if the users are present or absent from the company. There are other communication tools such as:

- Blogs
- Facebook
- LinkedIn
- Twitter

Some of the advantages of collaboration software are effective in achieving goals, mainly by saving time and improving project management.

However, there are also limitations of the collaboration software, which is truly a major investment, among limitations we may mention:

- Upgrading the configuration and maintenance hardware which can be very expensive
- Security: No data is ever secure, security measures must be taken through the establishment of authentication and authorization protocols.

2.3 The Cloud

Cloud Data Sharing refers to a range of services that allow users to store and synchronize documents, photos, videos, and other files using cloud computing technologies and share them with other people.

Cloud computing providers offer a distributed database/database in form of engines to expose a data-modeling paradigm that consumers can use to interact with the cloud system [11][6][10].

The use of cloud systems enables data sharing capabilities that provide the user with many benefits, including greater productivity, allowing multiple users from different backgrounds to contribute to data in less time and at a lower cost. And also to exchange manual data and share photos, videos, information, and events [15].

Google Docs, for example, provides data sharing capabilities so that groups of students or teams working on the same project can share documents and collaborate more effectively.

Cloud computing is the platform of choice for deploying and running many resources sharing. S ome of its highlights are:

- Greater productivity:

Many people can connect with their friends, family, and colleagues to share their experiences in life and catch up. Therefore, social data sharing usually offers people a rich experience because sharing personal information can improve and deepen relationships.

- Express opinions and disseminate high scale:

To express opinions, some people need to go worldwide. They want to promote their ideas, or opinions using social networking sites and through secure data sharing in the cloud.

- Sharing research data:

In order to accelerate the pace of scientific discovery, there is growing support for sharing research data. Such sharing will allow faster translation of science into practice.

With the advancement of cloud computing, the focus is increasingly aimed towards data sharing capabilities of implementation since shared data can be used to improve the modeling, analysis, and risk.

However, as the sharing of resources increases, the cloud method starts to show some limits .we must then find solutions to knowledge-based problems such as, incompatible systems and electronic formats that often prohibit document sharing between centers and networks [3][12][2][13].

We must also consider new issues introduced by the growth of resource collections, and continue working on solutions to older problems around sharing hardware resources and generally on workflow related to resources sharing.

However, despite the critical need for data sharing, many users are still reluctant to share data with other users because the cloud is full of privacy issues.

The main concerns regarding sharing in the cloud are availability, responsibility, integrity, and especially confidentiality.

As a result, some of the requirements for secure data sharing in the cloud can be listed as follows:

- The data owner should be able to specify a group of users who are allowed to view their data.
- Any member of the group should have access to data anytime and anywhere.
- Only the data owner and group members should have access to the data, and to the cloud service provider.
- He should be able to add new users to the group, and he should also be able to dismiss access rights against any member.
- No group member should be allowed to dismiss rights or allow new users to join the group.
- Thus, to be reliable and to ensure privacy and data security, the cloud must develop mechanisms such as standards, practices, and encryption.

2.4 Google and its G Suite

Developed by Google, and the Alphabet Company, G SUITE consists of several document-sharing tools and group conversation which can be real assets for an organization.

Free for the most, convenient and easy to use, these tools are intended to be accessible to all. Many organizations, like Gmail, have made it their first choice [9].

2.5 Cloud version of Google

This version allows you to share Word, Excel or even PowerPoint documents with other members who can edit the content and work together from different positions. Neither the file size nor the number of documents created is limited. Accessible on all devices, from smartphones to iPads, these services, such as Google Plus, and e-mail are designed for business communication and help speed up the dissemination of information and make it easier to share tasks and share knowledge.

2.6 Google Calendar

Google Calendar offers the ability to synchronize multiple Gmail accounts on an event and warn them all simultaneously. So many features related to the giant search engine, are available to everyone, easy to use and sometimes free. Other free, widely used data sharing services exist and encrypt their data like Sky Drive and Dropbox.

3. PROPOSED APPROACH

Multi-agent systems (MAS) are programmed with any language. Especially using object oriented languages which are a suitable medium as the concept of agent is similar to the concept of object. Agents have common properties with objects such as: inheritance, messaging, encapsulation, etc.

Agent-oriented programming languages are a new class of programming languages that focus on taking into account the main characteristics of multi-agent systems. Minimally, an agent-oriented programming language must include some structure corresponding to an agent, but many also provide mechanisms for supporting additional attributes of agencies such as beliefs, goals, plans, roles and norms.

One of the objectives of JADE is to improve on advancement while guaranteeing standard consistence through a far reaching set of framework administrations and specialists. During the advancement of the framework with JADE, the accompanying kinds of classes are made and carried out:

- Agent classes to depict different kinds of specialists.
- User Interface classes for client association.
- Agent movement classes for practices.
- Database classes to deal with the information base of the framework.

- Communication classes to deal with the exchange between specialists.
- Ontology classes to characterize ideas, predicates and specialist activities for the area.
- The framework should have the option to guarantee the specialists correspondence, including the correspondence conventions. Specialist's correspondence depends on:
  - Sending (activity);
  - Receiving (insight) messages.

The level of intelligence and coordination comes from the degree to which the framework dodges excess activities, rivalry on assets, bottlenecks and the hazardous working conditions. The objective is to keep a general rationality, without continually having a worldwide control set up.

The coordination between versatile specialists not entering the opposition depends on participation. For the specialists entering in the opposition, or those having proportional reliance, the coordination depends on exchange. The Communication between specialists is done by means of messages.

After analyzing the I.S specificities, its practice, its context, and its actors let us now submit a new approach to I.S from the perspective of multi-agent.

This approach is justified by the implementation of Multi agent system module called MISA (Management of Information Sharing based Agents) which develops sharing and collaborative culture while optimizing internal communication between cognitive and reactive agents.

Thus, in order to understand the information sharing with this new approach, we privileged an In-Situ observation of a university community, namely the University of Sciences and Technology of Oran (U.S.T.O-M.B) and we designed a model supported by a MAS suitable for a restricted flow chart of 3 faculties : Sciences and technology, physical and Chemistry.

One of the difficulties of the I.S occurs when one must manage it from various departments, faculties or services within the university. To avoid this, effective collaboration using all available tools for connecting each actor in order to share information must be enforced. This makes it possible to produce global schedules, manage time and costs, and the resources and equipment needed at the right time. In addition, effective information sharing reduces delays, shortens the problem-solving time, and adds value to the organization.

The agent technology is very suitable for modeling systems that require collaboration between several entities in order to achieve a common goal, such as building a system where agents work together, to find the best I.S services.

4. USED METHOD

MISA (Management of Information Sharing based Agents) is based on two elements:

1- The client's request (the client being either administrative staff or teaching staff) can be entered in a textual form or in user-filled forms to describe the type of I.S that he wishes to invoke.

2- The intermediate system is hierarchical Service (Department, Faculty or supervisor (rector ship) as the organization of the university and his task is to receive request, analyze, search and compose the best I.S corresponding to the characteristics described by the applicant, applying, However, to the extent possible, one of the multi criteria methods(Electre1 or PrometheeII). MISA that we propose has the following characteristics:

- Reliability: the distribution of tasks on specific agents (Department, Faculty or supervisor), facilitates resolution of any flops in the system, quickly and efficiently.
- Extensibility: the independence of agents from each other facilitates the modification of their behavior.
- Robustness: The cooperation between agents allows the system to cope with uncertain situations and increase fault tolerance since the failure of one agent does not affect the functioning of others.
- Maintainability: Agent inter-independence also maintains each agent separately from the others without influencing the overall operation of the system.
- Scalability and Flexibility: The ability to self-
- Adapt allows developers to add or remove new constraints (or even new agents such as the case of a new

faculty, department or service) without altering the overall mechanism of the system.

- Costs reduction: a centralized system is always greedy in terms of development and maintenance.

4.1 Description of agents' society

The actors responsible for the structures making up the university (head of the faculty, head of department, and head of service) are defined as agent where each agent represents his structure. In the same way, the different substructures services (schooling, secretariat, and pedagogy) are represented in turn by their respective leaders, defined as local agent (Figure.1).

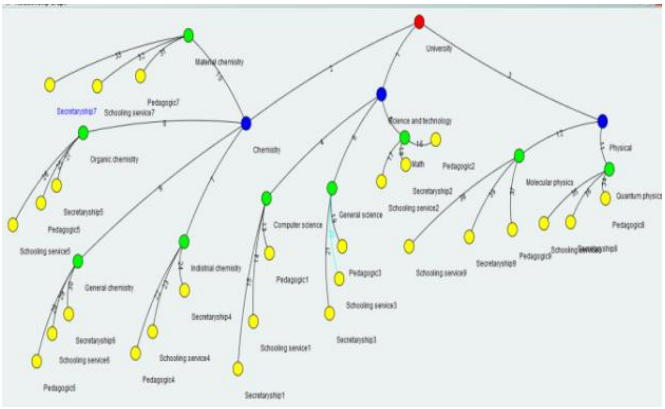

Figure 1.The University and its structure

4.2 Organization's structure

The university is identified by a set of agents and is supervised by a Senior Agent: Agent University will be called Supervisor agent. The general architecture of our system consists of five types of agents (Figure2.): The interface agent, the supervisor agent, the Faculties agents, the departments' agents and service agents are 3 (schooling's agent, secretariat's agent and pedagogy's agent).

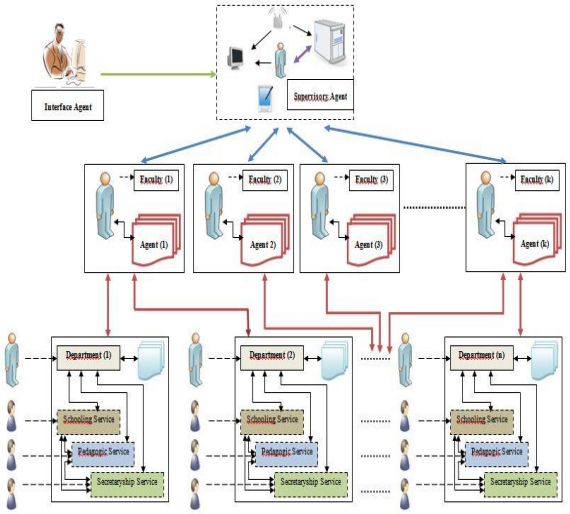

Figure 2.M.I.S.A architecture

4.3 Supervisor agent

Is an intelligent agent (Figure3.) is showing its internal architecture), he is the core of our architecture, and his main task is to ensure communication and coordination between intelligent agents of the system as the Faculty's agents. To do this, he uses a global directory containing information on the Shareable data Diagrams (the file itself, the file location, the file version, its availability, its accessibility, the number of shares, the

originality of file sharing) (data source) and finally the type of exploitation file (read-only, read/write or execution).

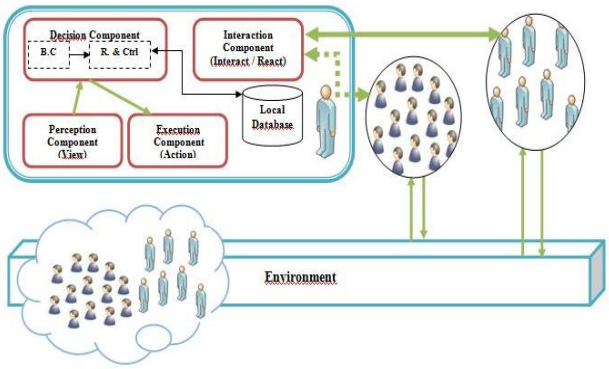

Figure 3.Internal architecture of an intelligent agent (supervisor or faculty or department)

4.4 Faculty's agent called Agt[Fac]i

In the case where we have several faculties, it has (i) as a local faculty's directory (Figure4.)

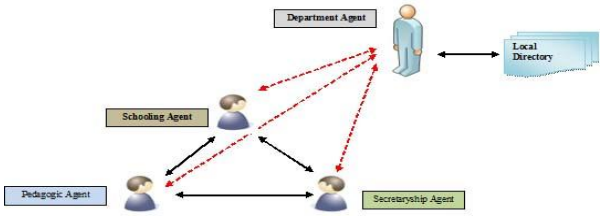

Figure 4. Communication between reactive agents and cognitive agents

4.5 Department's agent called Agt[Fac]i[D]j

Referring at the same time to the faculty to which it is attached (from example **AgtFac3D2**: is department2's agent of Faculty3) having a local directory's department.

4.6 Service's agent

The agent called Service is a reactive Agent:

- Agent sc referring to schooling service
- Agent s referring to secretariat service,
- Agent p referring to pedagogy service

From the moment, it has been assumed that a department is composed of 3 services at least.

4.7 Information Sharing –Procedure

A request for sharing is made by the Supervisory Agent. This request form Triggers sharing process. The following algorithm shows the general operation of the I.S. It takes into account as input the local and global parameters recorded in the perception module. The variables used are NbI.S: number of information sharing.

Algorithm

Step 1: Triggering an event at time t
Entrance : instant t = s ;
Step 2: Checking the instant t
IF Instant t as expected is in the scenario table THEN
Locate the search query (Requesting agent, file name, type of I.S requested)
Step 3 : Activation of the search query
IF Applicant agent = intelligent agent THEN
Go to Step 4

```
    ELSE (requesting agent is a reactive agent)
          Go step 14    {Start Local Search}
 Step 4   : Call to the procedure of the right of access {It is checked in the table right access}
   IF Type of I.S requested = I.S type assigned THEN
          Go to step 5
    ELSE go to step 16 {write I.S}
Step 5   : Launch the I.S Request
    IF requesting agent = Faculty agent       THEN   Go to    step 6
      ELSE go to step 13 {requesting agent = department agent}
Step 6   :  Start search at the local faculty directory
       Fill the Performance Matrix (P.M) by locations files found under actions/ Criteria   ;
        IF P.M is empty   THEN
           Go to Step 10 {Start research at   the Higher Level: root}
 Step 7   : Test on the number of I.S (NbI.S)
    IF NbI.S {NbI.S: Number of I.S} <= 0   THEN
          write " no sharing : access denied "Go to step 16
      ELSE
        IF the file exists in one location THEN
           Go to step 8
         ELSE      Go to Step 9
Step 8: Sharing
     - allow information sharing (I.S)
          - Go to Step 15   {Update}
 Step 9   : Decision helper Procedure for Locating the Best Location
        For File Sharing {Choice of method of decision}
    IF Method ELECTRE 1 THEN
            -Fill P.M and the vector weight
            -calculating the Concordance Matrix (C.M)
            - Calculating Discordance Matrix (D.M)
            - Calculating ranking vector {Result: gives the
                        best location of the file   Share}
             - Go to Step 8 {sharing +Update}
       ELSE {apply method Promethee II}
         -fill P.M and the vector weight
         -Specify Settings Subjective: P, Q, S
 -calculating Preference Matrix    ;
-calculating the flow of input, the flow of output
and the Flow Net   ;
         -Result: ranking vector
- Go to Step 8 {sharing + Update}
Step 10: launched research global at the hierarchical level
IF hierarchical level = Root    THEN
        Go to  step 11
ELSE  Go to step 12
 Step 11: Test the file
         -Launch research at the Global Directory
  IF      file is not found      THEN
          write "file not found" Go to step 16
 ELSE    Go to step 7
Step 12:  launch local research faculty
    IF the hierarchical level = Faculty THEN
  Go to step 6 {research in the local directory of faculty}
     ELSE    Go to step 13
Step 13: Launch research local Department
           - Start search at local directory
   IF      the file is found      THEN
              Go to step 7
   ELSE     Go to step 10
 Step 14: Launch of the sharing request to different services {Schooling,secretariat,Pedagogy}
    - launch the sharing request in services {Schooling,secretariat,Pedagogy}
```

IF the sharing request is accepted THEN
Go to step 8
ELSE Go to step 13 {launch the application to the next level}
Step 15: Update shared file
IF requested file type is writing THEN
New version = old Version +1
NbI.S = NbI.S-1
ELSE {decrement the number of I.S}
NbI.S old = NbI.S old - 1
Step 16: End of the I.S process

The following flowchart defines the different steps followed when sharing information in the MISA module.

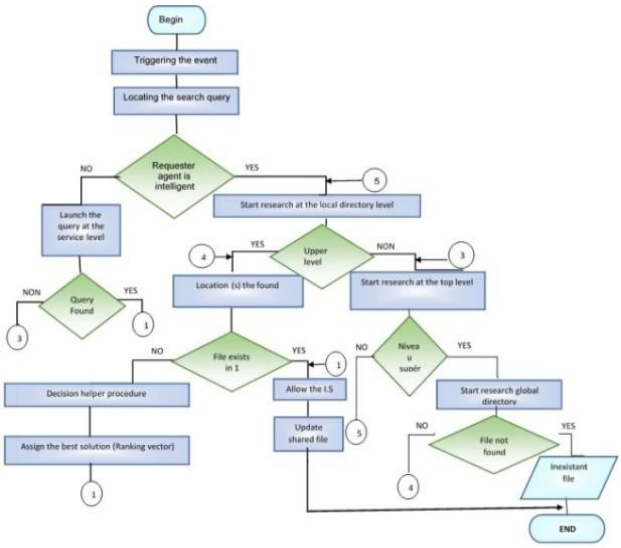

Figure 5.Global flowchart of M.I.S.A module

5. RESULTS AND DISCUSSION

Supervisory agents, department and faculty described in our architecture they have the 3 following properties:

- Independence: An agent is considered an autonomous and active entity and therefore has its own set of resources and knowledge.
- Communication Power: Collaborating agents must be able to communicate to exchange
- Information defined by7.
- Intelligence: Agents pursue goals based on their skills, so they must have in addition to their own knowledge, and skills, enough mechanisms for reasoning.

To find out how intelligent agents take decisions such as Agents Faculties, Departments agents or supervisor agent, you need to refer to organizational issues in society agents, not only from the standpoint of the structure of communication between agents, but also from the point of view of the degree of cooperation and forms of communication between agents.

The I.S issue addressed in this study is related to the decision of allocation process information (documents, files,) that is why our multi-criteria analysis aims to explain a coherent family of criteria such as:

- The shortest path (assuming there are several) in this case, we have used Dijkstra's algorithm to find the shortest path problem. It allows, in our case study to determine the shortest path to reach the location of the file share formulated during an information sharing request from a source (service, department, faculty or rector),
- The number of shares, file version of the file, its availability and accessibility.

In this approach, we provided the MISA module with a decision support protocol and entrusted a specialized agent: Supervisor or Faculty or Department, to apply the decision from the global view that it owns on the other agents. And this by examining either its local directory or its global directory to identify the file to share formulated during a request of I.S.

These interactions between agents are then designed to exchange resources.

The requested file can then to be:

- One location (only 1 address), at the time we take it as it is (Figure6.).

```
try {
  ACLMessage msg1 = new ACLMessage(ACLMessage.INFORM);
  String pwd1[]  = new String[] {"Found","1",mp.mp.getValueAt(0,0).toString()};
  msg1.setContentObject(pwd1);
  msg1.addReceiver(new AID(mp.Ddeur.toString().substring(3), AID.ISLOCALNAME));
  myAgent.send(msg1);
    }
    catch (java.io.IOException ex) {}
    try {
         Thread.sleep(1000);
       } catch (InterruptedException ex)
       {
         Logger.getLogger(F1.class.getName()).log(Level.SEVERE, null, ex);
       }
     }
```

Figure 6. Slice of A.C.L program showing the case In which the file to share is in one single location

Multiple locations: The resolution of this problem is to find the best solution among others proposed Hence the need to integrate into this perspective, an I.S system using one of the multi-criteria methods Electre1 or Promethee II.

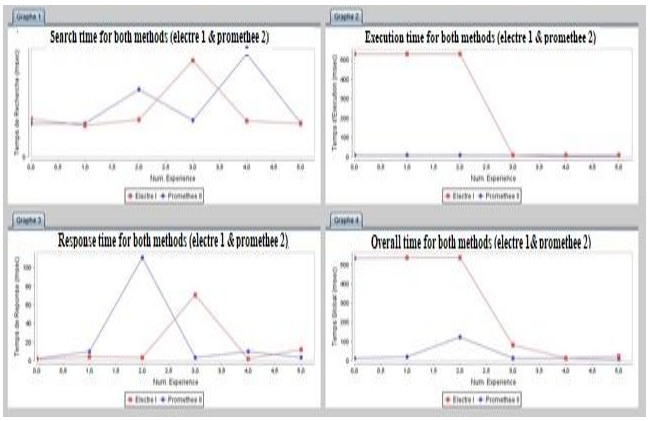

Figure7. Comparison between electre1 and Promethee II in (search time, response time, execution time and overall time).

This consists of the search for a satisfactory sharing of information in the best criteria.

If the requested file does not exist at the local directory, we should then make the I.S request to the next higher hierarchical level (flowchart Figure6.).

The F2 file is in multiple locations :

- At the secretariat service of Department 1 (faculty 2) and at the secretariat service of department 3(faculty 2).
- At the faculty 3 at two (2) different locations : schooling service of department 2 and pedagogy Service of Department 1.

To find the better location of the file to share, we apply one of two Advanced methods (Electre1 or Promethee II) referred to above by filling the performance matrix (P.M), for example Electre1, therefore focuses on each share

(possible paths) of all and compares all others a comparison is made in pairs ordinate (a p / r p b ≠ b / r a) and is then asks if the action outperforms or not the action b. the result is as follows (Figure8.).

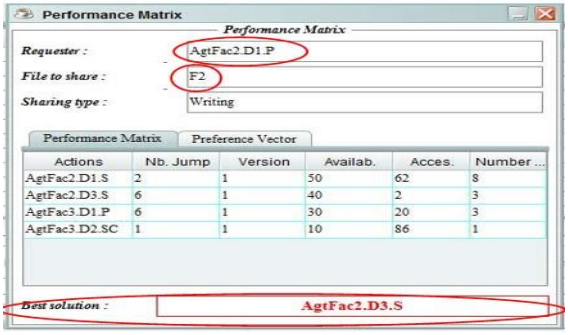

Figure 8.Performance Matrix

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The results obtained showed that: MISA is very useful in each organization (university or company)

Among the benefits of utilizing shrewd agents, one might specify higher work proficiency, implying that user saves time, as specialist work independently and all the more viably, as they can look and share tremendous measure of informations. This opens new methodologies for scientists in consolidating choice help strategies with smart agents.

We proposed a multi-agent work process based system to automate processes. The proposed system is described by the benefits of independence; versatility and cooperation of various agents all together give basic and quick arrangement. Utilizing agents as leaders made the system more vigorous and speedy in settling issues in any mind boggling circumstance. At the point when it comes applying the proposed system, different contemplations are excessively consolidated in to it. The exercises are diverse in their tendency: they work with different information, have various errands and limitations. Simultaneously, they are interrelated to guarantee the accomplishment of a definitive objective of taking successful choices.

With MISA module, we decentralize the management of the I.S, creating subsystems represented by agents (supervisor, faculty or department) at the university level and according to its organizational chart to better understand the information flow through the different components of the latter. MISA reveal another space of exploration to fabricate more strong systems.

6. CONCLUSION AND PERSPECTIVES

This work has been implemented to the amount of demonstrating the validity of a proposal that shows the results of an application to a practical case of use our university and thus our research has permit to :

- Mobilize the mass of information available to the university, the aim being to extract, to disseminate and to exploit information required avoiding waste of time and resources searching for knowledge we already have.
- Promote the sharing of information quality, unambiguously, and with ease, which implies that a number of obstacles are removed.
- Develop the method of sharing and collaboration while optimizing internal communication.

- Establish an I.S system based on agents to enhance collaborative systems already existing.

By helping to solve many problems for the entire university community (service "mandatory" cost optimization, etc.) SHARING could and should be considered a basic service not exclusively in the hands of a particular category of actors but on the contrary for a use intended to both teachers, and staff members (intra-university). This work opens up several research perspectives, including adaptation, in the short term, to others universities.

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