

**REDECOOP - Research Group:**  
***Cooperation Network and Knowledge Management***  
**University of São Paulo-BRAZIL**

POMS Production Operations Management Conference – San Francisco USA  
April, 5-8, 2002

**PROPOSAL FOR DATABASE ARCHITECTURE TO AID A DYNAMIC  
COOPERATION NETWORK RESEARCH.**

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**Abstract**

This paper intends to propose the development of computational database architecture to aid a research about dynamic cooperation network among small and medium enterprise in Brazil; The enterprises will provide the data via electronic media; these data will be organized utilizing an object-oriented database modeled with UML (Unified Modeling Language). This database aims facilitating data search, as well as report generation to help and simplify a posterior research using this data.

(UML; DATABASE, COMPUTATIONAL ARCHITECTURE, RESEARCH AID)

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# PROPOSAL FOR DATABASE ARCHITECTURE TO AID A DYNAMIC COOPERATION NETWORK RESEARCH

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## **Abstract**

This paper intends to propose the development of computational database architecture to aid a research about dynamic cooperation network among small and medium enterprise in Brazil; The enterprises will provide the data via electronic media; these data will be organized utilizing an object-oriented database modeled with UML (Unified Modeling Language). This database aims facilitating data search, as well as report generation to help and simplify a posterior research using this data

## **Introduction**

To do a survey with a great number of enterprises requires two main competences, the first one refers to the concepts involved in the survey, the second one addresses to the researches ability to organize a big quantity of data and analyses these information.

With the new electronic technologies the data amount collected by the researches is growing, for this reason this paper suggest a database architecture to allow a quick and easy data consult, as well as the generation of reports which will later make easier an analysis of the information obtained during the research.

This study was made with to help a second research about cooperation network among SME in the electro electronic sector in Brazil.

The electronic sector is one of the best examples of the deep structural changes on brazilian industry and economy. It is one of the most dynamic sectors, with wide branching on the modern industry. Therefore, technological development is the core element to those industries that want to keep up with its evolution, remaining competitive

Due to the growing entrance of international companies of this sector on emerging markets, it is important to investigate which are the strategic options that local companies can adopt to face the international companies. Among the various possible options, cooperation networks look very profitable to those SME (small and medium enterprises), because they make innovation and development easier.

To make data mining easier to an analysis of these cooperation networks, a field research is necessary, and a database would make this analysis much more organized and its data more simply stored.

This field research is being made by the research group "*Redecoop*" (Research group on cooperation networks and knowledge management) of the Production Engineering Department of the University of São Paulo, project to which this research is linked.

## Theoretical and Technological Background

### Database concept

A Database is a collection of organized data that could be easily accessed and managed. Database may contain collections of entries or archives such as business transactions, inventories, catalogs, consumer profiles, researches...

This way, additions or exclusions are much easier than in non-relational database (or "*flat*" plans), where it is only possible to work with one data table at a time. Therefore, flat databases are of difficult extensions in comparison to the relational ones.

The base language of relational database construction is "SQL" which is used for interactive consulting and to collect data to generate reports. This language is used by *IBM's DB2*, by *Microsoft's ACCESS* and in databases from *Oracle* and *Sybase and Computer*.

According to what was mentioned before, a relational database contains many different tables where the information is organized in many categories, and each column represents a type of information while each line is a different record. For example, a table for registry of companies would have this design:

#	Name	Phone number	Address	Name of Contact	e-mail
1	Company 1	4452-4344	A Av.	Contact 1	contact1@data.com
2	Company 2	2323-5656	B Av.	Contact 2	contact2@xyz.com
..	.....	.....	.....	.....	.....
N	Company N	7867-2322	NN Av.	Contact N	contactN@aol.com

### **About OOP- Object Oriented Programming**

The concept of object oriented programming was a revolutionary change in the development of computer programs. In OOP, the focus is put on objects, not in actions, the programming focus is in data organizing, not in this logic. The first program was *Smarttalks* and later came others such as C++, *Visual Basic*, and *Java*.

Objects are mathematical entities that represent in a software an object of the real world. Examples of objects may be human beings (clients, suppliers, users), where each one of these objects has specific information that is called attributes (name, address, phone number...). Another example could be material objects such houses and automobiles, which also have their respective attributes.

OOP is based on the following steps:

- Find which are the objects that the program will manipulate and what is the relation between them, eg., the object *Consumer* can buy the object *Product*.
- Group these objects in classes. For example: *Nathalia* is an object of the object class *women*. These classes may have **sub-classes** and so on, creating what is called **class hierarchy**. As an example, there could be a class *employee* with *salesman*, *technician* and *janitor* as sub-classes.

In this example, it is possible to point out that sub-classes have similar information types, because they are in the same class (every employee has a *name*, *address*...) but also have different information (*salesmen* have responsibilities over products, sales taxes, number of products sold, while other *employees* do not).

The most relevant benefits of OOP are:

- The software call the data by **objects**, and only access the relevant information for each object, increasing information security and denying unnecessary access to the data. This raises the processing speed of the software too.
- The concept of object classes and sub-classes allows that some information of sub-classes are inherited from information that are on classes. This implies on a more rigid data analysis, reduces development time and insures that the code employed is safer.

## **About the Unified Modeling Language (UML)**

In this study, Unified Modeling Language (UML) was used to model the software. UML is an evolution of a several approaches to specify, visualize, and document software system models, including their structure and design to meet their requirements.

UML was chosen due to the fact it is an object-oriented modeling language. Another of its advantages, comparing with other methods, is the establishment of a common modeling language that can be used at all kinds of systems, development phases, large or small scales and different processes.

This modeling language also has these characteristics:

- Accurate: The model can describe the system to be built.
- Consistent: Different views of the model do not express conflict with each other.
- Communicability: The model is easy to communicate to others people.
- Changeability: the model can be changed easily (this is characteristic of object oriented models)
- Understandable: The model is as simple as possible, but not simpler.

## **UML Development Phases**

There are five phases of system development in UML classic designing:

- Requirement Analysis: With the uses of cases, UML captures the customer's requirements without considering how functionality will be implemented.
- Analysis: In this phase, it was made the first abstractions (classes and objects) and mechanisms that are present within the problem domain. In the analysis, only real-world concepts are modeled as objects and classes.
- Design: The result of analysis is expanded into a technical solution, new classes are added to provide technical infrastructure. The design results in detailed specification for the programming phase.
- Programming: In programming (or construction), the design phase classes are converted to actual code in an object-oriented language.
- Testing: A system is normally tested in unit tests, integration tests, system tests and acceptance tests. These different tests use different UML diagrams.

## **Database Discussion**

Before start the database architecture development discussion like a aid a dynamic cooperation network research the first thing to discuss the kind of programming that will be used.

## **Required Characteristics**

The good software plan must have incremental steps in this conception. The type of programming adopted in this study is oriented-object programming, because it has the following features (PRESSMAN, 1994):

- The bigger problems can be decomposed in smaller ones, which are easier to solve, facilitating the software creation.
- The software components (also called modules), once designed and built, can be used many times.
- Once the modules are built, they are understandable without any other references to other pieces of information or modules.
- The programmer can make changes in the program, and these changes are only reflected in few modules, so changes are simpler with object-oriented languages; this characteristic will further reduce the error propagation throughout the software.

## **Database Analysis**

Once we defined the kind of programming to be used and the software paradigms (UML), it is necessary to choose the database requirements.

The database should be able to record more than one kind of questionnaire, since its format is not necessarily equal to all the research project ones. The database also needs to show and to print (when requested) reports using the stored data and some simple statistics tools like standard deviation, averages, graphs and so on.

## **Objects Class Definition.**

After the requirement analysis, the next step is defining the main object-class which will be manipulated in the database. The most important object-classes are:

- Research – Each research has only one questionnaire and reflects a researcher's work. The research includes a lot of work, data and documents.
- Questionnaire – the questionnaire represents all questions for one research.
- Question Group – The question group is a set of questions about a specific subject within the research.
- Question
- Enterprise – A company employee will answer the questionnaire. This class of object represents the company.
- Answer – This is the answer to a question inside the questionnaire.
- Document – There can be a lot of documents about a research in the computer or on the Web; this class of objects reflects this documents.

With this object class definition, it emerges an inheritance among some classes. There are the super class Research, the class Question Group and the subclass Question.

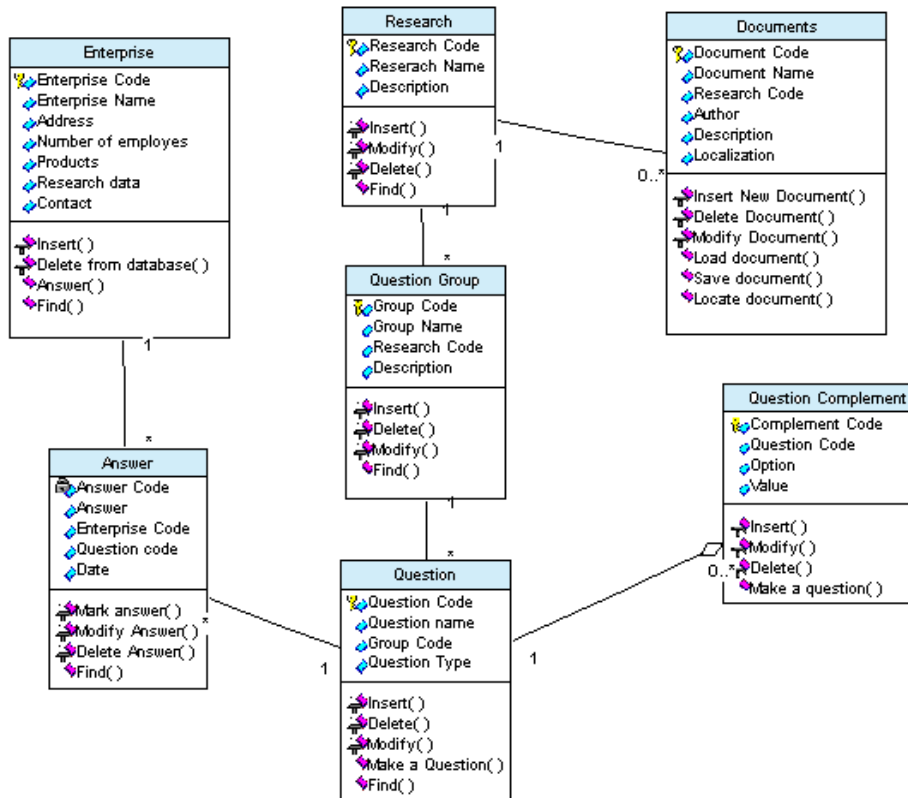
This object hierarchy reflects the fact that questions inside a research belongs to a set of specific subjects.

Yet about the questions, there are four kinds of answers:

- Question with open answers;
- Question with numerical answers;
- Question with yes/no answers;
- Question to choose the correct option.

One more object class is necessary, the Question Complement. This object shows the answer options a question could have, as well as the value that will be answered if these options were selected.

It was said before that it was used the Unified Modeling Language (UML) to model the software, and then the object classes may be described in the following diagram.



With this data structure showed above we can say that database architecture has the following advantages:

- It is possible to store a lot of different questionnaire (with different researches) without changing the original data structure, not being necessary to work the data model specifically for no particular questionnaire, because the programming could be done based in model questions for each kind of answers;
- Because there are no predefined questions in the database programming possible to add, delete and edit the questions. This would be more difficult if the questions were predefined

### Data Mining

The data used in the database provide from information given up by enterprises. They are three different caught ways:

- Electronic forms through a website;
- Attached files via e-mail;
- Directly from the keyboard.



A database in Access was built for this work using the model showed in this paper to aid a dynamic cooperation network research to SME in Brazil. However, the data catch started months ago (march 2002), and there is not enough information in the database to make an analysis about cooperation network in Brazil.

## Conclusions

This paper sought the development of one computational architecture to aid a cooperation network research among SME in Brazil.

The database suggested model supports the data mining of the questionnaires making possible that the user could modify the questionnaire.

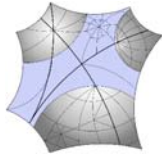
The system allows the answers tabulation and interpretation of these data in simplest way compared with the traditional way without use of database.

Although, it is necessary to repeat that it is an unconcluded research project, and the database model discussed above it is not in its final shape.

It is supposed this study would be concluded within the next three months, and the database architecture showed in this paper will be useful to future research projects.

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**MAIN PURPOSES**

Investigate the possible ways to improve the company's performance and competitiveness through the inter-organizational arrangements and productive cooperation networks as regional clusters, virtual organizations, cooperatives, supply chains, etc. Besides, it is intention to investigate the opportunities and barriers relating to the knowledge generation, diffusion and management through these kinds of inter-organizational arrangements and cooperative networks, under the context of industrial restructuring and globalization process. Specially it has been focused the emergency of the new flexible/agile and lean production paradigm.

The intensification of the telecommunication utilization through the modern *infoways* (*Internet, specially*), is already creating new business opportunities in the different human activities. Inter-firm networks have been created and got more and more importance not just in the developed countries as Italy, Japan, and Germany, but also in the newly industrialized countries as Mexico, Chile, Argentina and Brazil.

The main argument here is that the emergence of new types of industrial organization, specifically those relating to stimulate more inter-firm cooperation, offers new elements to public policies that can support the SME's development

plans. Policies which consider this dynamic aspect of cooperation among companies operating within the same production chain ( and not in an isolated form), that can create synergy of positive impacts, called "*collective efficiency*", in order to improve an inter-firm network as a whole. Considering the high potential of the SME's in terms of its contribution to social improvement ( job creation) and economic growth (increase of efficiency and productivity in the same productive chain), it is important to point out the necessity to offer support towards the modernization of SME's.

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