Software Developmet for Input-Output Analysis.

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Abstract:
We introduce the computational work realizad during the economic investigation projects, based on Input-Output Matrices. The work has been developed with the participation of specialists in Computer Science, this means we have considered and applied a specialized process for software development, to find and to solve some kind of persistent problems, although important commercial packages specialized in mathematical modeling could be used. Our aim is to provide a tool to agilize the work and to provide elements for having a better economic information understanding through images.

Key Words.
Input Output Modeling, Software Development, Software Engineering, Information Visualization, Matricial Estructural Analisys.

Introduction.

The research team in Input Output of The Economics Research Institute, decided to join economists and computational systems programmers in an interdisciplinary group to study the posibility of building a proper software program to support the research job for the Input Output analysis process.

They spect to count with an ad-hoc system to solve different persistent problems than are not yet being solved although they using powerful comercial computer packages for mathemetical modeling, in nowadays market, and to consider the development of better ways to represent the information obtained by the methods, mainly to make the cualitative analysis in this matter. Besides, it could result in an interesting a usefull tool to count with friendly visual ways than can help the undestanding of the economic behavior under study at glance.

The software project development is based on the consideration of defining it over an specialiced process of Software Engineering so based in it, could be possible to define the real problem and all the elements than can solve it.

This document briefly describes how this is accomplished from the Software Engineering point of view, the requirements detected, the proposed solutions, the product obtained since now and finally, the work that has to be done so this can be used as a real software solving tool in the near future.

Contents.

1. Introduction to the Software Engineering Process.

Software development can be focused with different perspectives, one of them based on Software Engineering is used in software laboratories to guarantee the product performance. In projects like ours, it allows to offer certain guarantees on the future product application carried out by a good number of users. Software Engineering technology is complex due to a variety of elements that are necessary to coordinate so we can obtain a good final product. It´s not the main goal of this work to explain all the features around this activity, however as in every project, it is necessary to establish the process to use and the rights and obligations of every role established in the software project.

In this project we have established two kind of roles: Users – economist and investigators, they must communicate their desires, needs and ideas as concrete as possible. Programmers – especialists in software development, they must organize the requirements and traduce them in a program code. Actually both, users and programmers have the same responsibilities on software development.

One of the hardest problems to solve in this kind of software development is the communication one. It is common that users doesn't understand the exact reason to define the whole preamble necessary to develop a program before even writing the first code line, in this way it is sometimes necessary to make them participate with more confidence than only their knowledge in the software development solution process.

Some of the advantages of developing software from this perspective are:

- ✧ Holistic analysis of the problem
- ✧ Definition of its requirements
- ✧ Efficient integration of new processes into the system
- ✧ To make good use of the computational resources
- ✧ Ratification of the methods and concepts used

The main goal of Software Engineering (SE) is to provide useful ways of making the software, so it is capable to give the usability guaranty on the product made available. The SE is accomplished by processes, tools and standards. The process we have selected is known as “Iterative and Incremental” and is capable of working out a system in fairly short steps in such a way that all the processes can eventually get integrated and refined according to the planned requirements. Each step of the process is developed as an iterative and incremental way. Such steps are:

Gestation: step in which the form the system will take is accomplished according to the information available, it´s running platform, the processes and functions we are going to use to develop it. Communication with users is initially stablished.

Elaboration: step in which the analysis is performed. It is the step in which the requirements are done and the overall design is born. Participation of users is vital in this step as it is here where the problem is actually analiced. Although the problem is evident in many ocassions the expertice of the analist should be taken in account to look for other ways of solving the problem in more adecuate but practical ways as in requiring less maintenance in the short or medium time limits.

Building: Step in which all the system elements are programmed and get integrated. It is in here where users join and participate in testing the system from the interface adaptation point of view.

Transition: Where the documentation and users manual is made. The product is finally set free to outer users. Bugs are encountered and fixed. Comments, suggestions and concerns are compiled and the next version of the system is concibed.

2. Capture Requirements.

The first question we should auto-formulate is: Which is exactly the problem that is necessary be solved ?. To answer this question it is necessary to organice working sessions with the users in which the must tell us:

- Which is the knowledge area his work is refered to.
- Tools, methods and processes been used.
- The way they perform their job.
- Problems the have to face.

The analyst must be shure to enclose all the information about the matter by looking after it in documents, articles, books and by questioning other users. After tracking all this steps, the research team was able to conclude some interesting points. These points are:

The job asociated to the Input Output Matrixes (IOM) can be split in two phases:

1. ***Building*** the IOM.
   It consists of methodologically structure the economic information so the IP analysis can be make through a matrix, made by several partitions. This one is stablished based on the theoretical structure of the IP and it´s place within the market being modeled. This complex process is developed by each department of the interior of each country and need to process very large amounts of information. This complex process is not included in this job.

2. Making the *analysis* of the MIP from the economics point of view. It consists of:

   a).- Application of the methods that conforms the IP theory so we can understand cuantitatively and qualitatively the properties of the economy which is represented by the matrix model of the data.
   b).- Updating and reimplementation in the data model. This is done for the development of newer economic hipothesis. Some times this job is related with data extraction processes from the original sources, it is associated with the process of building the MIP´s.
   c).- The search and apply of mathematical models for the optimization and obtaining of newer economic features from the IOM.

The IP analysis by itself has it´s own stages:

- Operational Stage: for the update and organize of data, checking of the economic validity of results and the use of methods according to the quantities, volumes or prices to use in order to backup any economical hipothesis.

- Descriptive Stage: The analysis must consist in reflecting cauntitatively the “who”, “how”, “where” and “why” of interindustrial relations, that is, the way that the diferent sectors of the economic structure participate. This stage also defines the weight of each one of the sectors with respect to the total system or with respect to the other sectors.

- Interpretative Function: It´s a function to analyce the quality state of these relations (cualitative analysis), it also analyces the strenght or weakness of the relation between sectors and its causes (historical, structural, coyuntural). Concepts as key relations, impact, fluxes, hierarchy and clustering among others are used.

- Planned Function: It´s a function to take a stand from the acquired knowledge, for example, decide about economic politics: investments, technologies, employment impact, impact in the final demand or economical growth.

It is setted up that the economic analyst job consists also in disigning and confirm the validity and economical aplicability of a model. To perform this, the analyst needs to define explicitly the set of transforms applied to the structural components of the matrix under the algebraic symbolism of the modeling discipline used. For the IP analysis the next disciplines used in the applications are mainly identified:

- Matrix Algebra - Clusters.
- Graph theory. - Mathematical Programming.
- Pretopologies. - Statistics.

It is also determined that some models, mainly those refering to the cualitative analysis, could be improved by presenting their output in a visual way so it can be possible to distinguish the economical elements under study in a lively, direct and attractively way.

The posibility of automatize some methods used in IP was considered, however it was seen that even the best known methods are nowadays suffering changes, and even if they are very small, can have an impact in the overall performance of the system if we are not able to update them.

Lastly, users gave their needs and told what do they expect about a new software beyond what they use nowadays as MAPLE, MATLAB and EXCEL among others.

In general form, these requirement are:

- The cell format in a worksheet is suitable to interact with data, however there are restrictions to interact with fairly big matrixes. There still many steps we have to perform previously to the analysis, and we need to “adapt” those that are time consumers.

- Many users have problems to work with packages that use compley languajes.

- Developing visual ways of the economic information can be attractive and could improve the performance in using the IOM information making it easier.

3. Design.

Once defined the requirements we are able to proceed with the design of the solution. It lead us to:

- Produce a system as if it was a worksheet and that will contain the elements to use the matrix collection which conform the Input Output system as a whole.

- We found that to manipulate and use the information in an easier way (accessibility and mathematical use), the best option is to use a system with variables, that is, mark data and nameit as a name of a variable.

- To have an element to develop ecuations and that use a languaje as similar to as the mathematical one.

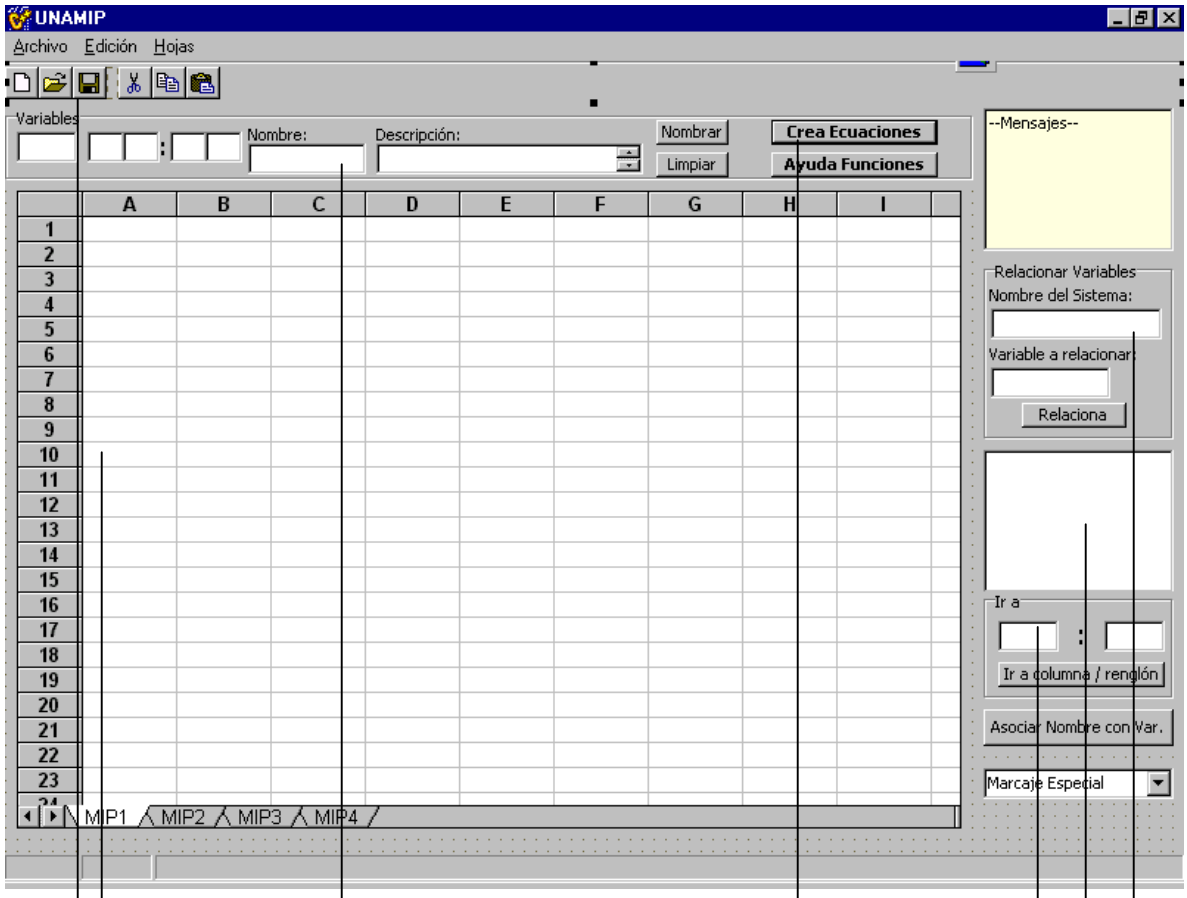
- Deeply watch the performance of the system by using efficient computational algorithms allowing process executions at a good operating speed.

- Implement output reports in a visual and printed form.

- To make it interact with other packages

4. Results and Future Work.

The system under construction looks like:



Through this interface you can:

- ✧ To copy and paste information from EXCEL spreadsheet.
- ✧ To mark an area an name it as a variable name. The name and variable characteristics will appear in the selecting variable area for direct access.
- ✧ Select variables and to relate them to conform de Input Output system, so you can perfom operations over the whole system like Σ and aggregations.
- ✧ To build and execute ecuations using variable names, supported by a mathematics package.
- ✧ To access a variable specific element.
- ✧ To seve all the project information to future work.

Thanks to the iterative and incremental process we are involved with, we expect to improve the system by adding functions to it. We also expect to improve it´s functionality by eliminating the limitations it has in this area and add features to make it interact more friendly with other packages.

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