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CEPE: A Cooperative Editor for Processes Elicitation

**Flávia Maria Santoro
Marcos R. S. Borges
Jose Alberto Pino**

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Universidade Federal do Rio de Janeiro

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Flávia Maria Santoro flavia@cos.ufrj.br COPPE/Sistemas UFRJ Caixa Postal 68 511 - 21 945 270 Rio de Janeiro -Brazil	Marcos R. S. Borges mborges@nce.ufrj.br NCE & IM UFRJ Caixa Postal 2324 - 20001-970 Rio de Janeiro - Brazil	Jose Alberto Pino jpino@dcc.uchile.cl DCC Universidad de Chile Casilla 2777 Santiago - Chile
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Abstract: Companies normally hire external consultants to carry out their Business Process Re-engineering. While this can be straightforward in the short term, it does not produce the desired result on the mid and long terms. A low level of workers' involvement with a consequent resistance to changes, and a continuous dependency on external consultancy are the main drawbacks. We propose an alternative approach to BPR, specifically to Workflow Design, where company workers play an active and important role in re-designing the organization's processes in a cooperative style. The paper describes the essence of a BPR method based on participatory design and stepwise refinement, which we believe, will generate better results than the traditional approach. We also present CEPE - Cooperative Editor for Processes Elicitation -, which is a cooperative graphic editor that supports the processes knowledge building. That is the second phase of the proposed method.

Keywords: Business Process Reengineering, Workflow, Process Elicitation

1. Introduction

Business Process Reengineering (BPR) can be defined as a total replanning and redesign of manpower, internal system and structure, and processes in direct or indirect response to external forces, in order to achieve some objectives which are usually not easy to achieve given current conditions of an organization [POH98].

BPR is the natural first stage of process automation within an organization. The Workflow Management Coalition has in fact separated Process Automation in two consecutive steps: Business Process Definition and Workflow Automation [MARS97]. Although a process can be automated without a redesign, it is probably less expensive than including the study, but also less satisfying to the organization. The last consequence occurs because the same old approach will be used in the process to be automated and an opportunity for real change will be missed.

Various approaches to BPR have been proposed at all levels. From a strategic point of view, the following are some proposals. Strategic Reengineering [SCHN93] uses Critical Success Factors to define strategies and processes. Transitioning [TAPP93] perform the Reengineering of the business together with Retooling Information Technology and

Realigning the IS Function along four concepts: Reimage, Reshape, Realize and Renew. The Gemini Consulting's Framework [GATE93] has also four concepts to be applied as a methodology to reengineer: Reframing, Restructuring, Renewing and Revitalizing.

From the tools point of view there are also several proposals. Action Workflow Analyst (from Action Technologies, Inc.) can be used to create graphical maps that model business processes. These maps can be analyzed, optimized and then exported to Action Workflow Builder to create applications [ACTN94]. BPwin (from Logic Works, Inc.) also provides a graphical environment to the users. It can be used to view the business model from a variety of perspectives (tree, process-oriented, etc.) [LOGC98]. BPwin has features to help ensure quality and consistency in the data model and allows "what-if" analysis. Animated simulation of a business process model is allowed by Extend+BPR (from Imagine That, Inc.) and the whole modeling can be done graphically [IMAG95]. ExSpec (from the Eindhoven University) uses Petri-nets to model and analyze workflow processes [VAN94 et al.].

BPR is usually provided by outside consultants. The obvious advantage of doing this is that consultants are not involved with a fixed model of how the business can be done. However, this openness is compensated with some disadvantages that the incorporation of external consultants involves. The first is the high cost of hiring consultants [MARS97]. Then, perhaps the BPR result is too ambitious for the current culture of the organization and thus it has little chance of being implemented. Third, the employees are excluded of the analysis and faced with the result, they may reject it or accept it only because they are forced to it.

This paper presents an alternative to the work of the outside consultants. The model to be described involves the employees of the organization and thus, it does not have the last two disadvantages of the external consultants mentioned above.

It also has as additional benefits much satisfaction from the employees: self-esteem, joy of being capable to understand and analyze the goals of what they are doing, be able to propose changes, joint work with colleagues, etc. But it may be slow and need management orientation and guidance.

The remainder of this article is divided in 4 parts. In Section 2 we present a summary of the PAWS method. Section 3 presents details about the process elicitation. The CEPE tool is depicted in Section 4. Section 5 illustrates a possible interaction with the tool and finally, Section 6 concludes the paper.

2. PAWS - Participatory Design Methodology

The PAWS method has been proposed by Borges & Pino [BORG95, BORG99] as a solution to the problem of lack of participation of workers in the organization's reengineering. The PAWS main idea is to directly involve members of an organization undergoing a business process re-engineering in this task. This involvement should be done in six consecutive stages aimed to: get acquainted with the method and the objectives of the exercise; elicitate the current processes and identify their problems; generate solutions and alternatives to potential candidates for re-engineering; evaluate options and select a model; implement and validate the selected model and finally, maintain it. These six stages are outlined below.

a) Learning Stage

During the learning stage workers involved in the selected processes and willing to participate in the re-engineering project will be subjected to training sessions. Re-engineering and cooperation are complex concepts that need to be fully understood before actually applied. This stage aims at preparing participating workers to the subsequent phases of the re-engineering project by means of teaching the correct use of re-engineering concepts and also how to have a cooperative attitude towards the collective tasks required in the PAWS approach.

Explanations and theoretical discussion may not be enough to reduce employees' doubts. They may need to grab the concepts by applying them to concrete examples. Because understanding of concepts requires some practice with the method, this practice should not occur during the actual re-engineering process. Letting employees practice with re-engineering applied to a hypothetical case will help them to get acquainted with the method and be prepared to use it with their own work environment. Moreover, employees should be encouraged to exchange their own views and doubts. This may be a good way to start the collaboration.

b) Elicitation of the Process and Identifying Problems

At this stage, project participants should model the current process definition. Most existing non-automated processes are ill defined and without documentation. An organizational memory whose function is to store these definitions is either inexistent or obsolete. Besides, participants are seldom aware of other participants' roles and tasks making it difficult to recover the process definition without the cooperation of all people involved. The goal of this task is to have the process fully elicited and all or most doubts about the process flow resolved.

The identification of problems is the fuel for workers to reach a more ambitious goal: the process elicitation. It is impossible for somebody to define a process that is not fully understood. On the other hand, it is necessary to define a starting point for this understanding. The reason why we started with the identification of problems and bottlenecks is two-folded. First, workers at the bottom level of the organization probably have difficulties to fully understand the conceptual business. They normally focus on their daily activities and their immediate neighborhood. Second, they are best in pointing potential problems than solutions until they understand the full implications of their work.

During this collective knowledge building step, participants are also expected to contribute to the identification of possible problems with the current work environment. These problems may or may not be real and refer to little or large bottlenecks, redundancies, exceptions, common shortcuts, excessive paperwork, delays, task dependencies and lack of necessary information, among others. The interaction process should produce some evidence and agreement that these problems exist or are misleading. The output of this activity should be an initial documented identification of the real problems and their origins.

A computer-based system to easily store and depict both problems and solutions is called for at this stage. The idea is that people themselves be able to describe their contributions in a non-ambiguous fashion. The specification should be largely iconic and without much detail. The PAWS proposal is to support this stage with a cooperative editor, both graphical and textual, where people will collectively represent their knowledge and

concern about the processes. A system prototype supporting this interaction and recording the process elicitation is the focus of this paper.

c) Generate solutions and alternatives

After the identification of problems and bottlenecks is complete, it is necessary to work on their solutions. It is well known it is much better to have several options and then choose the best one than immediately adopt the first satisfying solution. Therefore, the group should be aware of this and share the need for several solutions. There is also the danger of solving small problems without concentrating on alternative problem statements at a higher level, which would provide better solutions. Of course, this is a problem in any engineering design [KRIC69], but in the PAWS proposal it is particularly critical because employees will naturally tend to view problems at an operational level, missing statements at the tactical level.

The output of this phase is a set of optional solutions to the problems identified in the previous phase. People may have preferences and they may be stated, but no decision is made yet.

d) Evaluate options and select model

This phase has a new model of the organization's processes as its output. Since this involves a very crucial decision, it has to be led by management. The design group has to present the choices to the managers, including an evaluation. The evaluation may be incomplete, since the design group may not be aware of certain costs, strategic decisions or other information. If management provides this type of feedback, a new cycle begins.

The generated model needs also to be validated in conformity to the original goals of the business process re-engineering. Although the proposed method induces a continuous validation by systematically exposing the solutions to the group, the result should also be submitted to an independent body. In carrying out the validation process a number of techniques might be used. Inspections and walkthroughs are good examples of such techniques. Simulation techniques or use cases can be used to produce insights and anticipate potential improvements.

e) Implementation

After the process model has been reengineered, it is necessary to put it to work. If the process control is automated, the implementation stage is called workflow automation by the Workflow Management Coalition [WFMC95]. Part of the advantage of having a well-defined process is that it can be easily automated and supported by a workflow management system.

The activity of mapping the process model generated by the reengineering work to a workflow model was greatly facilitated by the interfaces defined by the WfMC [WFMC97]. The major software developers have adopted the reference model defined there, which means the implementation is an almost straightforward activity. It also means it is easy to go back and forth if some problem in the process model is found during the implementation phase.

f) Maintenance

In software maintenance, it is easier to maintain a system if the maintenance team participated in the design of it. The same applies to business process design. Moreover, the maintenance needs and their materialization are greatly facilitated if participants of the process are also the ones who provide maintenance. The PAWS approach shows its major advantage during this phase. If a consultant has to be called every time a process changes then the cost of the maintenance would be very high.

Essentially, the maintenance process is very similar to the cycle defined by the four previous phases. Problems have to be identified, alternatives proposed and a solution selected and implemented. The maintenance phase can be considered a mini reengineering cycle.

3. Elicitation of the Process

As we mentioned before the identification of problems is mainly the fuel for workers to reach a more ambitious goal: the process elicitation. It is impossible for somebody to define a process that is not fully understood. On the other hand, it is necessary to define a starting point for this understanding.

The reason why we started with the identification of problems is two folded. First, workers at the bottom level of the organization have difficulties to fully understand the conceptual business. They normally focus on their daily activities and their immediate neighborhood. Second, they are best in pointing potential problems than solutions until they understand the full implications of their work. The sequence of steps we defined as ideal consists of the following operations:

- workers agree on the definition of working stations. A working station is a logical unit of work representing one organizational unit;
- workers define one or several working stages and for each stage they describe the task (s) they are directly concerned;
- for each task they should also describe its known outcomes and its destination by means of linking it to another stage. If the destination stage does not exist they can link the outcome to one of the working stations previously defined;
- when creating a new stage they verify whether there exists in their working stage, one or more links applying to this stage. In this case, they connect the appropriate links to the stage being defined.
- if they are in doubt in any of these definitions they can tentatively define them and assign a question mark to them.
- in parallel to the definition of their stages they can also state doubts, problems and suggestions to other elements (stages, links, outcomes, etc) of the processes.

As we can infer from this definition, workers should go through several interaction steps until they reach something meaningful. One worker can contribute to others by explicitly expressing their knowledge in the form of clarification of doubts or definitions.

The whole idea is to advance in the definition of the process adopting a stepwise refinement approach. At the end of the interaction, we expect that most of the stages have been defined, but a number of questions might still be open. We also expect a number of problems and suggestions in each of the elements. In the next section we define in details this interaction process and the tool to support it.

4. CEPE - Cooperative Editor for Processes Elicitation

CEPE is a groupware tool developed to support the second stage of the PAWS Methodology-Elicitation of the Process and Identifying Problems. In this way, it should meet the following objectives:

- To allow collective elicitation of knowledge on existent problems, its origins and possible solutions.
- To facilitate description of a model for the processes through a group of graphic elements and the possibility of incorporation of ideas and comments on this process.
- To present the contributions of the involved group members in the least ambiguous possible way.

4.1. Description

This tool presents a Cooperative Graphic Editor which provides a space for basic workflow model collective construction, where problems could be discussed, allowing addition of comments and suggestions about each of the workflow stages. Besides it provides some awareness mechanisms. It uses a set of elements extracted from the Regatta Project Model [SWEN93] and generates an outlet closer to a real workflow model.

The Regatta Project had the goal of developing a software to support workgroups, and to aid in business processes reengineering [SWEN93]. The model proposed in this project treats processes as tasks requisitions, using graphic elements to represent them.

CEPE was developed with the GroupKit environment, which is a toolkit intended for building real-time shared applications supplying group communication functions [GRPKT98]. The applications are written in Tcl/Tk.

During a session of a CEPE conference within the GroupKit environment, participants may add elements in order to represent the processes they want to describe. They may also describe their current tasks and the relationships among them. Table 1 describes the CEPE elements.

Participants can also associate comments, suggestions, documentation, information on possible mistakes or inquiries on the process, and free drawings done in a scratchpad. The scratchpad serves as a discussion space as well. The members can also send messages to the others and optionally associate them to a selected graphic element.


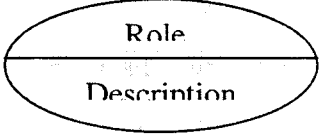


Element	Description	Graphic Representaion
Roles	<p>A role represents the function carried out by somebody who executes some task.</p> <p>All tasks (stages) must have one role associated to them.</p>	
Places	<p>The first expression that a person can use trying to describe what she or any other one does is the place, department or work section. Then, inside this place, people's tasks can be detailed.</p> <p>A place is represented by a graphic window in which all the other elements will be positioned. It contains a self description.</p>	
Stages	<p>A stage represents a task, that is executed in the process.</p> <p>It contains a self description and a role associated to it.</p>	
Options	<p>An option represents a possible outlet for a task (stage).</p> <p>It contains a self description</p>	
Events	<p>An event represents a flow of passage through stages when an option occurs.</p>	

Table 1 - Elements and their Graphic Representation

The consultant should play the facilitator role, observing how the process is being followed and eventually interfering with suggestions and messages, making the participants review the previous work. For example, there may be interrupted flow (a stage not having a successor). The consultant is responsible for determining the end of the process, whenever the work flow seems to be closed for that group.

A file can be generated registering the whole process, as well as the associations made by the participants to its elements, guaranteeing the memory of the whole process is to be preserved.

4.2. Elements

Through the "Elements" option of the Main Menu, the CEPE elements can be added to a design. The following is a description of these elements.

1. Roles

The user can add new roles into a list with this option. This list will be used for selection at the time of adding a new Stage.

2. Places

The users should fill a description for the Place. In the main cooperative work space, a square with this description will be positioned, indicating there is a new place, and being visualized by every participant of the session. A window will also be created which will contain the stages performed in this place (Figure 1).

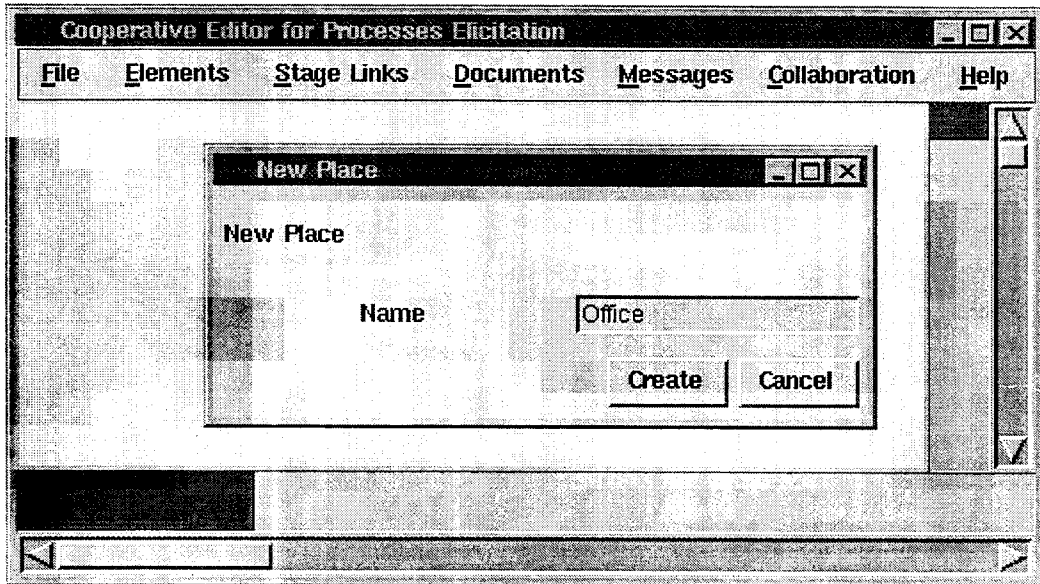


Figure 1 - Addition of a Place

3. Stages

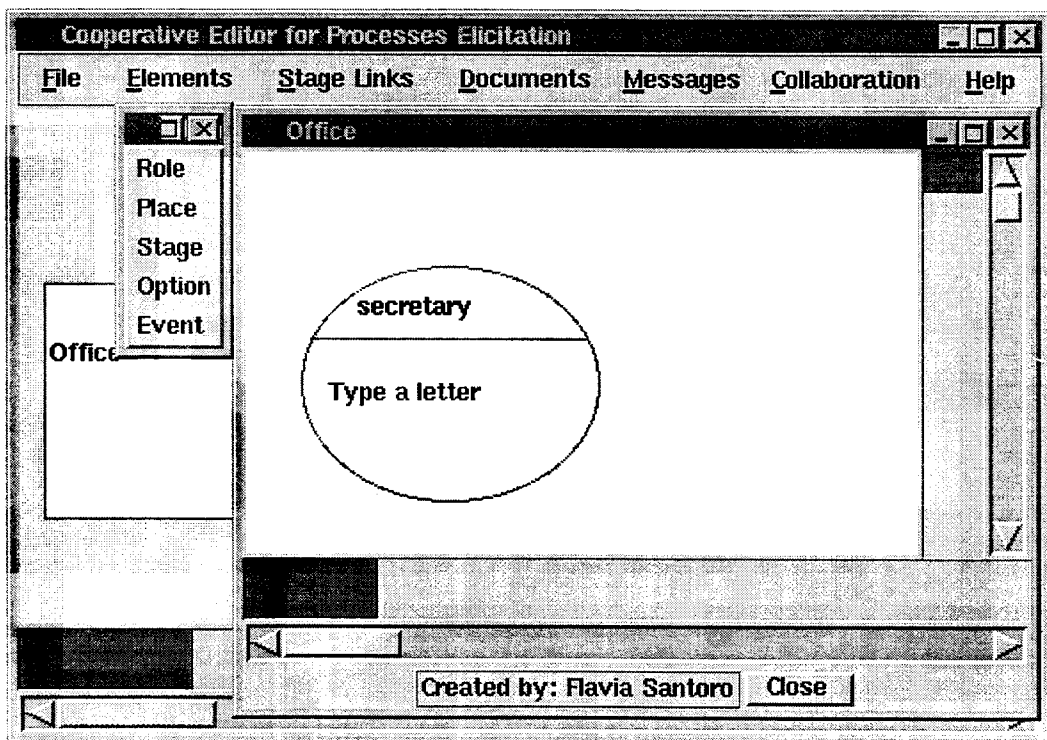


Figure 2 - Addition of a Stage

The users should fill a description for the Stage, as well as to select one Role and its Place. The new stage will be immediately incorporated into the cooperative workspace, being visualized by every participant of the session (Figure 2).

4. Options

The result of the accomplishment of a task described in a Stage is represented through an Option. The users should supply a description, and then indicate in which Stage they want to incorporate the new option (Figure 3).

5. Events

After selection of an Option, the flow of tasks proceeds to a new Stage. To indicate this flow, Events can be added (Figures 3, 4 and 5). A person may indicate the exit or entry of a stage without knowing exactly which stage this exit is going to, or from where this entry comes from. In these cases, the person can just indicate the place of destination or origin (Figure 6).

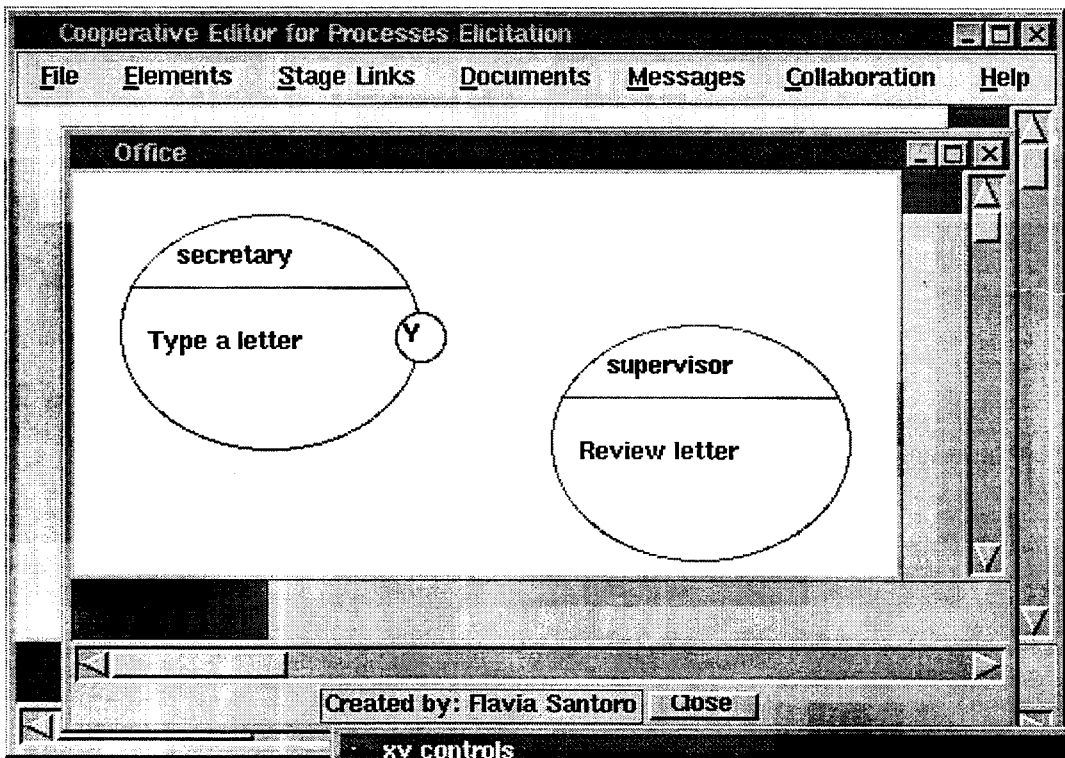


Figure 3 - Options

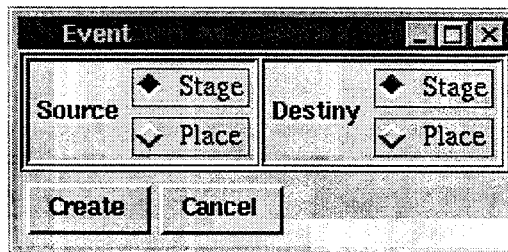


Figure 4 - Events (selection of origin and destination types)

Later, this uncertainty can be solved with the help of the tool, which indicates all the places where unsolved entries and exits exist, through a small circle positioned on the left side (entries) or on the right side (exits) of the place, with the number of indefinite situations. A list of the entries can be observed when pressing the central button of the mouse on the place. Pressing the right button allows to view a list of the exits. A double-click in an item of these lists allows the user to select a stage, solving the situation Figure 7).

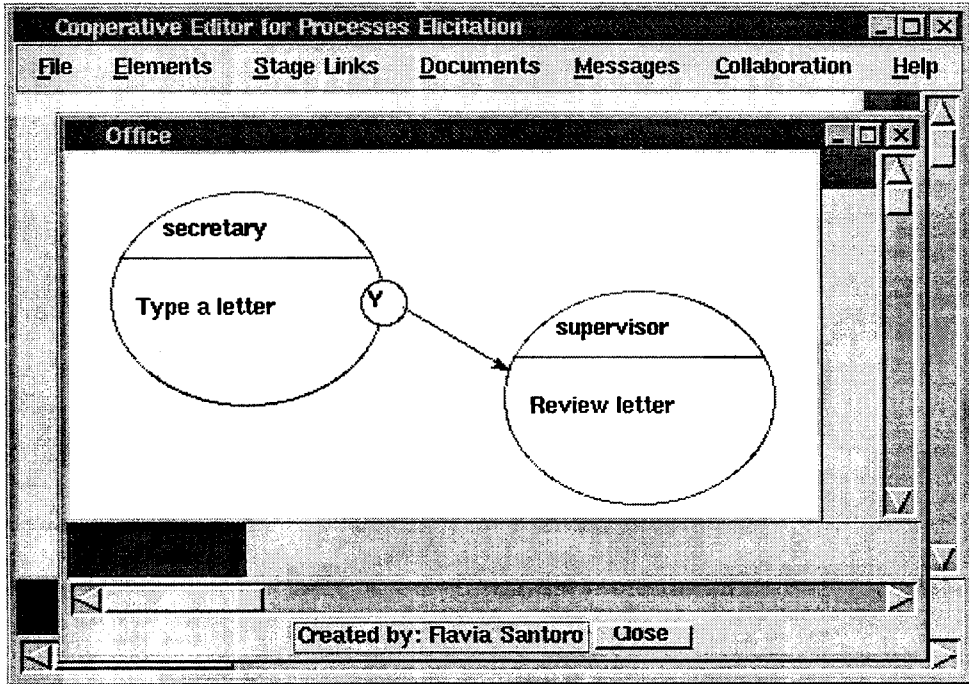


Figure 5 - Connection between two Stages

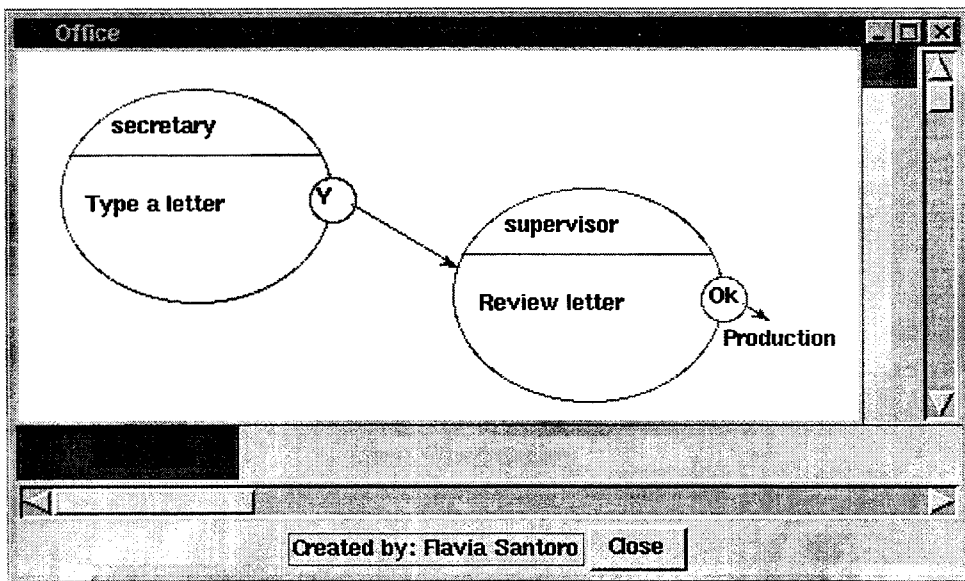


Figure 6 - Connection between a Stage and a Place

4.3. Documents

In processes related to business, the stages usually produce documents, which are passed or not to the following stages. Entrance and exit documents can be registered and associated with stages.

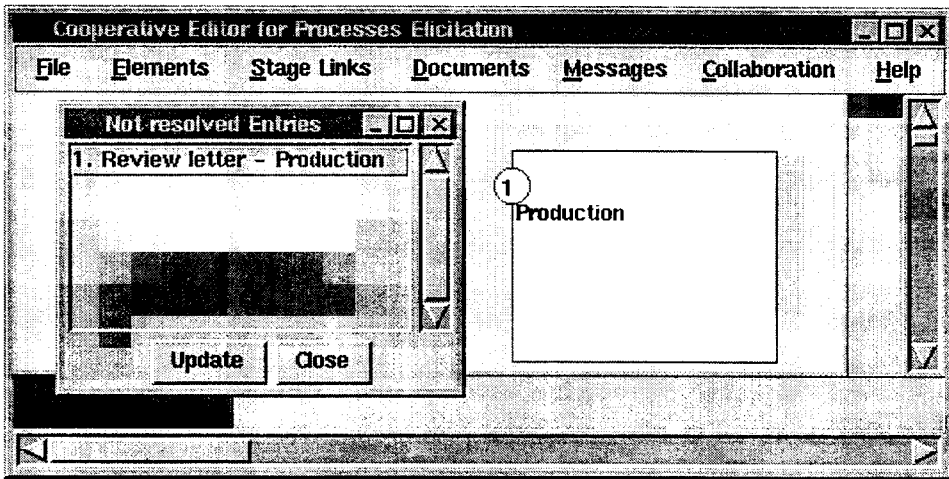


Figure 7 - Solving of an undefined situation

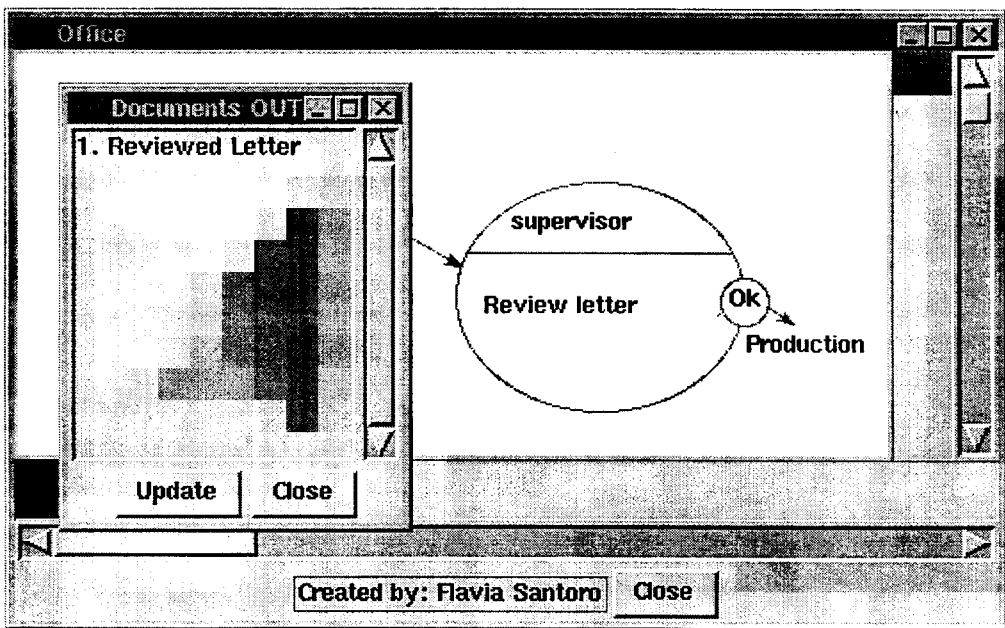


Figure 8 - Documents OUT

Through an event, a stage can pass some of its exit documents to the following stage. People involved with the tasks represented by these stages can confirm the exit and entrance of the documents, marking them in a list. If a document is associated to a certain stage, but the person in charge does not accept it, there is a conflict to be solved..

Pressing the central button of the mouse on a stage, the list of its entrance documents is presented, and pressing the right button, the list of its exit documents is presented (Figure 8). If the right button is pressed on an event, a window with the exit documents will be presented, with the possibility of selecting those to be passed to the following stage (Figure 9). If the documents are selected they will automatically appear in the following stage entrance list.

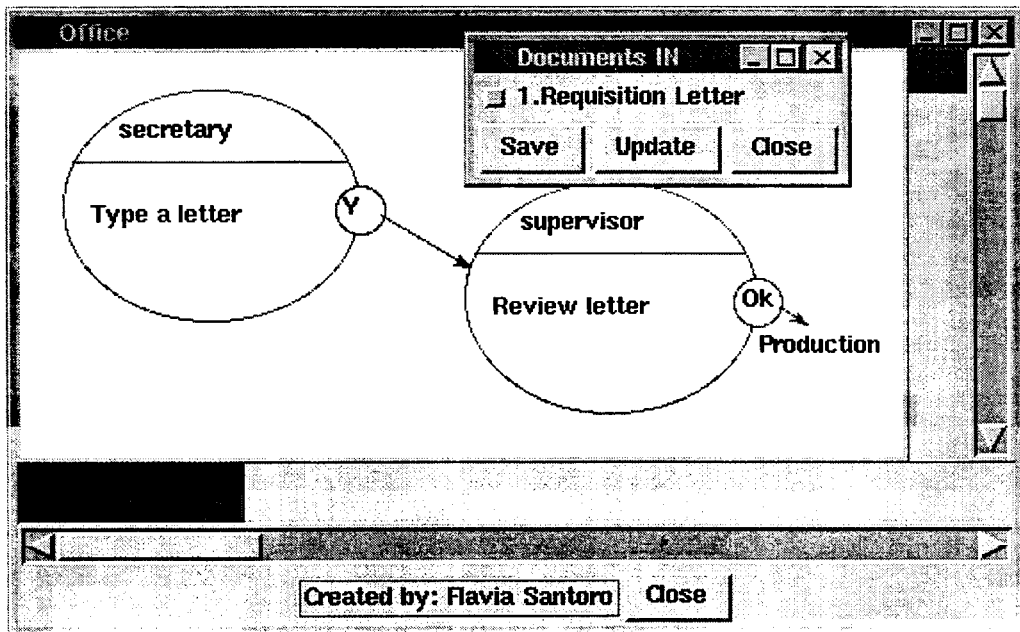


Figure 9 - Documents IN

4.4. Messages

The tool has available a system of messages. The messages can be sent to one or more persons. The messages may also be attached to any element of the design. They are quite useful for the facilitator who can call attention for not well-solved situations and to address suggestions to specific members of the group (Figure 10).

4.5. Group of Icons

The tool allows the incorporation of comments, suggestions, inquiries, mistakes, and free drawings /discussions on the elements proposed by the group. Thus, the participants' opinions and ideas can be stored for later reference.

The means to insert comments, suggestions, inquiries, mistakes, documents and free drawings (or discussions) can be through an icons table, open automatically when the conference is invoked, or selected through the Icons option of the Windows menu.

Each column of the window of icons corresponds to an element and its possible associations. Thus, for example, if the user wants to add a Stage it should press the first icon of the first column, and if he wants to add a comment to this Stage, it should press the second icon of the first column. By doing this, users enclose a window containing a text about the element they have selected (Stage, Option, or Event). An indicative icon for the comment will be positioned close to this, and its background color will be the user's color set during the conference. Besides the easy visualization of the comment type, its text can be accessed at any moment, for any participant of the conference, and the author of the comment is also registered.

The access to the text is made by pressing the central button of the mouse on the representative icon enclosed in the main window. A double-click on any element makes a window with all the associations done to it to be presented (Figure 11).

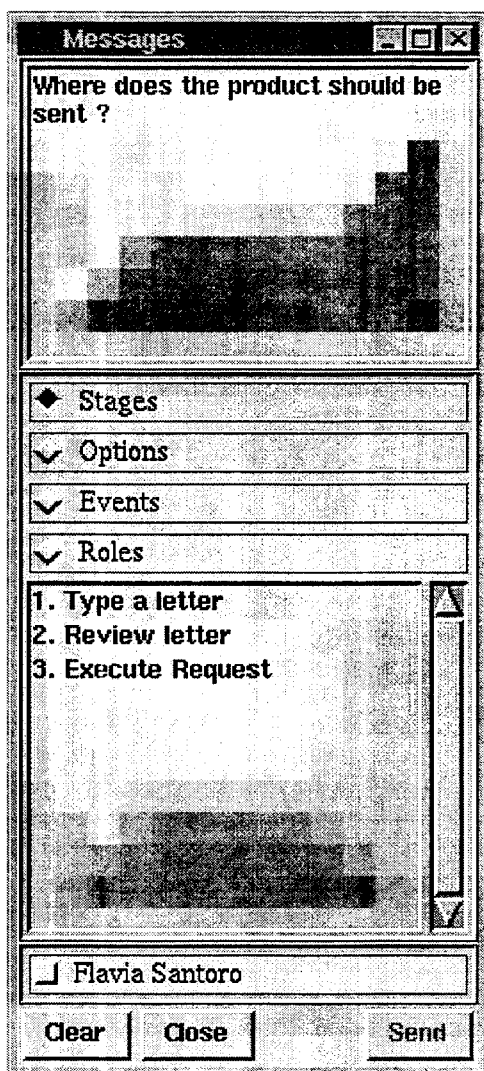


Figure 10 - Sending a Message

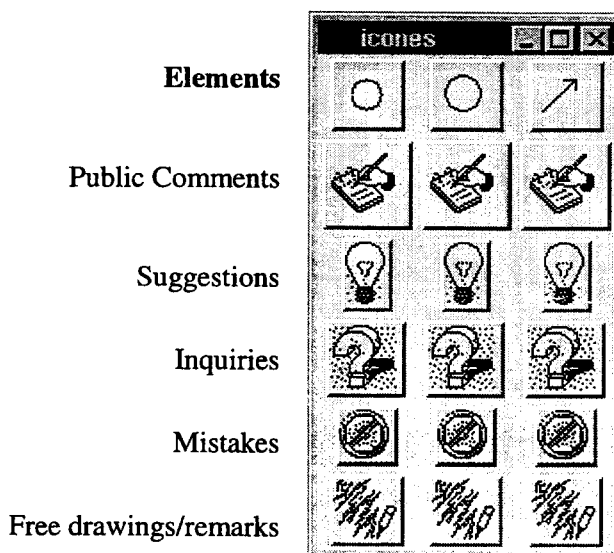


Figure 11 – Icons

1. **Public Comments:** Users can write more information, or just give some opinion about the process (Figure 12).

2. **Suggestions:** Users may just want to present a suggestion for a problem, and it will be represented by special icon.

3. **Inquiries:** During the description of the process, doubts and unresolved questions may arise. The possibility of registering them is to add a window with a text describing it, represented in the workspace by an inquiry icon.

4. **Mistakes:** Through this mechanism, the users can enclose a window with possible mistakes they found to be happening in the definition of the process, on an element.

5. **Scratchpad for Discussion and Representation of Outlines:** The Scratchpad allows collective insertion of texts and free drawings. It can be used for discussion on some subject approached during the elaboration of the processes, or to create a schematic representation in the context of the described problem.

A discussion/drawing can be stored during the conference and can be accessed through a representative icon associated to any element. The access to this picture is made pressing the central button of the mouse on the representative icon enclosed in the main window (Figure 13).

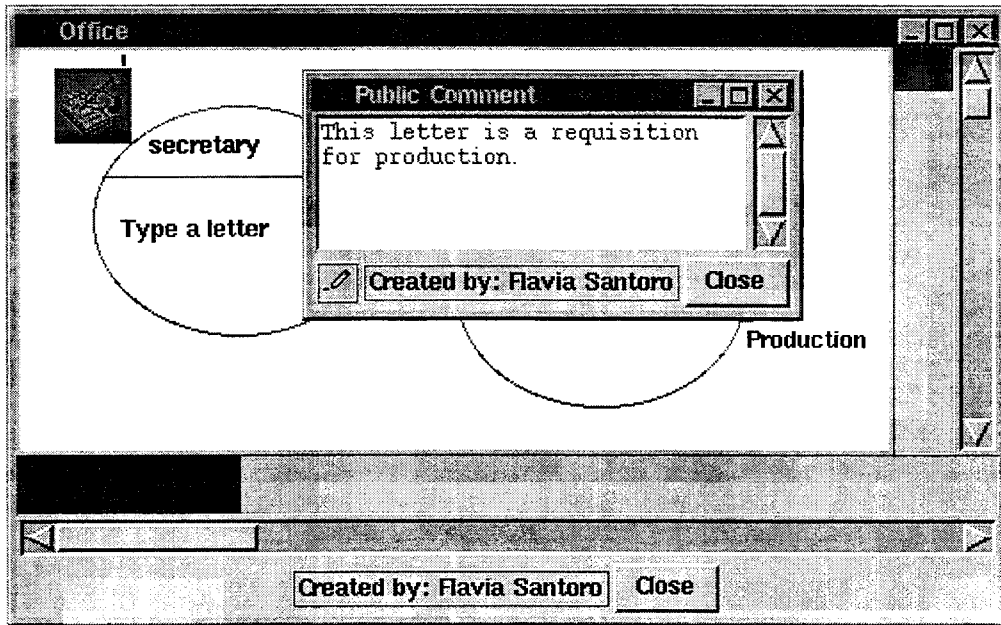


Figure 12 - Public Comment on a Stage

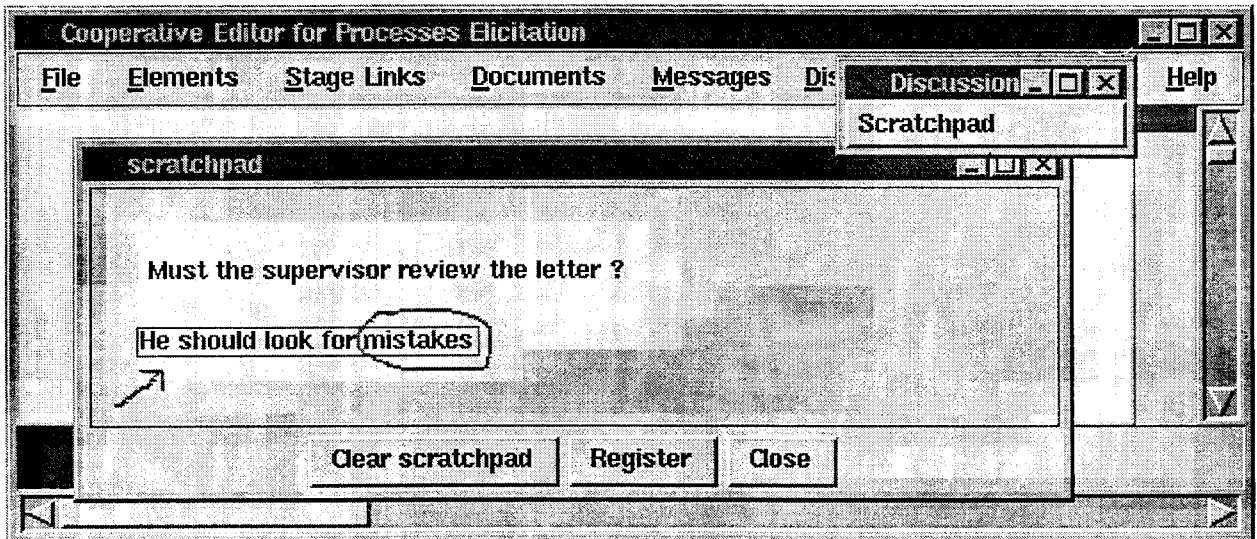


Figure 13 - Scratchpad

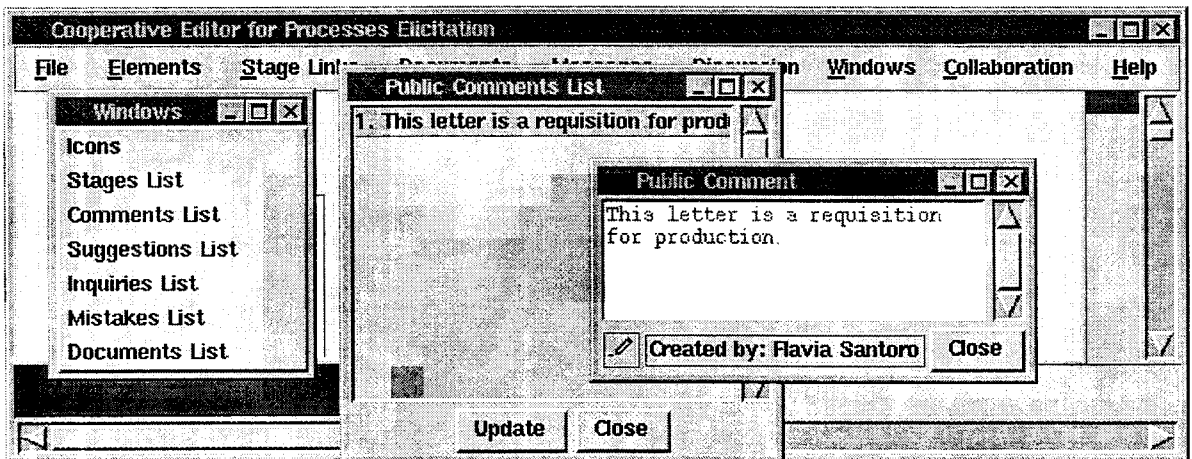


Figure 14 - List of Comments

4.6. Lists of Associated Elements

The Windows option of the main menu can be used to select the lists of comments, suggestions, mistakes, and inquiries associated to the several elements of the process. For example: A list with all the enclosed public comments can be visualized, if the Comments List option is selected in the Windows menu. The double-click on any item of the list allows access to the text of the selected comment (Figure 14).

4.7. Awareness

The tool provides the following awareness mechanisms:

1. Each user is associated with a different color. In the main window, the elements inserted by the users receive the contour of their respective colors, and the background of the comments' icons also gets the users' colors.
2. Telepointers with each user's color indicates where the cursor of each one is positioned.
3. Shared Scrollbars, with the different colors, show the position in the text of each user.

5. Typical Use of CEPE

In the previous session we described all CEPE functions. We will now illustrate how the CEPE tool should be used in a typical situation, in which CEPE operates under the PAWS context. We should start by considering a group in the organization that will apply the PAWS method to process reengineering. The group members should have gone through the Learning Stage, so they are already familiar with the method and the CEPE environment.

The BPR group will interact several times before the work can be considered done; it means, until all tasks and their relationships are exhaustively described. During an interactive session, each participant is expected to describe his own tasks within the process and then to point out problems in the whole process and give suggestions to their solutions. It is necessary to define the list of roles played by the group. The initial list can be extended as necessary to accommodate additional roles identified during the elicitation process.

After the role identification step, group members, with the help of an external consultant, start describing the "Places" where activities take place in the organization (for instance, Sections, Departments, etc.). Each member will then try to describe the tasks in which he participates. These tasks are called "Stages" by the tool. When a member writes about a task, he must associate it to a role and provide a short description.

After a period of time, it is expected that several Stages should have been described. By then, it is time to start thinking about the relationships that exist among them. The relationships will establish the process flow. A Stage is always associated to a task, which may have several outcomes. Each of these outcomes should be linked to another Stage. The possible outcomes of a task are defined by the Options Stage in the CEPE tool. When registering an outcome, the associated "Documents" must also be defined.

During this “clarification” phase, some disagreement or doubts might occur. The tool supports the registering of all opinions and doubts. All suggested process flows can be graphically represented, even if they imply ambiguity. At this time, the group should not be worried about decisions, but about eliciting problems, uncertainties and suggestions for solutions. At this time, everybody is encouraged to “express” and represent what they think about the process. For instance, one member might declare that a document he produces goes to a certain stage, but the member in charge of this stage might not confirm this.

People may use the “Scratchpad” to discuss something they find relevant in order to register it. At any time, they can open a window and invite others to give their opinion by placing some text or schema in the scratchpad. At the end of the discussion, they may select the <Register> option in order to save it and associate it to one of the elements (a stage, for example).

The CEPE tool also allows members of the group to add comments to any element of the process. A comment consists of a text, and is represented visually as an icon placed next to the element to which it is related. The icon represents the type of comment, making it easy to understand what is being remarked about that element.

It is also possible that participants send messages to others and associate these messages to a specific element. In this way, every interaction will be related to some element and made persistent by the system.

This entire interaction will lead to an initial elicitation of the process and may be carried out in as many sessions as necessary. The facilitator is responsible to determine when the resulting model is satisfactory. The outcome of this tool is a set a descriptions, suggestions and relationships that will be processed in the next stage of PAWS method, when the solutions will be selected.

6. Conclusions and Future Work

Re-engineering may be considered a challenging and permanent cooperative task. In order to achieve the best results, we should involve as much as possible all agents that can contribute to the understanding of current practices and to their improvement. As already confirmed by several studies [DAVE93], reengineering is not only a one-time event, during which all processes have been optimized. It requires a permanent care of the processes, adapting them to the demands of the organization.

This paper presented a proposal for how to deal with reengineering with full participation of baseline workers supervised by reengineering consultants. It presents a method and a tool to support one of the six stages of the method.

The tool is aimed at the elicitation of processes. By elicitation, we mean the specification of processes, the identification of problems and bottlenecks and their requirements for improvement. The tool embeds a support for the necessary interaction among workers to express their knowledge about the processes and to reach a consensus about what needs to be improved and where.

CEPE was developed on top of the Groupkit environment [GRPKT98]. It intends to give support to one of the six stages of a reengineering method. The focus in workers' participation and cooperation provided by this method is the main benefit brought by this tool.

Both the method and the tool require validation in real situations. Although we have used it in experimental situations, we believe that much can be learned when the tool is used in real BPR projects. We are especially interested in finding out whether the interaction process really contributes to the improvement of the reengineering work and to increase cooperation among workers.

To test and validate the tool, we expect to use it in a real-world case. Several cumulative conditions are necessary for the experiment to have a high probability of success. First of all, the participants must be willing to undertake a BPR project, meaning they must find time, patience and availability for a new working scenario. Second, the participants must be computer users and must have some short training in CEPE. Third, the project must not be too simple or too complex. Fourth, ample support must be available, both on the software side and on the business processes.

While designing the experiment, it should be clear CEPE could be used in just one of the six stages of the PAWS method. Therefore, participants must be made aware the remaining stages will not yet be computer supported. This will ameliorate frustration while doing the next stages without a computer tool.

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References

- [ACTN94] Action Technologies, Inc.: "Action Workflow Analyst - A Modeling and Analysis Tool for Business Processes". Alameda, CA, 1994.
- [BORG95] Borges, M., Pino, J.A, "PAWS: Towards a Participatory Approach to Workflow Design", Unpublished Paper, 1995.
- [BORG99] Borges, M. & Pino, J.A., "PAWS: Towards a Participatory Approach to Business Process Reengineering", To appear on CRIWG'99, Fifth International Workshop on Groupware, September, 1999.
- [DAFT86] Daft, R. and Lengel, R.: "Organizational Information Requirements, Media Richness and Structural Design", *Management Science* 32 (5), May 1986, pp. 554-571.
- [DAVE93] Davenport, T.H.: "Process Innovation", Harvard Business School Press, Boston, MA, 1993.
- [GATE93] Gatermann, M. and Krogh, H.: "Special Report on Reengineering" (in German). *Manager Magazine* 12, pp. 117-213, 1993.
- [GRPK98] <http://www.cpsc.ucalgary.ca:80/projects/grouplab/projects/groupkit/>
- [IMAG95] Imagine That, Inc.: "Extend+BPR, Business Process Reengineering, Product Information". San Jose, CA, 1995.
- [KRIC69] Krick, E.: "An introduction to engineering and engineering design", 2nd edition, Wiley, New York, NY, 1969.

- [LOGC98] Logic Works, Inc.: "A pragmatic process for BPR".
<http://www.logicworks.com/products/bpwinpro/bpr.htm>.
- [MARS97] Marshak, R.T.: "Workflow: Applying Automation to Group Processes". In D. Coleman (ed.): Groupware - Collaborative Strategies for Corporate LANs and Intranets. Prentice-Hall, Upper Saddle River, N.J., pp. 143-181, 1997.
- [POH98] Poh, H.L. and Chew, W.W.: "Business Process Reengineering: Definitions and Models Revisited".
<http://www.iscs.nus.sg/~isasia/Paper/complete.html>.
- [SCHN93] Schnitt, D.: "Reengineering the Corporation Using Information Technology", Journal of Systems Management, January 1993.
- [SHAR93] Sharples, M., Goodlet, J.S., Beck, E.E., Wood, C.C., Easterbrook, S.M. and Plowman, L.: "Research issues in the study of Computer Supported Collaborative Writing". In: M. Sharples (ed.): Computer Supported Collaborative Writing. Springer-Verlag, London, 1993, pp. 9-28.
- [SWEN93] Swenson, Keith D., "Visual Support goes Reengineering Work you Process ". Proceedings of the Conference on Organizational Computing Systems, November 1993.
- [TAPP93] Tappscott, D. and Caston, A.: Paradigm Shift: The promise of Information Technology. McGraw hill, New York, 1993.
- [VAN94] Van der Aalst, W.M.P., van Hee, K.M., and Houben, G.J.: "Modelling workflow management systems with high-level Petri nets". In G. De Michelis, C. Ellis, and G. Memmi (eds.): Proceedings of the Second Workshop on Computer-Supported Cooperative Work, Petri nets and related formalisms, pages 31--50, 1994.
- [WFMC95] Reference Model - The Workflow Reference Model V 1.1, Workflow Management Coalition General Publications, WFMC-TC-1003,
<http://www.aiim.org/wfmc/mainframe.htm>
- [WFMC97] Interface 1 - Process Definition Interchange V 1.0, Workflow Management Coalition Standards, WfMC-TC-1016-P,
<http://www.aiim.org/wfmc/mainframe.htm>