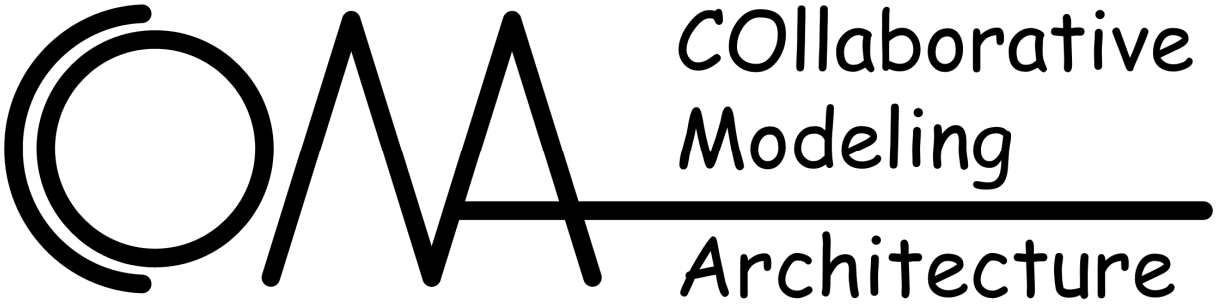

COMA - A Tool-Supported Method for Process Modeling

Collaborative Modeling Architecture

Version 4.0

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1 Introduction

The collaborative nature of conceptual modeling as an instrument for describing and changing the social world has been widely accepted [1-5]. Despite this overall agreement there is little research on detailed and specific architectures for organizing the process of collaborative modeling and on tools that can support it.

Most studies take a certain distribution of roles for granted: The modeling group consists of a facilitator (or modeling expert) and a number of domain experts that possess the required knowledge. The job of the facilitator is to "squeeze" out this knowledge and to cast it into models. The necessity of the facilitator is often motivated with the argument that the domain experts do not possess the required modeling capabilities and cannot sufficiently abstract from their concrete experiences.

I agree that this argument is indeed valid for many modeling projects and that a facilitator is therefore often required. But even if we accept this distribution of roles, there are still points in favor of a tool support for collaborative modeling. The group members might be distributed physically, which renders the traditional tools of seminar-based modeling useless. The group facilitator might want to present different model variants to the members and get feedback on the individual merits and drawbacks of each of them. He might also want to be able to change the variants easily according to the feedback without having to make a mess of a flipchart or having to redraw the whole diagram again and again.

But the role of the facilitator as the "lone driver" of the modeling process is also challenged. He represents a costly bottleneck in many projects and many companies are looking for better solutions. Pre-packaged facilitation knowledge has been discussed as an option [6]. But there is also a trend towards a more active involvement of the domain experts. Many models (e.g. of business processes) are intuitively understood quite well by them. So instead of giving oral feedback concerning required changes, for example, they could in many cases incorporate these changes into the models themselves. This implies bypassing the facilitator bottleneck and thereby saves costs and time.

But all these suggestions require an infrastructure that supports group modeling and that allows a group to work on a model together, maybe in different roles. The tools on the market today are mostly one-person tools, i.e. they assume that only one modeler is changing the model at any point in time. Shared document editing is a technology that does provide for a number of users to work at the same model at the same time but all interaction is performed on the same instance. This makes it impossible to compare and evaluate different proposals against each other. It also renders versioning difficult.

The COllaborative Modeling Architecture (COMA) has been developed to overcome these problems and to provide modelers with a tool that effectively supports them. The foundations of this architecture have been laid in [7]. An initial prototype was built in the summer of 2007 based on the Unified Modeling Language (UML) [8, 9] and it has been tested in autumn in two empirical studies. The one was a case study in a large company manufacturing mobile network components. The aim of that study was to find out which kinds of problems occur in collaborative modeling and which of those can be supported by the current architecture and tool. I was also interested in finding possible extensions and improvements of the existing

tool and the underlying architecture. The results of this study were the versions 1.0 of method and tool.

The second study was a student experiment that was carried out in a final-year course on Information Systems and Business Processes. Here the focus was primarily on the tool itself. I wanted to know in how far the tool supported the students in their assignments regarding business process modeling of a real-life hospital case that was somewhat adapted for educational purposes. I was also interested in learning about the usefulness and usability of the tool, i.e. changes in the functionality and the user interface required for making the tool more useful and easier to use. The result of this study was version 2.0 of the tool. The method remained unchanged (version 2.0 = version 1.0).

The studies have shown that the tool fulfils the purposes for which it was built, i.e. modeling in groups is supported in a way that the group members experience as natural. The tool is also usable, i.e. the participants were able to handle it without effort in a short time. Most of the necessary functions were already available in the version 2.0 but some vital aspects, e.g. the layout of the user interface and the support of offline work were observed as insufficient and were therefore changed or added in version 3.0. The method has also undergone substantial revisions in response to the (unstructured) observation of some key factors that are relevant to process modeling. This led to version 3.0 of the method.

In addition, a number of basic generic activities were identified that are performed in group modeling to address important problems that arise in the social construction of a common artifact. I have analyzed them with respect to known factors from collaboration theory, namely the type of problem solving domain (natural vs. formal language) and the degree of collaboration (individual, coordination or cooperation). The results are shown in table 1. The activities in italics are not supported by the tool. The use of complementary tools is suggested here, e.g. (voice) chat systems.

Table 1. Generic group modeling activities

	Individual	**Social**	
		Coordination	**Cooperation**
Concretization	Understanding a situation	*Managing a modeling project*	*Clarifying an issue, Resolving a conflict*
Abstraction	Conceptualizing a situation	Communicating a view	Aligning views, Agreeing on a view

A design-science study [10] delivered the scientific proof that COMA solves a number of open issues in collaborative modeling.

Further case studies and field experiments in 2008 and 2009 stimulated a further refinement of method and tool leading to versions 4.0 of both.

The COMA approach outperformed regular brown-paper sessions in 7 out of 12 criteria for model and modeling-process quality and scored equally well on the others.

The following chapters explain the different components of the COMA method. They are:

- 2 Infrastructural requirements
- 3 Teaching the tool

- 4 Steps towards a business process model
- 5 Alternative ways of modeling

2 Infrastructural requirements

Modeling in COMA can be done in a number of different ways depending on the needs of the modeling project. The requirements specified below assume the standard procedure as given in section 4.

Room requirements

A COMA session is typically carried out in a meeting room with U-shaped tables for the participants. In the front there is a single table for the facilitator. The facilitator sits at that table facing the group. Behind the facilitator there is a projection screen that is large enough so that far participants can read the models without any problems. Lighting should be such that it facilitates reading. All tables are equipped with a PC/laptop and the ceiling is equipped with a strong beamer.

Group requirements

The group should consist of all the people that together have the required knowledge about all aspects of the business process to be modeled. Two people are sharing a computer. These two people should ideally possess complimentary knowledge about the process to encourage and stimulate discussion. In small groups of 6 people or less each participant might also work on their own.

Facilitator requirements

The facilitator should be familiar with the COMA method and its variants as well as with the tool and its ins and outs. Apart from facilitating the session he or she will also have to build, check and/or enhance models as well as helping participants with handling the tool.

Technical requirements

The tool runs in Windows environments (XP, 2000, Vista) and is installed on the clients, i.e. it does not require a server installation. All PCs should be networked and have access to the same LAN. A file server is required. On it a shared network folder is created to which all the group members have read and write access. This network folder is mapped to a drive on the participants' computers, e.g. to drive L:. A sub-folder called COMA is created on this drive. The facilitator's PC is connected to the beamer. The settings are described in the tool manual.

3 Teaching the tool

Before the first COMA session with a group can be started, the members need to know how to operate the tool. Conventionally this is done in training sessions that consume time and are often met with little enthusiasm. COMA follows another approach by making learning the tool part of a game. The game is fun and it makes the participants forget that they are actually learning something as a “side-effect”. It is played largely in the same manner as the real modeling session proceeds so that even the method is learned to a certain degree. The whole game can be played in approx. one hour. It can therefore be done on the same day the actual modeling session is planned.

On the next pages you find the details of the game.

The Teller Machine Game

A teller machine (or cash dispenser) is a machine for the automatic withdrawal of money from your bank account. It replaces the traditional over-the-counter process that involved manual processing by a bank clerk. The teller machine gives you 24/7 access to your bank account. It is so common today that everybody can be assumed to be a process expert and to possess the required process knowledge in that area.

We will therefore conduct a process modeling session that aims at developing a model of the business process "Withdrawing money from your account with the help of a teller machine," or for short **"Teller Machine"**.

The modeling session is divided into four modeling rounds. The first one is concerned with collecting all the necessary steps (activities) that are part of the process. We call it "**Activity Collection**." The second round deals with scoring the activity proposals and determining the best one. We call this "**Activity Scoring**." The third round is about the ordering the activities into a consistent flow. We call this "**Flow Modeling**." The fourth and final round is about scoring the flow proposals and determining the best one. It is called "**Flow Scoring**".

0. Making the settings

Go to Options → Settings and enter your complete name (first and second name) under User Name. Then go to the Folders tab and enter the common folder (will be announced in the session, e.g. L:\COMA). After that, you click OK and then you exit the COMA tool and start it again (to save the settings).

1. Activity Collection

Use the My Model tab to draw all the activities that in your opinion have to be performed to get money from a teller machine. Include both the steps that you and the **machine** perform. Create an activity box  in the activity diagram for each activity. Inside the box you write just two words that describe the activity:

- The first word describes the activity itself, for example, Register, Check, Print, …
- The second word describes the object of the activity, for example, Customer, Invoice, Order, …

Examples of correctly named activities are: Register customer, Check invoice, Print order …

Please make sure that you always follow these rules so that we get a coherent model!

You have 15 minutes to complete this round. When you are finished you can post this model in the following way:

- Right-click on the background. From the context menu select the item "**Propose model**" by left-clicking.

2. Activity Scoring

In this round you look at the proposals made by your team mates. You do so by going to the Proposal tab and clicking  . Choose one file after the other and give it your personal score from 0 (very bad) to 10 (very good). To do so right-click on the background and select "**Score proposal**". Repeat this procedure for all available proposals.

At the end of this round a winner will be determined.

3. Flow Modeling

In this round you copy the complete list of activities into your My Model window. You then perform the following tasks:

- Divide the activities into the ones that are performed by the customer and the ones that are done by the teller machine. Use the swim lane for that and head the lanes with "Customer" and "Teller Machine" with the help of the text function.
- Connect the activities in the right order by using transition arrows.

You have again 15 minutes for this task. Propose your finished model in the same way as you did before.

4. Flow Scoring

In this round you again look at the proposals made by your team mates. You do so by going to the Proposal tab and clicking. Choose one file after the other and give it your personal score from 0 (very bad) to 10 (very good). To do so, right-click on the background and select "**Score proposal**". Repeat this procedure for all available proposals.

At the end of this round another winner will be determined.

This concludes the description of the game. In order to make it even more attractive you might consider giving a prize to the winner(s).

4 Steps towards a business process model

Step 0: Making the settings and creating an empty group model

Everybody:
Go to Options → Settings and enter your name (for a single user: First and second name; for a group of two: First names separated by '+') under User Name. Then go to the Folders tab and enter the common folder (will be announced in the session, e.g. L:\COMA). After that, you click OK and then you exit the COMA tool and start it again (to save the settings).

Facilitator:
Before the modeling session can begin the facilitator has to create an empty model of type "activity diagram" to get the session started and to establish a common point of reference. The tool manual explains the technical details. The name of the model should be the name of the business process. Ask the participants to go to their Group model tabs and open V000 → Model Name.

Step 1: Brainstorming activities

Facilitator:
The purpose of this step is to collect input for the process model in the form of activities. Before that the facilitator must make clear what the scope of the model is, i.e. exactly which process are we looking at; where does it start; where does it end; and so on. The facilitator must also determine the desired abstraction level of the process, i.e. how detailed should the description be. This can, for example, be done by specifying the approximate number of activities.

Please specify a reasonable amount of time for the brainstorming and make clear that the exercise will be finished after the specified time has elapsed. I usually use 15 minutes for a model with 10-15 activities but this figure depends largely on the complexity of the process and the mental capabilities of the participants. You need to make your own experiences.

Participants:
After the task is understood the participants will create activity boxes in their *My Model* tab for each relevant step of the process as described in the tool manual.

At the end of the specified time each group of two has to submit their proposal by selecting "Propose model" (see tool manual for details).

Step 2: Scoring the brainstorming output

Participants:
In this step each sub-group (of two) has to score the output of the others. Technically this is done by going to the *Proposal* tab and opening the proposals one by one and clicking on *Score model* for each (see tool manual for details).

Facilitator:
The facilitator must make sure that the participants know:

1. What should the model in question be compared with?
2. What is the criterion for deciding which score to give?
3. What is the reference point for the 0 … 10 scale?

I have made very good experiences with asking the participants to score other models against their own. The criterion for an as-is model would typically be the model's completeness and correctness with respect to reality (as perceived by the scorers). If they think the other model is of the same quality as theirs they give a 5. If it is worse they give a lower score depending on how much worse they consider it in comparison with their own, if it is better they give a higher score depending on how much better it is in their view.

But these are only suggestions, as a facilitator you have to find out for yourself which criteria fit your particular situation.

When everybody is finished with scoring, the facilitator shows the final results by clicking on *Show all scores* in the *Facilitation* menu (see tool manual for details). The model with the highest overall score will be selected for the next step. The facilitator does this by going to the *Proposal* tab, opening the winning proposal, and selecting *Facilitation* → *Accept proposal* and answering yes to the question that pops up. After this the facilitator asks the participants to go to their *Group Model* tab and click on the update button (). Do the same!

Step 3: Consolidating the best proposal

Facilitator:
Even the best proposal from the participants will not be a perfect model. There is a good chance that activities are missing or superfluous or wrongly named. In step 3 the facilitator will therefore copy the new group model to his/her *My Model* tab, and go through the model, which can be seen by the participants on the big screen, and ask them if anything is missing or wrong.

All necessary changes will be made by the facilitator so the participants do not use their computers in this step. The facilitator should also check whether there are obvious mistakes such as not adhering to naming conventions (e.g. verb + noun). At the end of this step all participants should be satisfied with the result. The facilitator submits the result by making a right-click on the background and selecting *Propose model*.

Step 4: Structuring the activities

Participants:
In step 4 work returns to the participant. You copy and paste the result from step 3 into your *My Model* tab, after first clearing the tab and opening the facilitator's proposal in your *Proposal* tab (see tool manual for details). You then use this collection of activities as a starting point for building the process model. In order to do so, you have to do three things.

- First, identify the relevant actors in the process and make a swim lane for each of them (see tool manual for details).
- Secondly, sort all the activities into the right swim lane.
- Thirdly and lastly, introduce transition arrows for sequential behaviors, and decision points for the alternative ones (see tool manual for details). Do not forget that the outgoing arrows of a branch should be labeled with the condition under which they are taken.

After that each group of two submits their proposal as described in step 1.

Facilitator:
Again it is important to specify a time limit for this task. Be aware of the fact that model and cognitive complexity grow more than linearly with the number of activities. For 10-15 activities 15-20 minutes should be fine.

Step 5: Scoring the process models

This step proceeds exactly as step 2 but the scoring criterion might be different depending on your particular situation. For an as-is model completeness and correctness are appropriate even here.

Step 6: Consolidating the best process model

Facilitator:
Again, as in step 3 we cannot assume that the winner of the scoring is actually a good or even acceptable model. In most cases though there is little that needs to be changed. Remember that the winner got high scores from most participants so it is unlikely that there is much wrong with it.

The facilitator copies the new group model to his/her *My Model* tab, and go through the model, which can be seen by the participants on the big screen, and ask them if anything is missing or wrong. The facilitator should watch out for syntactic mistakes and for situations where an activity that apparently involves a decision is not followed by a decision point, i.e. does not branch into at least two paths. Make also sure that in the case of two or more outgoing paths each arrow is labeled with a condition. The facilitator should go through the whole model with the group step by step making sure that nothing is missed. A typical intervention of the facilitator is also the layout of the boxes and arrows, which is often not done well by the participants.

After that step the facilitator submits the result by making a right-click on the background and selecting *Propose model*. As this is the final version he or she also go to the *Proposal* tab, opens his/her own proposal, and selects *Facilitation* → *Accept proposal*, thereby generating a new version.

The business process model is finalized now and can be used for further purposes. The tool stores all models in a standard XML format so that it should be easy to write a converter to import the model into model management systems that exist in the company. In the worst case it has to be redrawn but remember that COMA is only a replacement for brown paper where you also would have to draw the model again with another tool.

5 Alternative ways of modeling

Section 4 describes a standard way of modeling business processes in COMA. This approach might have to be adjusted depending on type of group and complexity of the model. Other factors might be to save time in meetings or to work in a distributed setting. These alternative ways of modeling are discussed in the following sections.

5.1 Problems with abstraction, cognitive load and model complexity

Step 1 (brainstorming activities) is easy enough to be performed by any group and for any business process. Step 4 (structuring the activities), on the other hand, can be problematic as it requires that the participants have some potential for abstraction. The cognitive load of that task can also be quite high if the model is relatively large and/or dense (i.e. it contains many branches). Your experience as a facilitator of e.g. brown-paper sessions should help you in determining whether your particular group can handle this task. A group of engineers will, for example, be able to handle more complex tasks than a group of call center workers.

In cases where you think that the group cannot handle step 4 you can replace it and the rest by the following

Step 4a: Facilitator-led structuring of activities

The facilitator copies the activities to his/her My Model tab. The participants can see them on the big screen. Now you ask the participants which actors are involved in the process and create a swim lane for each of them. After this you ask them which activity is performed by which actor and move the respective activity to the corresponding swim lane. When this is done you ask the participants which activity comes first, which next and so on, introducing an arrow between the indicated activities. The same is done for activities involving decisions, where you introduce a decision diamond (see tool manual for details) and the outgoing paths. Sometimes this step requires you to introduce an end state, or new activities that have been forgotten earlier, to get a second path. Do not forget to label the outgoing arrows of a branch with the condition under which they are taken.

5.2 Saving time in meetings

Another important issue is that the availability of common meeting times is scarce and that the human capital that is bound in these meetings is expensive. Therefore many organizations naturally wish to keep meeting times to a minimum. In the first modeling project that is not possible though as participants may not know each other and are not yet familiar with the way of working in COMA.

But if the same group has to perform a succession of modeling tasks, some of the work can be shifted from the meeting to individual work, and can therefore be performed at times where the individual employee is idle.

For example, step 1 can easily be performed by the group members before the actual face-to-face meeting. A lead time of one week seems appropriate to give the employee enough time to find an empty slot to think about the activities.

The same could be done with step 4, assuming that the employees are able to handle this task and a facilitator is not required.

5.3 Distributed modeling

In principle a whole modeling project can be conducted without the group members actually meeting each other physically at any point in time. In this scenario the more interactive parts of the modeling process should be executed synchronously, less interactive parts can also be done in an asynchronous fashion.

Synchronous distributed collaboration

The synchronous distributed collaboration requires some prerequisites. The most important one is the availability of a multi-party video-conferencing system. Seeing and communicating with each other are necessary ingredients of collaborative modeling as spoken language and body language are often key in understanding a point someone makes. Regarding the tool no changes have to be made as long as access to the same LAN is still provided, e.g. via a VPN tunnel (Virtual Private Network). The modeling process itself can follow any of the steps and procedures mentioned in the sections 4, 5.1 and 5.2. Steps 3 and 6 of the standard method are best done in a synchronous mode.

Asynchronous distributed collaboration

The advantages of asynchronous collaboration are that participants can work at their own pace and that the problem of finding a meeting time that works for everybody can be avoided. The facilitator has to specify a deadline for delivering the results for the respective step. Steps 1, 2, 4 and 5 can easily be carried out in this way. In principle this is also possible for steps 3 and 6 by using the functions *Comment proposal* and *Show comments* to replace verbal comments. We do not recommend this though as written comments cannot fully replace a dialogue. But if a common meeting, physical or virtual, is not feasible it is a way of working around. An issue with asynchronous collaboration is to make sure that the participants actually perform their work as this mode of operation provides them with less incentives.

6 References

1. Bommel, P.v., Hoppenbrouwers, S.J.B.A., Proper, H.A.E., Weide, T.P.v.d.: Exploring Modelling Strategies in a Meta-modelling Context. In: Meersman, R., Tari, Z., Herrero, P. (eds.): On the Move to Meaningful Internet Systems 2006: OTM 2006 Workshops - OTM Confederated International Workshops and Posters, AWESOMe, CAMS, COMINF, IS, KSinBIT, MIOS-CIAO, MONET, OnToContent, ORM, PerSys, OTM Academy Doctoral Consortium, RDDS, SWWS, and SebGIS, Proceedings, Part II, Montpellier, France, Vol. 4278. Springer, Berlin, Germany (2006) 1128-1137
2. Frederiks, P.J.M., Weide, T.P.v.d.: Information Modeling: the process and the required competencies of its participants. Data & Knowledge Engineering 58 (2006) 4-20
3. Hoppenbrouwers, S.J.B.A., Lindeman, L., Proper, H.A.: Capturing Modeling Processes - Towards the MoDial Modeling Laboratory. In: Meersman, R., Tari, Z., Herrero, P. (eds.): On the Move to Meaningful Internet Systems 2006: OTM 2006 Workshops - OTM Confederated International Workshops and Posters, AWESOMe, CAMS, COMINF, IS, KSinBIT, MIOS-CIAO, MONET, OnToContent, ORM, PerSys, OTM Academy Doctoral Consortium, RDDS, SWWS, and SebGIS, Proceedings, Part II, Montpellier, France, Vol. 4278. Springer, Berlin, Germany (2006) 1242-1252
4. Hoppenbrouwers, S.J.B.A., Proper, H.A., Weide, T.P.v.d.: Formal Modelling as a Grounded Conversation. In: Goldkuhl, G., Lind, M., Haraldson, S. (eds.): Proceedings of the 10th International Working Conference on the Language Action Perspective on Communication Modelling (LAP`05), Kiruna, Sweden. Linköpings Universitet and Högskolan i Borås, Linköping and Borås (2005) 139-155
5. Persson, A.: Enterprise Modelling in Practice: Situational Factors and their Influence on Adopting a Participative Approach. Department of Computer and Systems Sciences, Stockholm University (2001)
6. Briggs, R.O., de Vreede, G.J., Nunamaker, J.: Collaboration Engineering with Thinklets to Pursue Sustained Success with Group Support Systems. Journal of MIS 19 (2003) 31-63
7. Rittgen, P.: Negotiating Models. In: Krogstie, J., Opdahl, A., Sindre, G. (eds.): Advanced Information Systems Engineering, 19th International Conference, CAiSE 2007, Trondheim, Norway, June 2007, Proceedings. Springer, Berlin (2007) 561-573
8. OMG: UML 2.0 Superstructure Specification. OMG, Needham; MA (2004)
9. OMG: Unified Modeling Language: Infrastructure. OMG, Needham, MA (2006)
10. Rittgen, Peter: Collaborative Modeling – A Design Science Approach, Proceedings of the 42nd Hawaii International Conference on System Sciences (HICSS-42), Waikoloa, Big Island, Hawaii, USA, January 5-8, 2009, CD-ROM, Los Alamitos, CA: IEEE Computer Society, 2009, 10 p.