Evolving Workflows by User-driven Coordination

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Abstract

We will analyze the possibilities and limits of continuous participation and learning in the case of traditional workflow projects to derive a concept of user-driven coordination of business processes and cooperative tasks. This is explained by referring to an example, which can be used to discuss technical and organizational strategies of how the concept can be realized.

1 Introduction

Although the role model of the *learning organization* is becoming increasingly acknowledged, there is no reliable strategy to bring it into reality. Such a strategy should especially support the seamless integration between continuous learning and the continuous improvement of business processes and work procedures. This integration can only be successful if those employees who actually have to perform the tasks of the processes, regularly make contributions. Therefore, we consider the essential question of how the employees who actually carry out the tasks can be motivated and supported to continuously participate in the improvement of business processes. Regarding this question we will present an organizational and technical concept of how traditional workflow approaches can be overcome, and how the user-driven coordination of incompletely-described, non-anticipatable business processes can be facilitated. This concept is especially relevant for business processes or task procedures where only a small, but decisive, subset of activities are regularly repeated in the same manner. The concept is presented as a vision, which should serve as a role model for further organizational and technological development. From our point of view, no implemented technical solution supports this concept at the moment.

The vision is the concentration of several insights which we found in the research network MOVE[1] (Employee-oriented improvement of business processes with flexible workflow management systems). The next section summarizes the essential experience of this project. On this basis, the third section describes the concept of evolving workflow and gives an example. We will present an outline of how the concept can be technically supported (4th section) and give a conclusion (5th section) which deals with the vision's chances for success.

2 Traditional workflow projects

It was a basic assumption of MOVE, that flexibility and adaptability of workflows are indispensable if the employees are to be motivated to actively take part in the improvement of business processes. If they have the impression that the work procedures are strictly fixed and cannot be modified, they will not see any reason why they should propose measures and provide knowledge for improvement. Therefore, every phase of a cycle of continuous improvement of business processes and workflows (see fig. 1) should provide opportunities for adaptation to which the workers can relate their proposals and experience.

The phase of data gathering is decisive and should not only be used to reconstruct the current way of carrying out the processes, but also to find information about the employees' wishes and ideas about how their situation can be improved (Hoffmann et al. 98). Furthermore, the cycle offers numerous opportunities for collecting feedback from the workers. There are two types of feedback: The first type of feedback can be related to the preparation of the technical and organizational improvement of business processes (e.g. modeling and re-modeling the processes, design of screens, training). The employees should be able to comprehend that this type of feedback influences the quality of their future work situation.

The other type of feedback concerns the actual usage of the workflow application and its outcome. Its purpose is to point out organizational and technical insuffi-

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ciencies and to give relief to workers who are dissatisfied with their work conditions. The feedback should lead to measures which eliminate the problems. This type of feedback is ambivalent. It has a positive impact because it leads to improvements and it has a negative connotation because it reveals the deficiencies of the current workflow application. These deficiencies can potentially be related to the participatory process of development and introduction which was supported by the workers providing the feedback.

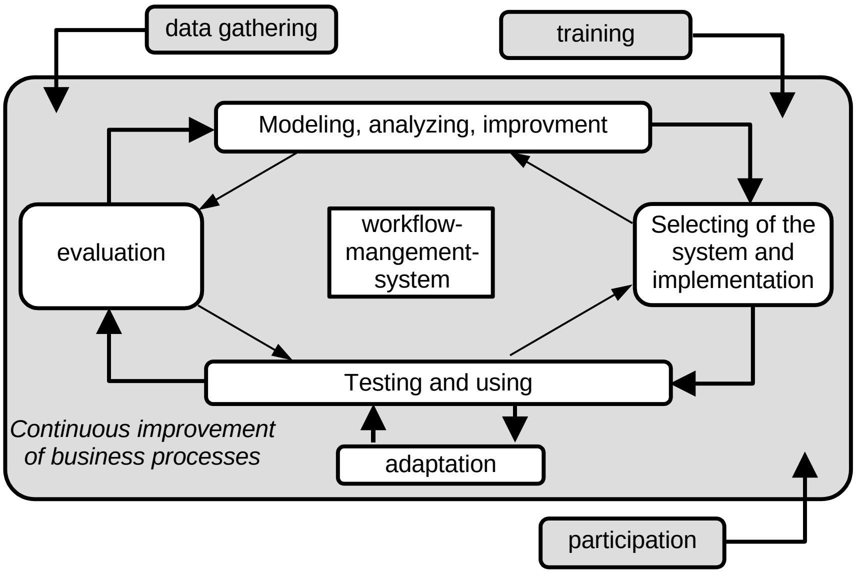
data gathering
training
Modeling, analyzing, improvment
evaluation
workflow-mangement-system
Selecting of the system and implementation
Testing and using
Continuous improvement of business processes
adaptation
participation

Figure 1: Workflow life-cycle and continuous improvement

If the necessity for feedback (which is related to improvement) does not decrease in the course of the usage of the workflow application, confidence with the sensibility and success of the feedback procedures will also potentially decrease. On the one hand, the decrease in feedback is an indicator for success. On the other hand, this decrease in feedback also leads to a reduction of potential opportunities of organizational learning. This dilemma can only be solved if the employees' activities of their actual tasks are seamlessly integrated with their contributions to a continuous improvement of organization and technology. The integration of both types of activities has to pursue the aim that the difference can hardly be realized by the employees. This can be supported by organizational means as well as on the level of human-computer interaction. The vision is that such a seamless integration would lead to an unquestioned and user-driven adaptation of technical and organization structures. By contrast, the traditional workflow approach suggests that adaptations should be possible but only be necessary in exceptional cases. Thus adaptation, is related to exceptions but not to continuous organizational learning. Adaptation should only be necessary in those cases which could not have been anticipated. Several authors (Thoresen 97, Saastamoinen & White 95) claim that non-anticipated events are not avoidable and they provide a list or systematization of different types of exceptions. The traditional workflow approach accepts that there is no technical solution to handle those non-anticipated events automatically because it is assumed that they only rarely occur. For example, if user-driven adaptation became necessary in more than one third of all cases, the basis of the traditional workflow approach would be obsolete, because it would not be achievable to reach as smooth a flow of work as possible based on standardization and only adjusted if exceptions occur (Craven & Mahling 95). From this point of view, a qualified contribution from the workers is only expected in the case of certain events or during special phases of the workflow improvement cycle.

By contrast, it is necessary to provide solutions for companies where an increasing number of cooperative tasks includes one part which can be analyzed as a regularly-repeated business process, whereas another part is represented by frequently-modified or new activities. Depending on the characteristics of the company, a mixture of these two parts can be found at nearly every workplace. This phenomenon will increase with the dynamics of the market, which coincides with the necessity for individual solutions for clients and increasing flexibility.

3 Evolving Workflows

Evolving workflow needs the kind of support with which the characteristics of available workflow management systems on the market do not comply. The new concept needs an integration of procedural (structured aspects of the process) and non-procedural content (unchoreographed interactions) (Abott&Sarin, 94). The concept of "evolving workflows" is especially suitable for work procedures with the following characteristics:

- Only a part of the procedure is repeated by following the same pattern.
- The tasks have to be carried out frequently and regularly.
- The task has to be considered as a unit which is usually carried out by one person but can or must be supported by others in certain cases.
- The appropriate selecting and sequencing of activities cannot be specified in advance by a manager who does not carry out the task by himself.
- The task performing is related to varying resources and responsibilities.

- Electronic support of an effective and efficient task execution and its coordination should be possible.

Typical examples of these kinds of tasks are the preparation of contracts, the engineering of services, the acquisition of customers, the preparation of training, the preparation of meetings etc. We assume that the coordination of these tasks as well as the planning of the activities and the consideration of their interdependencies can be conducted by the workers themselves. This includes a certain degree of freedom for decision and actions which leads to an increase in complexity. This complexity can be handled by the employees if software-based support for the execution of tasks and coordination of activities is provided.

The concept of evolving workflows can be described by a list of requests which are directed towards the employees who have to carry out the tasks:

- Regularly document all the activities which have to be frequently repeated. Try to identify sequences and to optimize them.
- While carrying out tasks, be aware of the question of whether your documentation is complete and appropriate. Make corrections if necessary.
- Compare the documentation of your work procedures with those of other employees with whom you have to cooperate – try to give hints on how others can improve their work or try to find hints which are useful for yourself.
- Try to improve your coordination by comparing different procedures of your or others work. Try to adjust these procedures to each other or even to combine them.

Complying with these requests includes the employees' creating models of their own work themselves and therefore a continuous learning on the organization's behalf (Argyris & Schön, 96). This is one of the best ways to achieve acceptable and understandable models of work. According to Grinter (2000), comprehensible models are one aspect of making workflow systems work.

The concept of evolving workflows is explained by referring to the example of preparing contracts with the customers of a company. This task can be found in numerous companies and it includes typical activities which are repeated for every contract, as well as new steps which might depend on the special wishes of the individual customer. The diagram in fig. 2 represents important sub-activities of the task preparing a contract. By using a documentation like this, the salesman will be able to remember the necessary activities in time and protect himself against forgetting important steps. The black semi-circle indicates that checking for the final approval contains embedded sub-activities such as submitting the written contract, adding additional explanations, checking and signing. Adding additional explanations is a typical example of an activity which might be easily forgotten. The empty semi-circle indicates the awareness of the potential incompleteness of the set of sub-activities of preparing a contract. The empty hexagon is annotated if sub-activities such as checking back or negotiation are only carried out under certain conditions which cannot be specified in advance. Furthermore, adding such attributes as deadlines or values to the sub-activities is also sensible.

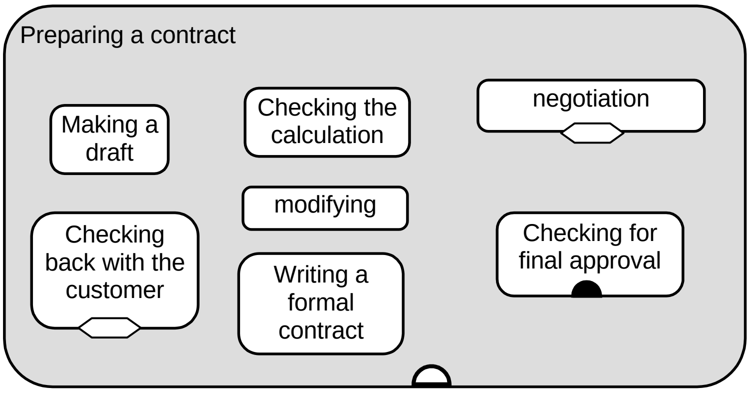
Preparing a contract
Making a draft
Checking the calculation
negotiation
modifying
Checking back with the customer
Writing a formal contract
Checking for final approval

Figure 2: Example of the work procedure „preparing a contract"

Fig. 2 does not provide more than a to-do-list or a checklist. However, in context with fig. 3 it becomes clear that fig. 2 is the starting point for the development of a more complex diagram which additionally contains individually determined units of workflows. Fig.3 presents therefore sequences between the activities. They can be improved step by step in a process of continuous learning. However, there are sub-activities, such as negotiation, which can start at any time and be carried out at the same time as other activities. The grouping of activities (such as checking the calculation, modifying and writing …) is another possibility to express that sub-activities are not sequenced but can be carried out at the same time. There is also a special relation between this group of activities and checking back with the customer. The arrows which cross the rounded rectangles (Herrmann & Loser, 99) indicate that one activity can be interrupted because the salesman wants to start or to continue with another, and vice versa. Furthermore, the starting point is not specified, e.g. whether checking back leads to a modification, or whether the activity of modifying reveals the need for checking back. The only strict sequences in fig. 3 express that making a draft happens before checking and that the submission of the contract cannot happen before the preparing of the contract (at least the mandatory parts) is completed. In our case studies we found (Herrmann et al. 2000) that the sequencing of activities should be minimized. Employees often do not accept a strict sequencing of those tasks which they have to execute themselves, because this causes a limitation of their flexibility. It happens easily in the course of a workflow management project that sequences are artificially identified by projecting the sequence of an interview onto real work situations or by assuming logical dependencies which do not correspond with reality. It is also obvious that checklists have the disadvantage that they impose sequencing on their users, while two dimensional diagrams allow the modeler to express concurrent activities and flexible sequencing.

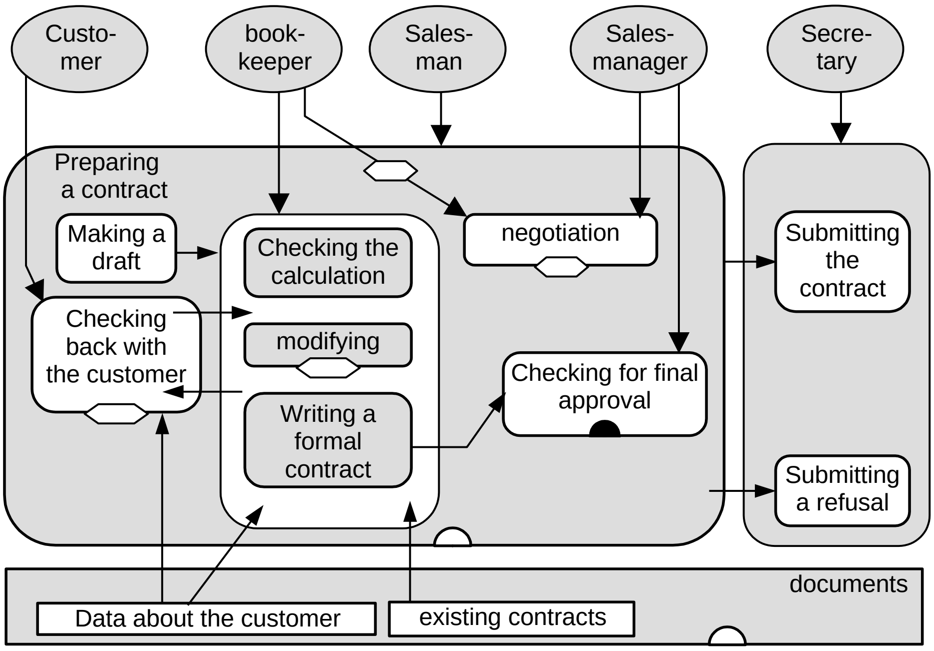

Figure 3: Sequencing of activities and assignment of resources and roles

In addition, two dimensional representations facilitate the assigning of resources (such as data about the customer or existing contracts) and roles to the activities. The grouping and nesting of the activities helps to express that the salesman has to work on every sub-activity of preparing a contract while other roles have only to contribute to selected activities. Fig. 3 also represents the connection with the work of others, e.g. the secretarial staff. Furthermore, the optional assignment of a task can be expressed with the hexagon – for instance, it is not always the case that the bookkeeper takes part in negotiation. The systematical identification of the participating roles can be a starting point for a check of whether the workers playing these roles have also developed similar diagrams for their own tasks. Thus, the referring to and access to persons, resources and activities that live outside the domain of a particular workflow can be supported (Abbott&Sarin, 94,117). For instance, the salesman can inspect the secretary's diagram to see whether they plan to do a proof reading of the contract or not. Or, he can check the bookkeepers work procedure to avoid a certain activity being executed twice. Diagrams, as shown in fig. 3, can be a basis to support cooperative learning improvement of procedures and execution of tasks. We differentiate between two levels: cooperation between employees who carry out the same task (1) and cooperation between roles which are assigned to different jobs (2).

Ad 1): We assume that all salesmen of a company might have developed similar diagrams for preparing a contract. Therefore it is sensible that they compare their diagrams and share their experience with the building of these models of their work. It is necessary to compare the terms which are assigned to the sub-activities, roles and resources or to ensure their understandability. They can discuss the structure, flows and content of the diagrams. Eventually, they can adjust the individual diagrams and might even agree on a diagram to be shared by all of them. However, the possibility for individual solutions must not be excluded.

Ad 2): The representatives of the different roles such as salesman, bookkeeper, sales manager, secretary can compare their diagrams and give each other hints to make their coordination smoother. For instance, a negotiation could start between the salesman and the secretary about who should do the proof reading or under which conditions tasks such as submitting the contract or writing a formal contract can be executed cooperatively. Similarly, the task sharing between the bookkeeper and the salesman could be optimized. Furthermore, the secretary can specify – by referring to the salesman's diagram – when they want to be informed about an ongoing contract preparation. It is obvious that these kinds of comparing diagrams and models of work need semantic adjustment. This way of improving cooperation can also be applied to the interaction between companies. For example, if the customer represents a company which also documents the work procedures with evolving workflows, they can improve the check back procedure or the information flow between them and the salesman.

The concept of evolving workflow is a bottom-up approach. It starts with the documentation of daily activities instead of deriving them by building a hierarchy of goals and sub-goals as proposed by Mahling & Craven (95). Thus, workers can lay out a detailed network of low-level tasks before they start aggregating groups or hierarchies of tasks (Abbott&Sarin, 94,118). This helps to avoid the imposition of procedures which interrupt the smooth flow of work which has already been established before a workflow project starts (Bowers et al., 95). However, the concept of making the models comparable and the requirements of adjustment do also imply that the coordination mechanisms of hierarchical organizations can be supported. This is an essential requirement according to Prinz & Kolvenbach (96).

4 Technical Support

The concept of evolving workflow requires special technical support which, as far as possible, provides a seamless integration of task execution and the preparation of task documenting. The higher the extra effort for documentation, the less motivation can be expected from the employees. Our concept starts with the coordination and structure of individual work. This type of structuring, especially the ex-post refinement and improvement of models, is hardly supported by current groupware or workflow concepts.

Evolving workflow requires the building of diagrams which has to be supported immediately during the usage of operative software applications, such as word processors, data base systems or spread sheets. The application system needs an add-on component which registers the users' activities, the documents being used and the roles involved, as well as the links to other applications and contextual entities (e.g. URLs, e-mail adresses etc.) which are relevant for the work procedure. The add-on component should deliver rough diagrams and allow the user to edit them. Thus, specific terms, attributes, sequences, conditions, and additional relations can be added later. Therefore an editor is needed which has interfaces with the different types of application software and allows the users to recall existing diagrams, to modify them and store the modifications as variants. It should be possible to combine existing diagrams to facilitate the cooperation and coordination with others. It might be sensible to integrate a critiquing component which give hints if a user's diagram contains problematic constellations from an organizational point of view. Furthermore, the editor should provide a presentation component which visualizes the diagrams, supports navigation and offers hide and show mechanisms. For example, clicking on the black semi-circle (fig.3, checking for final approval) should display the nested details of the sub-activity.

An editor which supports evolving workflows has to be based on special modeling methods to represent structures of individual and cooperative work procedures as well as elements of incomplete and vague specifications. Many methods in the field of software-engineering and business re-engineering can not deal with incompleteness and vagueness which allow freedom of decision, partially concurrent task execution and flexibility (Herrmann & Loser, 99). Therefore we have developed a special modeling method for semi-structured, socio-technical systems (SeeMe) which allows an integrated representation of aspects of human behaviour, organizational processes and technical structures. This method can be used on different levels of detail and complexity and we found that people can be trained to use this method and to accept it, if they are supported with prepared models which they can discuss or alter (Herrmann et al., 2000).

The way to use such diagrams as described above implies a distinctive difference to traditional workflow systems where the diagram represents a program which clearly determines the next steps to be carried out by the user. By contrast, in the case of evolving workflows it is the user who decides whether he carries out the next activity which is displayed in the diagram or whether he alters the procedure and also the diagram. Thus, workflow definition and execution are seamlessly integrated. The diagrams which represent evolving workflow can be considered as knowledge about the companies organizational procedures. Thus, the technical support should also include knowledge management features, which are based on the following functions:

Instantiation is needed to assign an abstract diagram to a concrete case and to be able to use it to control the task which is related to this case. After the instantiation of preparing a contract, it is assigned to a concrete customer and to a concrete sale. The modification of the instantiated diagram does not affect its abstract version. The following functions can be applied to the abstract diagram (on the level of classes) as well as to their instantiations.

Adjustment should help the user to compare diagrams, to detect incompatibilities and to solve them. System-based negotiation between different persons should be supported if diagrams are to be intertwined or connected to each other. It can be sensible to provide different perspectives: individual perspectives which contain personal preferences for certain ways of executing a job, and team perspectives which represent consensual diagrams which are the result of negotiations (Stahl & Herrmann, 99).

Specialization allows the employee to use an abstract diagram to derive a more concrete diagram which can be applied to a more specific set of cases. E.g. preparing a contract can be specialized to achieve a diagram for prolonging of a contract.

Generalization provides the opposite feature of specialization: Preparing a contract could be modified for the purpose of preparing and closing a contract. Specialization and generalization can be used to create a hierarchy of diagrams which describe the processes and work procedures of a company. This idea of a process inheritance hierarchy was already mentioned by Abbott & Sarin (94) in the context of traditional workflow systems and their type of descriptions of processes. They also propose to provide a **library of process descriptions** which is also a very sensible feature to support the concept of evolving workflows.

Modification is needed to the adapt a diagram to special requirements of organizational change without altering the level of abstraction.

We have to emphasize that all these features are only useful if the user can employ the diagrams to start applications immediately, or to access data or to establish contact with other roles or persons. Therefore, the system must be able to interpret all the elements of a diagram as buttons which can be activated to achieve selectable effects. This kind of connectivity must already be prepared when the operative application provides a rough outline of a diagram. The relationships to the applications or to certain documents must be maintained if the user does not explicitly modify or delete them. By offering the described type of diagrams as a means of control, all relevant features for coordination and operative tasks can be integrated and appear as one single system at desktop level. According to Prinz & Kolvenbach (96) this can be considered as a significant advantage.

5 Conclusion

The basic idea of evolving workflow is that those employees who execute the task are the same ones who develop fragments of workflows, refine them and eventually combine them to create a network of coordination. This bottom-up approach should be supported by a software editor based on an appropriate modeling method, which provides means for modification and navigation of diagrams. Diagrams are roughly prepared by application programs which can also be controlled with the help of the diagrams. The administration of the existing diagrams is supported by a library and several knowledge management features.

By the end of the research project MOVE (December 1999) we were not able to identify a technical system which supports and integrates the described characteristics (including interfaces with different types of application software). However, there are a number of approaches which can help to support the concept – most prominently Wargitsch et al. (1998). Furthermore, we expect several – mainly non-technical – problems which have to be overcome to establish such a concept:

- The employees have to be motivated to contribute continuously to the documentation of their work procedures.
- The additional work of documenting, administration and maintenance of diagrams has to be minimized and appropriately acknowledged.
- The comparison between diagrams of different workers has to be facilitated.
- Training and practice is needed to promote „thinking in diagrams".

The concept of evolving workflows can be used to support continuous organizational learning in the area of business processes and coordination of work if – and only if – the employees are recognized as experts in this area. Acknowledging the professionalism of the staff has been identified as the essential success factor of the culture of an enterprise for the successful handling of workflow improvement (Grinter, 2000).

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