Workflow Management As You Like It

Irene Vanderfeesten

Abstract

Workflow Management Systems (WfMS's) offer a tremendous potential for organizations. Shorter lead times, less mistakes in work handoffs, and a better insight into process execution are some of the most notable advantages experienced in practice. At the same time, the introduction of these systems on the work floor undoubtedly results in great changes in the way that business professionals coordinate their work. If a WfMS's coordination of work is experienced as too rigid or mechanistic, it may negatively affect employees' motivation, performance, and satisfaction. In this paper, we propose a set of measures to "tune" functioning workflow systems to minimize such effects. The measures we propose do not require undue cost, time, or organizational changes, as they characteristically lie within the configurable options of a WfMS. We asked an expert panel to select and validate the 6 most promising measures, which we present in this paper. From our evaluation of three commercial WfMS products, we conclude the east with which the 6 measures can be implemented depends on the specific WfMS product.

1. Introduction

A workflow management system (WfMS) is a software system that supports the specification, execution, and control of business processes ([6], [8], [13]). Commercial WfMS's have been around since the early nineties, while their conceptual predecessors range back even further, (see e.g. [5]). They have become *"one of the most successful genres of systems supporting cooperative working"* ([4]). The worldwide WfM market, estimated at $213.6 million in 2002, is expected to redouble by 2008 ([22]). Furthermore, WfM functionality has been embedded by many other contemporary systems, such as ERP, CRM, and call-center software. WfM technology, in other words, has become quite successful and widespread. The reason for this popularity is fourfold (see [20]):

- *The coordination of work becomes easier*. A WfMS liberates human actors from the efforts to coordinate their work ("What do I do have to do?", "Where is the *#& client file?", "Who must check this proposal next?")
- *A higher quality of service is delivered.* The WfMS will ensure that the process is executed in correspondence with the intended procedure: Important steps can no longer be forgotten, work will not get lost, and authorization policies are automatically enforced.
- *The work is executed more efficiently*. Work items will only be allocated to workers by the WfMS *if* and *when* they are required to be executed.
- *The process becomes more flexible*. Ejecting the business control flow from traditional applications and moving it towards a WfMS simplifies the redesign of the process.

Recent successful implementations of WfMS's have been reported within the banking, automotive, and IT industries ([2], [3], [16]).

Despite their success, WfMS's have received their share of criticism as well (see e.g. [4], [7]). Sceptical arguments are mainly raised by employees (the potential users) and work psychologists, who fear that workflow systems might lead to a mechanical approach to office work where man is seen as an exchangeable resource (like a machine) and not as a human being. In a study by Küng ([15]), an interviewee at an organization described the effects of a WfMS introduction like this:

> *"Jobs became more monotonous. The system forces the employees to work strictly according to the process definition. Through the use of the workflow system, we now have some kind of 'chain production' in the office."*

The image of a WfMS as a rigid system is also produced very glaringly in the well-known case study of a WfMS implementation in the UK print industry ([1]). The system was not accepted by the end users, who invented various ways to work around the intended procedures.

This paper proposes measures that can be taken to reconfigure an implemented WfMS so that it becomes more agreeable to the needs of performers working with such a system. An important driver in the creation and selection of these proposals was to come up with measures that have a wide applicability and are easy to implement as well. The proposals have emerged from the confrontation of two perspectives. On the one hand, we have considered the general characteristics that positively influence the motivation, performance, and job satisfaction of performers. On the other hand, we looked at the policies that WfMS's generally use for distributing and assigning work to performers. Even though such policies do not affect the work itself that has to be executed (as specified in an underling process definition), they have a direct impact on the human/machine interaction.

The paper is organized as follows. In the following section, we will give the theoretical background of the perspectives we mentioned, as used for generating the proposals. In Section 3, we will describe the various proposals, how they have been selected, and how they were validated by an expert panel. In Section 4, we will present the evaluation of three current, commercially available WfMS's to determine to what extent these systems can be reconfigured in accordance with the presented proposals. This paper ends with our conclusions and recommendations.

2. Theoretical background

In this section, we will briefly discuss the theoretical background used for the development of the "tuning" measures. It is founded on two pillars:

- job design theory from the area of psychology
- theory of workflow management systems

From both areas we selected an influential model on which to base our research. The first model describes job characteristics and the second model clarifies the ways in which a workflow management system can be tuned. These models will be explained below.

2.1   JCM model

We believe a user-friendly design of the technical system indeed can contribute to the success of information systems, particularly by improving an employee's experience of the work (s)he performs. Therefore we consider the important dimensions on which a job can be assessed in order to determine the degree to which a job is pleasant to the performer.

Based on the theory of human needs, Hackman and Oldham developed the Job Characteristics Model (JCM), ([9], [10]). Today this model is known as the dominant framework for defining task characteristics and understanding their relationship to employee motivation, performance, and satisfaction. According to this theory, a job can be characterized in terms of five core job dimensions ([11], [12], [21]):

- **Skill variety** – the degree to which the job requires a variety of different activities so the worker can use a number of different skills and talent.

- **Task identity** – the degree to which the job requires completion of a whole and identifiable piece of work.
- **Task significance** – the degree to which the job has a substantial impact on the lives or work of other people.
- **Autonomy** – the degree to which the job provides substantial freedom, independence, and discretion to the individual in scheduling the work and in determining the procedures to be used in carrying it out.
- **Feedback** – the degree to which carrying out the work activities required by the job results in the individual obtaining direct and clear information about the effectiveness of his or her performance.

The higher a job scores on each of these characteristics, the better the job is and the higher the motivation, performance, and satisfaction of the person executing this job will be ([21]). Therefore, it makes sense to design and improve working environments considering the impact on these characteristics.

2.2   Zur Mühlen model Assignment and Synchronization Policies

The second model describes the policies that WFMS's generally use for distributing and assigning work to performers. It was published by zur Mühlen in 2004 ([17]). The publication revealed the assignment and synchronization policies in a very detailed way. For the purpose of this paper it is not necessary to elaborate every extensively on this model. Therefore, we will shortly explain some basic parts and refer to the original paper for further information

Zur Mühlen's model consists of two parts. The first part, assignment policies, covers the distribution of work among qualified employees. The second part, synchronization policies, explains how a work item that is placed on a shared worklist can be accessed by individual workflow participants. In Figure 1 and Figure , the policies are stated. For clarity, we will shortly discuss some of them.

Property	Possible Values		
Planning of new work items	Net change	Re-planning	
Time of notification	Upon availability	Between availability and latest start time	At latest start time
Queuing of new work items	Queue	Pool	Combination
Activity execution	Individual	Collaborative	
Decison hierarchy	Final Assignment	Delegation possible	

Figure 1: Assignment policies (from: [17])

In these figures, a policy can be seen as an axis on which a certain variable can be varied. First, consider the "planning of new work items" policy from Figure 1. This variable can be valued as a *net change strategy* or a *re-planning strategy*. In a net change strategy, the workflow system assigns available work items to certain people and places them in their worklists. The work items stay there until they are performed. However, if a re-planning strategy is implemented in the

system the work items are assigned to worklists, but when they have not been picked up by the performer they can be recalled. Together with the newly available work items they are then re-distributed among the employees and their worklists. This may mean that a work item is assigned then to another employee.

Another policy is the "queuing of new work items." Here, three different strategies can be chosen. We will only discuss the two most extreme. When new work items are offered in a queue, it means that they have to be performed in the order they arrived (i.e., the FIFO-principle). When a pull strategy is used, the work items do not have to be performed in the way they arrived. Thus, this leaves more freedom in the order of work execution.

The "assignment of work items" in Figure 2 describes the way in which work items are offered to an employee. When a push-mechanism is used the system determines who is going to work on what work item at what time. When a pull-manner is used the employees can decide themselves when they are going to work on which work item.

Finally, "participant autonomy" describes to what degree the assignment of a work item is final. When "rejection of assignment" is possible an employee can reject performing a work item that is assigned to him or her. When the "assignment is final" the employee has no choice and has to execute the work item.

Property	Possible Values					
Coordination	Hierarchy		Group negotiation		Schedule	
	System	Manager	Market	Auction	FCFS	Other
Allocation mechanism	Fully automated		Partially automated		Manual	
Participant selection	Direct		Indirect			
	w/o substitution	w/ substitution	Role	Or. Pos.	Org. Unit	Other
Assignment specification	Static			Dynamic		
Assignment of work items	Push		Pull		Combination	
Participant autonomy	Rejection of assignment possible			Assignment is final		

Figure 2: Synchronization policies (from [17])

The assignment and synchronization policies usually belong to the configuration options of WfMS's. Therefore, they can be implemented and changed easily.

By these two models, we have shown the framework for developing easy to implement human centric "tuning" measures for workflow management systems. In the next section, the development of these measures is elaborated.

3. Tuning measures

Based on the theoretical framework, as described in the previous section, it seems a logical step to somehow combine these two models and propose a number of measures to "tune" a workflow system in such a way that working in the system becomes more pleasant.
In this section, the method of developing the measures will be discussed. Next, the most promising measures, according to an expert validation, are presented and the aimed effect of these measures on performers of the work will be clarified.

3.1   Method description: idea generation, selection, validation

The generation of ideas to "tune" a workflow system in a user friendly way has been a creative process based on the combination of the two models from the areas of psychology and workflow management. By thinking of the impact a change in one of the policies could have on the job characteristics, the idea was developed to find a way to "tune" a workflow management system in a user friendly way. To illustrate this process of generating "tuning" measures, we will give a simple example. In the explanation of the re-planning strategy in planning new work items, zur Mühlen ([17]) states:

> *"... A re-planning strategy would re-allocate all work items that have not yet been started, possibly removing work items from some performer's worklists and placing them on other worklists."*

> We think an employee will not like the fact that work that is allocated to him/her suddenly is removed or changed, as it affects his/her work autonomy. Therefore, one of the ideas we generated is: *"Do not re-plan work items by workflow enactment service."*

In this way, 32 ideas for tuning measures have been generated. Next, these ideas have been critically assessed on ease of implementation. We defined ease of implementation as an intervention that does not take too much time or too much money to be realized. 21 ideas survived this assessment, and 11 were eliminated. In particular, the ideas that caused changes in the organizational structure or in the process model of the process were eliminated.

In the next step, the 21 remaining ideas have been validated by a qualitative expert validation. The six workflow experts (with diverse backgrounds, from both psychology and IT, and practice and research) were asked to indicate if they thought the measure would have a positive impact on the employee, if it would be easy to implement, and if they could rank a list of the top five ideas. Based on these expert rankings, we selected the six most promising measures for further research.

3.2   Six "tuning" measures and their aimed effect on JCM characteristics

Below, we will shortly describe the most promising measures, selected by the experts, and we will explain their aimed impact on the job characteristics from the JCM-model in section 2.

In general, the measures provide the performer of the work with more autonomy, or, in other words with more self-determination, while the workflow management system still controls the situation.

[1] *"Use a shared worklist, from which an employee can choose himself: pull-manner."*
The first measure gives the worker more autonomy. By using a pull mechanism (instead of a push-mechanism) the employee can decide himself when he starts which work item. The execution of work is not forced by the system, and thus the employee has more freedom. Through this freedom, he can also ensure that the work he is doing is alternating, and thus he can improve skill variety.

[2] *"Show an employee if he or she works hard enough, if he or she is satisfying the targets."*
This measure is improving feedback to employees. In many workflow systems the performers have to satisfy targets to the amount of cases they have to process every hour or every day. It is good for an employee to know if he or she meets the requirements that are asked. This information should, of course, be private.

[3] *"When a work item has to be performed again after a (negative result of a) check, return it to the same employee to execute it again."*
The aim of this measure also is to improve feedback. Often the execution of important steps in a process is checked by, for instance, a supervisor. In this case, the supervisor determines whether the step has been performed properly. If that is not the case, the step has to be redone. When an employee has made such a mistake or error in executing an activity for a certain case, it can be very valuable to know what went wrong and why it went wrong. Therefore, the case should be sent back to the same employee that made the mistake so he or she can learn from it.

[4] *"Create 'team batches' of work items. A team of employees (having the same competences/roles) can divide the work according to their own preferences. (Here we assume the allocation mechanism is manual, but is not necessarily controlled by a team leader or manager.)"*
By creating "team batches," employees will experience more autonomy, skill variety, and task significance. In "team batches," the work that is assigned to the team still has to be divided amongst the members of the team. By negotiating and discussing who should do what, employees can have more influence on the work they are supposed to perform, and they can experience more task significance.

[5] *"Give employees the opportunity to adjust the appearance of work items in their worklists to their own preferences: FIFO, earliest due date, random, etc. (Here we assume the assignment of work items is in a pull manner and the worklist is private.)"*
The fifth measure provides an employee with more autonomy. When there is a possibility to adjust the appearance of work items in the worklist the employee can create a better overview of the things he or she has to do according to his or her own preferences. This makes it easier to decide for oneself which work item should be performed next.

[6] *"Case management: let an employee work on the same case as much as possible."*
Finally, case management improves the task identity and task significance for employees. When employees work as much as possible on the same case they know the ins and outs of the case; they will get more concerned with the customer's point of view; and they will feel more useful.

The final step we conducted in this research is an evaluation of the measures by means of current workflow technology. This evaluation will be described in section 4.

4. Evaluation

To test these theoretical ideas on how to tune a workflow system, we have evaluated the most promising measures, using three common workflow systems, Staffware (TIBCO), COSA (Transflow), and FLOWer (Pallas Athena). Based on documentation about these systems we have identified to what degree the six measures are supported by these systems. In the first subsection, we will explain why we selected these systems. Next, we will present the results of this evaluation, and this section will be concluded with a short discussion.

4.1   Selection systems

We have selected three influential and well-known workflow management systems for evaluating the presented measures. As mentioned in the introduction of this section, these three systems are Staffware, FLOWer and COSA.

An important criterion for selection of the systems has been the popularity of the systems. At the moment, Staffware and COSA both have substantial market shares in Europe. They are good in production workflow (i.e., handling a large number of cases that all have to be processed in a similar way). Furthermore, we felt that FLOWer is an interesting system because it is growing in popularity, and it is based on the case handling paradigm [20], which provides more flexibility in the system. The differences between those systems with respect to the measures are discussed in the next section.

4.2   Outcome evaluation

Firstly, we will give an overview of the evaluation results. shows to which degree the actual workflow management system is able to support a measure. This degree is expressed by the following symbols:

+   The idea can be directly supported by the workflow management system itself.
+/-   The idea can be partly supported by the workflow management system; some small adaptations to the system have to be made or some "add-on's" have to be installed.
-        The idea can not be supported by the workflow management system, or the underlying concept of the workflow management system makes the facilitation of the idea not possible (indicated with a "-").

Table 1.   Summary of the result of implementability of the six best ideas.

	Staffware 9.0	FLOWer 3.0	COSA 4.2
Idea no. 1	+	-	+
Idea no. 2	-	-	+/–
Idea no. 3	-	+	+
Idea no. 4	-	-	-
Idea no. 5	+	-	+
Idea no. 6	+/–	+/–	+/–

As revealed in , not all the ideas can be implemented or supported (yet) by the three contemporary workflow management systems we considered. Overall, we can conclude that COSA provides the best support for realizing these ideas. A remarkable result is the difference between the two production workflow systems, COSA and Staffware. Although they are based on the same concept, they do not provide the same support for the measures.
Moreover, FLOWer (as the newer type of workflow management system) seems to provide less support. This is due to the difference in concept. The case handling paradigm already provides a lot of flexibility and autonomy to users, but this is done in a way (see [20]) that makes some of the tuning measures impossible to realize.

5. Conclusion

The schism around WfMS's is accurately captured as follows ([4]):

> "On the one hand, they are perhaps the most successful form of groupware technology in current use; but on the other, they have been subject to sustained

and cogent critiques, particularly from perspective of the analysis of everyday working activities."

In this paper, we have looked for practical ways to make these type of systems more agreeable for those who have to use them in their everyday work. We have taken a approach that is uncharacteristic for most of the active workflow research, where much attention is devoted to making WfMS's more flexible. (For an overview of the various approaches, see [14].) The underlying idea here is that it is the rigidity of a WfMS makes it unsuitable to deal with exceptional situations, in this way frustrating end users.

However, we do not think such a research direction is the most effective way to go. Firstly, despite the broadness of the flexibility research, few research results make their way to commercially available WfMS's. This raises the question whether this type of research, aside from being intellectually satisfying, addresses organizational needs. Secondly, current research seems to indicate that the perceived usefulness of WfMS's by end users is not primarily determined by the flexibility they provide. On the basis of various case studies of workflow implementations and an extensive survey among end users, Poelmans ([19]) concludes that the provision of flexible features will likely not rule out the necessity of appropriating a WfMS in more thorough ways. A tentative conclusion from his research is that not the selection of the right WfMS, but the way it is configured and implemented is crucial in the success of a workflow implementation:

> *"The most important factor is giving the end-users sufficient influence, after implementation, to have the system appropriated to their needs." (p.160)*

This attention for reconfiguration possibilities is in line with earlier insights into the successfulness of IT technologies (see e.g. [18]).

The measures we have proposed are simple ways to reconfigure existing WfMS implementations to address the needs of end users. All of them are thought to positively affect the factors that make work enjoyable and satisfactory. The measures' validation by experts from both research and practice, IT and psychology, adds credability to their usefulness and feasibility. Taking a very general model of workflow policies as starting point, a wide applicability of the measures among WfMS's was aimed for. From the limited system evaluation we carried out, we can conclude that the specific brand of WfMS determines the ease of actually implementing a measure.

This also identifies the opportunities for further research. It would be useful to broaden the scope of systems we considered to provide insight for praxis which measures can be used in what situations. Also, a more thorough evaluation of the various WfMS's will give a better insight into their reconfiguration capabilities. Finally, a closer study of the other generated ideas seems worthwhile to provide organizations with the means to improve the efficiency of their existing operations, with an eye for the human perspective.

6. References

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Irene Vanderfeesten is a student in the Eindhoven University of Technology's Master of Science in Computer Science program. This paper was originally prepared for a course taught by Dr. Hajo Reijers.