

The Impact of Workflow Systems on Organizations

A literature review

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Abstract. Although many companies invest in the implementation of workflow systems to automate, streamline and improve their business processes, only few studies have investigated the actual impact such systems make on the organization. The aim of this paper is to present an overview of literature on the impact that these systems have on the operational processes and the organization in a broad sense; from operational efficiency to cultural change and economical value.

1 Introduction

Many companies introduce information systems in their business to automate work, streamline their business, and improve their service. Well-known enterprise information systems are Enterprise Resource Planning (ERP) systems, such as SAP and Oracle, Customer Relationship Management (CRM) systems such as Salesforce, Supply Chain Management Systems, and Workflow Systems. In this paper we only focus on the impact of one of these types of systems: workflow systems, also called business process management systems or process-aware information systems. These systems coordinate and streamline business processes and their activities in order to make them more efficient and effective. Little is known, however, about the real impact of these systems on the operational processes, and on the organization as a whole. In this paper, we therefore summarize literature on the reported impact of workflow systems on organizations.

The structure of this paper is as follows. First, we describe the methodology of the literature review we conducted and present the quantitative results of it. Section 3 further summarizes the information found by discussing several categories of studies: (i) early case studies on experiences with workflow systems, (ii) studies discussing the operational impact in a single case study by comparative case study analysis, (iii) studies investigating the organizational and cultural impact, (iv) studies measuring and modeling the economic impact and business value, and (v) studies that elaborate on the critical success factors for implementing workflow systems, and on selection the right workflow system.

2 Methodology

In order to get a complete and comprehensive overview of existing works on the impact of workflow systems on organizations, we have conducted an extensive literature review. In this section, the literature review protocol that was followed is discussed, including an overview of the results. The content of the articles that were found through this search is discussed in Section 3.

The first step in our literature search is the definition of a search term. Since the terminology used for workflow systems has changed over the years, we included several terms that are related to our understanding of workflow systems: workflow system, workflow management system, process aware information system en business process management system. Also, we used several synonyms for ‘impact’ such as effect or result, to be able to retrieve all articles that describe the outcome or evaluation of the implementation of the workflow system. The complete search term that was defined is as follows:

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(impact OR effect OR benefit OR result) AND  
("workflow system" OR "workflow management system" OR "process aware information  
system" OR "business process management system")
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The above search term was applied to several search engines subsequently: (i) ScienceDirect, (ii) SCOPUS, and (iii) Google Scholar. ScienceDirect is a search engine that mainly covers journal articles, SCOPUS has a wider article base and also includes conference and workshop proceedings. Finally, Google Scholar was added to

widen the scope even further and to also find more recent articles or unreviewed articles that may be of interest. Since the development of workflow systems originates from the mid 1990's, we have restricted our search to articles that were published after 1989. In addition to the search engines, we used a 'snowballing' technique (backward and forward) on the retrieved articles to extent our literature list further.

The quantitative results of our literature search are presented in Figure 1. By applying the search term to each of the search engines, 81, 827 and 17,600 papers were found respectively. These papers were all scanned for relevance based on their title and abstract. Irrelevant articles were removed from the literature list, leading to 3, 20 and 19¹ relevant articles respectively. After that, duplicates between those lists were removed leading to 3 relevant articles from ScienceDirect, 17 additional relevant articles from SCOPUS (after removing 3 duplicates with the list from ScienceDirect), and 10 additional relevant articles from Google Scholar (after removing 9 duplicates with the articles already found through ScienceDirect and Scopus). Thus, a total of 30 relevant articles was found from the search engines. These articles were then used for backward and forward snowballing, leading to an additional 9 articles, such that the total literature list contains 39 articles for further analysis. The next section summarizes the content of our findings, classified into categories.

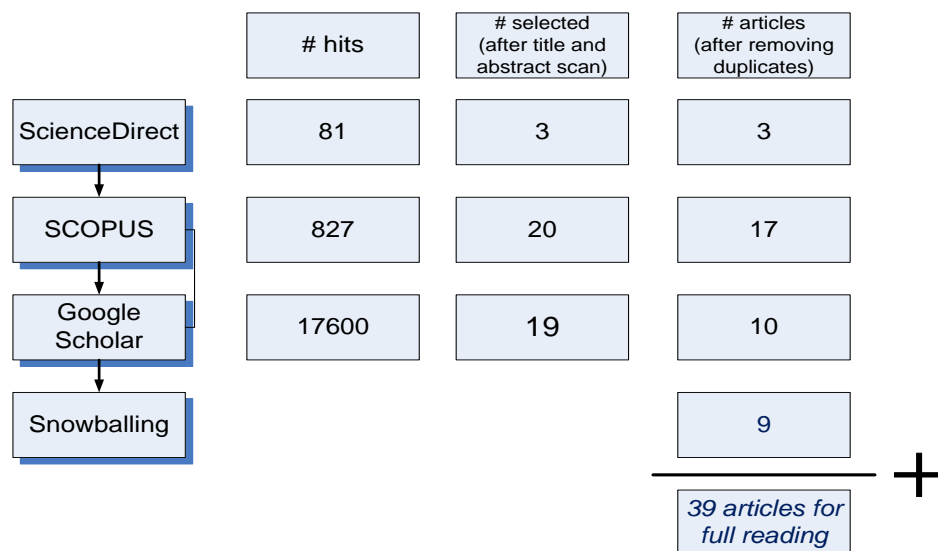


Figure 1: Overview of the number of articles retrieved in the subsequent steps of the literature search.

3 Results

After reading the selected articles, the articles could be categorized into several groups based on their content. The papers in the first category report on early case studies of successful workflow system implementations. They describe general and unquantified effects of the system. Secondly, a group of studies on quantified operational impact on the process could be distinguished. Also, a few comparative studies into operational impact in several cases were identified. As a fourth category, works on the organizational or cultural impact were found, as well as studies that try to model the economic impact of the implementation of a workflow system. Finally, we have found some studies that report on critical success factors for the implementation and use of workflow systems. These six categories are discussed in more detail below.

3.1 Early case studies of successful workflow system implementations

In the early 1990's a number of papers were published describing the first experiences with workflow-like systems in practice. Most of these papers only describe very general, unquantified effects of the workflow system, illustrating the possible effects such a system could have. We will summarize these studies here in chronological order.

¹ since the article set retrieved by Google Scholar was too large, only the first 500 hits (sorted on relevance) were scanned for relevance based on their title and abstract.

(Schael & Zeller, 1993) describe the implementation of a workflow system in an Italian bank. From their analysis of the project they recognise four main benefits of the system as perceived by the users: (1) the reduction of temporal and spatial constraints in cooperative work, (2) the completeness of information, (3) the increase in volume of work that could be handled, (4) the monitoring and management of the total process lifecycle by the system. The impact of these benefits is not quantified in this study.

(Bowers, Button, & Sharrock, 1995) report on a field study of workflow technology in an organization in the print industry. The introduction of the workflow system had a great impact in the company. Although, the implementation of the workflow system had disrupted the shop floor at first, employees reported a positive impact on the operational performance of the process after the system was fully implemented: a well-organized, smooth flow of work.

In addition to these early reports on the operational impact of workflow systems, a few studies discuss the development and potential of workflow systems in general. (Prinz & Kolvenbach, 1996) present the incremental design of a system to support the workflows in a governmental environment. Their study mainly focusses on the requirements analysis and does not present any measurable outcomes of the system. (Schmidt, Meetz, & Wendler, 1999) describe the possibilities and opportunities of the application of workflow technology to the radiology department in general without reporting on a specific application. (Dourish, 2001) builds on the study by Bowers et al. and tries to explain the successful implementation of workflow technology in practice by listing their pro's and cons and by elaborating on their dual role in supporting work: (1) workflow systems coordinate the work, and (2) workflow systems help to explain the work.

3.2 Operational impact of WfMSs

After these positive, but qualitative, reports on successful workflow implementations a number of researches focused on quantifying the operational impact of workflow systems. Below we will first elaborate on the articles that present single case studies into the impact. Next, we will review a number of studies that compare the impact of various implementations in several companies. The results of these studies are summarized in Table 1.

Single case studies

(Goebel, Messner, Schwarzer, & Ag, 2001) elaborate on their experiences in introducing a workflow system in a large insurance company. The pilot project they conducted was successful: they achieved a 70% reduction of the overall execution time. This result was mainly achieved by introducing electronic data and automating the routing of tasks: Furthermore, they discuss a number of opportunities they identified with workflow technology as well as the obstacles they encountered in the first phases of the project.

(Küng & Hagen, 2007) report on the increased performance of several processes in a Swiss bank through business process reengineering efforts in combination with the use of modern process-oriented information technology: the cycle time has been reduced, the output per employee increased, and the quality of work has increased.

(Brahe & Schmidt, 2007) describe the effects of the implementation of a workflow system together with business process re-engineering in a large financial institution. The computational workflows have increased labor productivity dramatically: the number of cases handled per day increased dramatically and the workers were about 19 % faster doing their job with the new workflow system.

Recently, workflow management technology also started to receive attention in the healthcare domain.

(Halsted & Froehle, 2008) describe the results of the implementation of a workflow system (complemented with a 'filmless' document management system and speech recognition) in a radiology department. Case turnaround times decreased by 22-38%, because of several reasons: (i) time was saved by removing the manual task of sorting, prioritizing, and distributing waiting requests, (ii) less interruptions of the radiologists occurred because of a faster transmission of results, and (iii) it was easier to track who is doing what.

(Li et al., 2013) report on the positive effect of the implementation of a workflow management system to manage the sonography workflow. The use of the system has significantly decreased a number of quantitative performance measures: (i) the patient waiting time (measured from initial registration to until called for examination) decreased, (ii) the average number of patients waiting at any time of the day decreased, and (iii) the number of patients treated per month increased. Apart from that, also some qualitative measures were positively affected: the staff workload stress decreased and patient satisfaction increased.

Comparative studies between several cases

In addition to the single case studies, there are a few studies that compare several implementation cases in different organizations.

Kueng (Kueng, 1998, 2000) has performed a qualitative study on the effects of workflow systems on organizations. His interviews among eight people from five different companies showed that through the use of a workflow system the quality of the output of the business process improved and the productivity, measured by cycle time or the volume of work, increased. His study does not include quantitative support for these statements.

(Oba, Onoda, & Komoda, 2000) reports on the development of a mathematical model for predicting the reduction rate of processing time based on data of 25 case studies in which a specific workflow system (Groupmax Workflow) was implemented. To measure the effect the authors introduce the notion of turn-around time (TAT) reduction rate, which is assumed to indicate how much the introduction of the workflow system improves on business processing time as compared to before system introduction. For the 25 case studies a TAT reduction rate between 36% and 85% was measured. Unfortunately, no details are given on the characteristics of their study and the exact data on processing times measured.

As mentioned in the introduction, the work by Reijers and van der Aalst (Reijers & Van der Aalst, 2005; Reijers, 2004) reports on the expected operational effectiveness of WfMS's implementation based on simulation studies. In 15 of the 16 cases considered, a significant decrease of lead time (throughput time) was expected based on the simulations (ranging from 25% to 83% decrease of lead time). For 12 out of 16 cases a significant decrease in the service time was expected to take place (between 4% and 47%)

(Theoretical) models describing operational impact

Finally, a number of authors develop models to predict and/or explain the operational impact a workflow system may have.

(Choenni, Bakker, & Baets, 2003) present a model for measuring the impact of a workflow system that is gradually introduced in an organization. The model assumes that performance indicators such as speed, quality, flexibility, and reliability are related to cost. The quantitative impact of a workflow system on a business process is expressed by the total cost. The proposed model is tested on two case studies in the same organization and was evaluated with mixed results. The paper includes some details on the case studies that show for instance that in one case the speed of the process (i.e. throughput time) has decreased with the introduction of the workflow system, while in the other case the speed has dramatically increased.

(Mans, Russell, van der Aalst, Bakker, & Moleman, 2010) study the impact of the use of a schedule-aware workflow system in a gynecological oncology process by using simulation. The simulation output shows mixed results for the performance measurement on (i) waiting time for the first visits at the clinic, (measured from the time the appointment is made until the appointment takes place), and (ii) waiting time for the diagnostic tests (measured from the time of the first visit until the appointment for diagnostic test takes place).

Table 1: Overview of studies into the operational performance impact of workflow systems (ordered chronologically)

	performance indicator(s)	impact	outcome	nr. of cases considered	time-span of study	Type of measurement
(Kueng 2000)	throughput time (cycle time)	positive	qualitative	8 people from 5 different companies	>1 year of experience with workflow system	qualitative through interviews
(Oba, Onoda, & Komoda 2000)	throughput time (processing time)	positive	quantitative	25	N/A	N/A
(Goebel, Messner, & Schwarzer 2001)	throughput time (overall execution time)	positive	quantitative	1	N/A	Pilot project; measurement before and after implementation
(Choenni, Bakker, & Bowers 2011)	throughput time (speed); quality; flexibility; reliability	mixed results	quantitative	2 (within 1 organization)	N/A	Quantitative measurement through questionnaires (before); and real data wfms (after)
(Reijers & van der Aalst 2005)	throughput time (lead time), service time, wait time, resource utilization	mixed results	quantitative	16 (within 6 organizations)	-	based on simulation
(Kueng & Hagen 2007)	throughput time (cycle time), output per employee;	positive	quantitative	4 (within 1 organization)	N/A	measurement before and after implementation

	quality of work products						
(Brahe & Schmidt 2007)	productivity	positive	quantitative	1	longitudinal (3 years)	quantitative measurement of productivity (number of cases handled per day, speed of workers executing tasks)	
(Halsted & Froehle 2008)	throughput time (case turnaround times)	positive	quantitative	1	longitudinal (2,5 years)	pilot study, measurement before and after implementation	
(Mans, Russell, Aalst, Bakker, & Moleman 2010)	waiting time for first appointment; waiting time for diagnostic tests	mixed results	quantitative	1	-	based on simulation	
(Li, Tsai, Chen, Lin, Pan, & Yang 2012)	Patient exam waiting time; Number of examined patients per month; Avg. number of waiting patients	positive	quantitative	1	1 year (comparison before and after implementation)	performance data (before and after)	

3.3 Organizational impact

Apart from the operational performance improvement that the implementation of a workflow system can achieve, the system may also have an impact on the organization and mainly on the employees that have to use the system. The results reported in this area are described below.

(Atkinson & Lam, 1999) describe the organisational impact of a groupware enabled workflow system based on Lotus Notes. Apart from positive impacts such as the increased control by managers, and the usefulness of the system, they also report on negative impacts on the decreased social interaction in the organization.

(Kueng, 2000) reports an increase in job satisfaction in his qualitative study based on interviews with only 8 people. The degree of responsibilities for the employees was found to be un-altered and no evidence was found for the statement that workflow systems make interesting jobs even more interesting, and uninteresting jobs monotonous. Finally, the study shows that workflow systems may lead to a dis-empowerment of lower management.

(Sarmiento & Machado, 2000) present a discussion of organizational changes that may be induced workflow systems. They identify five categories of impact: (i) communication, (ii) collaboration, (iii) coordination of tasks, (iv) productivity, and (v) knowledge and learning. Furthermore, the authors propose to use the Improvisational Change Model (by Orlikowski and Hofman) to explain the organizational changes due to the adoption of workflow systems. The work described in this paper is theoretical and not supported by case studies.

(Doherty & Perry, 2001) conclude that workflow systems have the potential to modify the culture of an organization in a positive way by improving the organization's customer orientation, flexibility and quality focus. They have performed a qualitative research through a preliminary survey and semi-structured interviews with 16 participants from the financial services industry.

(Vanderfeesten & Reijers, 2005) introduce a number of ideas to fine-tune a workflow system's implementation in order to overcome the supposed rigidity of a workflow system that may lead to a lower perceived quality of work based on Hackman's job characteristics model. The proposed measurements give employees more autonomy over their work. Also, in (Reijers & Poelmans, 2007) a number of re-configuration decisions, such as a finer step granularity, are discussed in order to facilitate a smooth flow of work in the workflow system.

(Mutschler, Rijkema, & Reichert, 2007) also build on Hackman's job characteristics model to investigate in which way employees of two Dutch companies perceive the impact of a newly introduced workflow system with respect to the important five job dimensions: skill variety, task identity, task significance, autonomy, and feedback from the job.

In the same line of thought, (de Waal & Batenburg, 2008) investigate the impact of decisions made in the design of the workflow system on the perceived quality of work of the employees working with the system. Based on sociotechnical systems theory they formulate a number of hypotheses, among others that the "workflow control decisions of the workflow system have a negative effect on the employees' learning opportunities and a positive effect on their information of work. They have found no change in the perception of work quality before and after the implementation of the workflow system for the whole sample population, but for subsets of this population (employees with specific jobs) the workflow system made a difference. (Waal, de & Batenburg, 2009) develop a conceptual model to describe the relationship between user participation, user satisfaction, and quality of work, shortly after the deployment of the workflow system

Finally, (Poelmans & Reijers, 2009) have studied the impact of workflow technologies on the perceived usefulness, end-user satisfaction and perceived organisational benefits. Their findings through an online survey among 246 end-users show that workflow applications are generally accepted and positively evaluated.

3.4 Economical impact and business value

Although the introduction of a workflow system may result in high costs, it may be worth the investment if business process performance is improved. This return on investment is also researched. (Mutschler et al. 2006) present an evaluation methodology to systematically evaluate the economic impact of workflow systems. (Pantazi and Georgopoulos 2006) discuss a theoretical model to measure the impact of business process competent information systems on business performance. (Gruber and Huemer 2009) develop a method for the evaluation of the profitability of a workflow system based on a cost-benefit analysis. This method was also successfully applied in a banking corporation.

3.5 Critical success factors for implementations

In order to achieve the possibly positive impacts on operations, organization and business value, a project introducing the workflow system should be carefully executed and managed. In contrast to the vast majority of papers studying the critical success factors of ERP-system implementation, only a few papers report on the critical success factors for workflow systems implementation specifically.

(Parkes 2002) describes a long list of critical success factors for workflow system implementation, among which the most important once identified are *management commitment*, *communication*, and *end user participation*.

(Mutschler, Reichert, & Bumiller, 2008) investigate the critical success factors for achieving business process support by a survey. They distinguish organization specific, project specific, an technology specific critical success factors. Their survey shows that the essential organization specific factors are *end user participation* and *access to required information*. *Management commitment* and *communication with end users* are the essential project specific factors, while in the technology specific category none of the success factors was rated as essential.

(Ravesteyn & Batenburg, 2010; Ravesteyn, 2007) present a literature review and survey among BPM consultants, developers, and end users on the critical success factors in BPM systems implementation. They conclude that *communication*, *involvement of stakeholders* and *governance* is critical.

(Gross & Pekkola, 2008, 2011) explain why the introduction of a workflow management system for travel management in higher education failed and derive fail factors from that. They take three different perspectives to do this. From the technological frames perspective they discovered that the workflow system automated the secretaries work but caused extra work in different levels of the organization. Seen from the socio-technical requirements perspective the workflow system was techno-centric: emphasizing the technical challenge and separating the social component from the technical. And from the technology in use perspective, they report that the ongoing adaptation of the workflow system to changing business environment and context was not done.

(Weber, Mutschler, & Reichert, 2010) study the effort needed for implementing and maintaining business processes based on standard workflow technology on the one hand, and on a case handling system on the other hand. They conduct an experiment with 48 students. The experiment shows that the efforts (measured by time spend on several aspects) for implementing workflow technology are lower than for a case handling system. In addition to that, they show that domain knowledge had an impact on the efforts needed for implementation of either system.

(Trkman, 2010) builds a theoretical framework (based on contingency theory, dynamic capabilities theory and task-technology fit theory) to identify critical success factors in a case study from the banking sector.

Finally, a few articles focus on the evaluation of various workflow systems in order to select the right system for a specific situation, e.g. (Berger, Ellmer, Quirschmayr, & Zeitlinger, 1997; Gruber, 2009; Zur Muehlen, 1999).

4 Discussion and conclusion

In this review we analysed the literature for the impact of workflow systems on organizations. We identified three main types of impact: operational, cultural/organizational, and economic impact. In addition to that, some articles were found on critical success factors and tool selection processes specifically for workflow systems.

From the perspective of operational impact only few studies exist that actually compare cases. Many papers report on a single case study and the comparative studies often take a theoretical comparison (e.g. prediction model or simulation model) as the starting point. From the actual case studies we conclude that in a majority of cases a positive effect on the operational performance was achieved. Mainly through a decrease in throughput time, waiting time, and cycle time, but also through a higher work volume

The studies on organizational impact focus on many aspects such as culture change, work quality, job satisfaction, control and empowerment. Most of these studies also aim for the development of a theoretical model and only a few contain evaluations with real users and real organizations. From these studies, workflow systems in general are evaluated as positive, although there is a risk of making the job more boring for employees when the system is not properly designed and introduced. A number of articles therefore focus on the improved design of workflow systems to overcome these problems.

The few available works on economic impact are all based on theoretical models that quantify the cost and benefits of introducing the workflow system.

Finally, the critical success factors for workflow system implementation identified from the literature are comparable to earlier research on critical success factors for enterprise information systems: e.g. management commitment, communication, and user involvement.

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