Business Process Redesign for Effective E-Commerce

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ABSTRACT

Many companies have found out the hard way that successful e-commerce requires more than a flashy web presence. Existing business processes must be seamlessly integrated with the new, electronic form of interaction with suppliers and customers. Despite this insight, little research has focused on the transformation of doing business to achieve the presumed benefits of e-commerce. This paper elaborates on both qualitative and quantitative support for redesigning business processes in the context of e-commerce. First, we give directions on how processes may be reengineered with this aim, particularly within the service industry. The presented views are based on existing research into Business Process Reengineering (BPR) best practices and applied in two case studies: one broad and qualitative case study to show the applicability of the best practices, and one small quantitative case study to show the benefits in terms of lead time reduction due to the application of best practices.

Categories and Subject Descriptors

H.4.1 Office Automation – Workflow management

General Terms

Management, Performance, Design.

Keywords

E-commerce, Service Industry, BPR, Process Models.

1. INTRODUCTION

The other day, we tried to buy a birthday present for a friend via the Internet. Looking for a subscription to a local newspaper, we were pleasantly surprised to see that its agency offered a variety of subscription offers. The option 'gift subscription' covered a five-week delivery of the paper and seemed the best buy. In no time, the web form was filled out which started with "yes, I'd like the gift subscription". The web page itself explained that the newspaper agency would send a gift voucher to us in 10 days, which could be handed over to our friend personally. However, instead of the gift voucher we received an e-mail, which curtly inquired into the type of subscription we preferred. It took the newspaper agency 10 days to 'process' our request and it appeared that their back office didn't know the offers on their own web page!

There is a historic parallel for the current uphill battle of e-commerce. The first wide-scale introductions of IT in the business place focused on the improvement of isolated parts of business operations, for example on the generation of invoices. Productivity increased locally, but the overall effect was small. Only during the 80s and 90s, companies started to see the benefits of considering entire business processes when implementing information systems, and as a result, huge gains were achieved.

Today, it seems, companies are at the start of this same loop again. The focus is on creating "brochure-ware pro forma, this-is-who-we-are Web sites"[4]. Others report that 85% to 95% of corporate e-commerce web sites are not even linked up with their back-office processes[12]. Once again, the view on the entire process is missing, which prevents the new technology to become truly effective.

We want to put the emphasis on the process context of e-commerce. We address guidelines to redesign business processes when e-technology is introduced. The purpose of such a redesign is to meet business partners' expectations raised by doing electronic business, in particular improving its performance.

The direct cause for us getting involved in such change processes is a longitudinal research into the effectiveness of workflow management systems (WFM systems) [17]. Currently, eight Dutch organizations of different sizes participate in this research to get a better understanding of the impact of this technology on performance indicators such as lead time, resource utilization, and service time .

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The paper is structured as follows. In Section 2 we define e-services and then focus on different scenario's for applying Business Process Redesign (BPR) in the context of e-services. Based on characteristics of e-commerce and the service industry, we provide an overview of 13 BPR best practices that are promising in this context (Section 3). Based on this overview, we show the applicability of the best practices in two case studies, each aiming to illustrate a different point. The first one is a qualitative case study that we carried out for a Dutch municipality. We elucidate most of the BPR best practices and show the related process models, represented in Petrinet-based Workflow nets (Section 4). The second case study is a quantitative analysis that we carried out for a large Dutch service organisation which shows the possible gains of applying BPR best practices in terms of lead time reduction (Section 5). The paper concludes with conclusions and directions for further research.

2. BPR FOR E-SERVICES

The area of e-business is very broad, and many definitions exist. We use the term e-commerce (EC) for activities related to marketing, buying and selling of products and services on the Internet [7], and we focus explicitly on e-sales: selling via the internet: to consumers (B2C) or to other companies (B2B) [8].

EC initiatives are well known for the delivery of both physical goods and services. In this paper, we focus on services. This part of business is traditionally underexposed in literature, although we feel that it offers much more potential for EC initiatives than the manufacturing environment. After all, physical constraints are almost absent, making digital copies of reports or documents is simple, transportation of information can take place instantaneously and there are no real limitations with respect to the in-process inventory. This suits the properties of the Internet perfectly. Examples of electronic services include e-finance (banking, insurance, stock exchange, etc.), e-health care, e-government and electronic travel services (booking a flight, renting a car, booking accommodation, etc.). Within the electronic context, an e-service is then a service that is accessible through electronic means (e.g., a web interface) [6].

The constraints on an EC process are obviously very different from those on a conventional process. For example, consider the 24-hours/7-days- availability that is almost a standard requirement for an EC process. Our claim is that many known BPR practices to improve a process may be used to make an EC process *better aligned* to such new constraints. Consciously using the best practices of BPR could make the difference between a process that allows EC and a process that *excels* in supporting EC. There is an analogy in software design: Although a functionally correct program is nice, a correct program with a good performance is a killer.

To illustrate this point, consider the central mortgage office of a large UK retail bank, as described by Barnes et al. [2]The bank recently has taken over a major competitor, where applicants were already able to submit a mortgage application electronically. Because of the incompatibility between the various systems, the bank's processing department currently must generate a hard copy of each application. For applications received for the former competitor's products, this means that the on-line application has to be manually re-keyed by the bank's operators. From a cost perspective, the bank may benefit from a BPR initiative to get rid of this inefficiency. More importantly, reengineering is a must because the delay involved with generating a hard copy, transferring it to the bank, and re-keying it will sharply contrast with customers' expectations on the speed of doing EC.

When a conventional process is being transformed into an EC process, then clearly there is a momentum of change: Web-servers have to be installed, web pages generated, etc. This momentum is ideal to consider BPR: (i) no additional work is required to understand the process and (ii) changes from both the EC and BPR perspectives could be combined.

Truly integrating the efforts to, on the one hand, enable a process to support EC and, on the other hand, to reengineer it is just one of the possible scenarios.

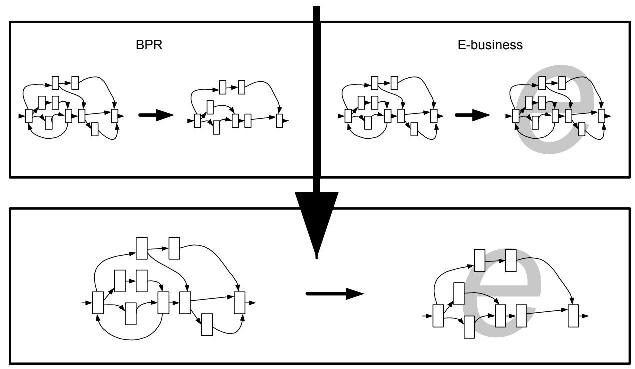

Figure 1 BPR and e-enabling integrated in one step

An example is Ducati Motorcycles (Italy), which started to sell exclusive motorcycles through the Internet in 1998, but recently streamlined this process drastically to attract new customers[11].

We also found cases where business processes were reengineered, with attention for future EC demands, while its e-enabling took place in a later stage. Consider for instance the Chinese-based Haier Group, a multinational firm in household appliances. In preparation of their B2C initiative in 2003 to sell their products online, they first reengineered their entire business operations [5].

Note that we did not mention in any of the scenarios whether the original, conventional process would still remain effective after the EC initiative. For example, an UK subsidiary of a large US insurance broker explicitly decided not to integrate its EC processes with all other processes; even staff was not mixed.[6] The issue will not be dealt with it at this place. Independent of the chosen scenario – split or mix – any redesign should obviously address the typical success factors for EC processes in the service industry.

3. BPR BEST PRACTICES IN E-SERVICES

Up to now, we have discussed the relation between EC and services and the relation between EC and BPR. The question is: How do BPR best practices contribute to e-services? We define a BPR best practice as a heuristic that can be applied on a business process and which results in a redesigned business process.

3.1 Selection of best practices

Our work has been inspired by previous work from Rupp and Russell ('The golden rules of business process redesign')[19], and, more recently, by publications such as 'Business Process Orientation' by McCormack[14]. The various practices they mention are often derived from experience gained either within large companies or by consultancy firms with repetitive application of these practices in BPR engagements. For example, the rules as proposed by Peppard and Rowland [15] are derived from the experiences within the Toyota Company. An extensive overview of BPR best practices as can be found in reengineering literature has been carried out by Reijers [16]. Unfortunately, many of these best practices lack an adequate quantitative support. As a result, their application to EC cases in this paper is qualitative and explorative, while further research focuses on the development of such support.

The original list of BPR best practices consists of 30 rules, but not all of them are equally promising in the context of e-services. To be able to select the most potent rules, we first identified the most relevant performance criteria within the context of EC and the service industry.

The absence (or limited impact) of physical constraints in the service industry can be classified as a major enabler for BPR in the service industry. Another important characteristic of the service industry is the fact that the process output is difficult to value. *Transparency* of the business process is an important performance aspect that might reduce this effect. Furthermore, aspects such as customer loyalty and quality of the fulfilment cycle determine the success of a particular e-service. These contribute to an adequate and timely delivery of e-services. A newspaper that is a day late, for example, lost all of its value. Therefore, *speed* is part of the quality of an e-service and an important performance criterion for EC-processes. Other process performance aspects related to the quality of the fulfilment cycle are the *time-to-market* and the *cost* and *quality* of the business process. The last performance criterion that we would like to mention here is the *availability* aspect, caused by the time-independent nature of EC processes. Although this listing may not be exhaustive, we feel that the mentioned aspects are especially important to make e-services effective and successful. Summarizing, we identified the following six performance criteria for e-services:

1. Transparency: the insight that a customer has in how his e-service is fulfilled;
2. Speed: the period of time used to deliver the e-service;
3. Time-to-market, the period of time necessary to introduce new e-services in the market;
4. Quality: the quality of the e-service itself, as a result of the business process;
5. Cost: the cost of the business process, reflected in the price of the e-service;
6. Availability: the percentage of time the e-service is available.

Applying these characteristics to the overview of existing BPR best practices, 13 best practices seem especially promising in the context of EC. In the remainder of this section we present short descriptions of the relevant best practices. In Sections 4 and 5 we provide more detailed explanations and apply them in two case studies. A complete and detailed overview, including all literature references of the survey on characteristics on EC and services, is available [10] (download http://tmitwww.tm.tue.nl/staff/mjansen/)

3.2 The 13 BPR best practices for e-services

In this section we summarize the selected best practices for e-services. We realize that the descriptions are short; more explanation, references to literature, examples and nuances are described in [16].

3.2.1 Task best practices

Task best practices focus on optimising single tasks within a business process. Two of them are of special interest:

1. Task elimination: delete tasks that do not add value from a client's viewpoint.
2. Task automation: introduce technology if automated tasks can be executed faster, with less cost, and with a higher quality.

3.2.2 Routing best practices

Routing best practices try to improve upon the routing structure of the business process. The most effective of these in an EC context:

3. Knockout: execute those checks first that have the most favourable ratio of expected knockout probability versus the expected effort to check the condition.
4. Control relocation: relocate control steps in the process to others, e.g. the client or the supplier, to reduce disruptions in the process.
5. Parallelism: introduce concurrency within a business process to reduce lead times.

3.2.3 Allocation best practices

Allocation best practices involve a particular allocation of resources to activities. One in particular is especially promising in relation to EC:

6. Case manager: make one person responsible for the handling of a specific case.

3.2.4 Resource best practices

Resource best practices focus on the types and availability of resources. In an EC context, the following resource best practice should be considered:

7. Empower: give workers most of the decision-making authority and reduce middle management.

3.2.5 Best practices for external parties

This type of best practices tries to improve upon the collaboration and communication with the client and third parties. The most promising are:

8. Outsourcing: relocate work to a third party that is more efficient in doing the same work, to reduce costs.
9. Contact reduction: combine information exchanges to reduce the number of times that waiting time and errors may show up.

10. Buffering: subscribe to updates instead of complete information exchange.
11. Trusted party: replace a decision task by the decision of an external party.

3.2.6 Integral process best practices

This type of best practices applies to the business process as a whole. Especially these are of importance in relation to EC:

12. Case types: determine whether tasks are related to the same type of case and, if necessary, distinguish separate processes and case types.
13. Case-based work: removing constraints that introduce batch handling may significantly speed up the handling of cases.

For each of these best practices we are able to show how they affect the EC process, this is, explain how the process structure could be changed as a consequence of the redesign and which performance characteristics are affected. In the next subsection, we explain and apply a number of these as an example.

4. CASE STUDY: BPR WHEN DISCLOSING SERVICES THROUGH THE INTERNET

The Dutch local government under consideration in this section is currently in the process of supporting all their processes with workflow management technology. This municipality has 43,000 inhabitants, scattered over eleven residential areas. In 1999, the two town halls required considerable maintenance, both physically and infrastructurally. The municipal executive considered this a good opportunity to change the way of working for its 280 employees and to get citizens more involved in their official processes. In 2003, 'flex-working' was introduced for all of the municipality's employees, i.e. flexibility in when and where they work. For the citizens, a so-called 'digital counter' was opened. Many of the common services to the community were now disclosed through the Internet, such as the application for various types of licenses. To be able to realize this new way of working, all 300 business processes need to become supported by a workflow management system. This change process is still under way. This case study involves the way this municipality deals with citizens' applications for building licenses. The application process has been disclosed by the Internet already in the sense that citizens can apply through web-based forms, while the more conventional types of contact are still in place. However, no redesign of the application process had taken place so far.

4.1 Process description

From an organizational viewpoint, the handling of an application for a building license is a complex process. The process contains over a hundred activities and fourteen different organizational roles. Apart from construction regulations, also environmental regulations, fire safety, civil and cultural aspects must be taken into account. In this process about 20 employees (seven full-time equivalents (FTE's)) are involved and about 800 applications are being handled each year. For reasons of clarity, we only discuss those process steps that are necessary to understand the process. We omit those process steps that do not contribute to our understanding and do not influence the redesigns.

The process starts with supplying applicants of a building license with information if they require so. Then the receipt procedure starts of the application form, which is either electronic or not (see left part of Figure 2).

When the application has been received in order, the building application will be treated by the inspection committee. This committee is in session once every two weeks and acts as a building inspector who enforces the regulations regarding the external appearance of buildings ("inspection committee" for short). After treatment by the inspection committee, the applicant receives feedback based on the evaluation by the committee. Subsequently, a number of checks is made: the application is checked against environmental planning regulations, technical regulations, and if applicable the regulations which are in force for monumental buildings. After these steps, a decision is made either to accept, hold or reject the application. This part of the process is depicted on the right-hand side of Figure 2. We recall that this structure represents the way the application process is carried out at this point in time.

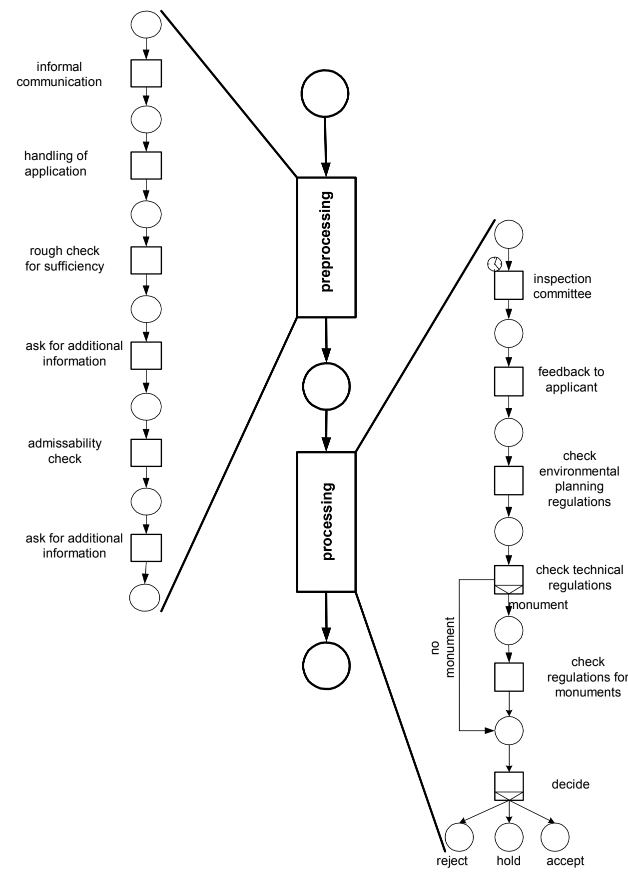

Figure 2 Application of a building license

After this part, the process proceeds with the settlement of the decision, first with respect to content and then with respect to administration. It also includes the handling of petitions against the decision to grant or deny the application. These steps will not be considered here.

We considered the application process a good case for an exploration and explanation of the best practices for three reasons: it is already being enabled for EC, it is rather complex and it was not subjected to explicit redesign before. The municipality itself showed an interest too: not so much to have a complete redesign, but to get acquainted with new ideas and approaches in process redesign. Because of these specific goals, a desk analysis of the current municipality's process models and work instructions seemed appropriate.

When starting our desk analysis it became clear that not all best practices could be applied in our case, because a best practice was not applicable (e.g. we did not find trusted parties in this context) or the best practice was inconsistent with another one (e.g. task elimination and task automation). We will discuss each of the relevant best practices for the case individually in the remainder of this section. For each of these, the general formulation of the best practice is given, after which its applicability is put in a EC context, and lastly its applicability to the case of the municipality is discussed. In a workshop of half a day, we received feedback from the municipality on our redesign scenario's which we used to come up with an overall process redesign. This will be discussed at the end of this section.

4.2 BPR best practices

4.2.1 Task elimination

Reducing unnecessary tasks or activities from a business process is a widely known BPR best practice [15]. A common way of regarding a task as unnecessary is when it adds no value from the client's point of view. Typically, control tasks in a process do not do this; they are there to fix problems created or not elevated in earlier steps. Control tasks can often be found back as iterations and reconciliation tasks and are often performed by middle-management.

In an EC context, the advantage of omitting a task that requires a scarcely available resource is huge. It can make the process execution faster and delivery dates more reliable. Omitting a task more easily outweighs the potential loss of quality than in conventional processes. Speed is especially important in a B2C context where clients generally are less loyal and more impulsive to look for alternatives[21].

When applying the task elimination best practice to our case study, the feedback after the session of the inspection committee is eligible to be eliminated. Note that we assume that this is only one-way communication. The applicant is mainly interested in the final decision; this intermediary result only serves a purpose if the total procedure takes a lot of time. If, in combination with other re-engineering principles, lead time is reduced, the intermediary feedback step can be eliminated as it adds no value.

4.2.2 Task automation

In many BPR projects, automating tasks is pursued to the effect that tasks can be executed faster, with less cost, and with a higher quality. In the context of EC, a paramount advantage of an automated part of a process is that it is available to be executed 24 hours a day & 7 days a week against relatively low cost.

Although the best practice is widely known [15], the possibilities of automating tasks against reasonable cost for actual processes are often underestimated. In a recent BPR project conducted for a social security office [16], on average 75% of all operations performed by human operators could be automated. As a result, over 10% of all claims required no human attention anymore. Only tasks that could not be explicitly defined and/or required an ethical judgment still required human involvement.

In the context of EC, an automatically produced *preliminary* task result that precedes a definitive outcome may also be of value. Customers, for instance, that request a personalized repair advice in an after-hours situation may be offered a standard list of solutions, accompanied with the promise of a specific answer at the start of the new business day.

Introducing WFM technology in our case opened the possibility to exchange information through the web. For example, after finishing the procedure by the inspection committee, the result could be made available on the web, probably in the same way as it can be made available to the internal employees. Furthermore, in addition to this explicit feedback moment, also feedback could be available after the checks for environmental planning regulations, technical regulations and regulations for monuments. This approach requires an adequate information security policy to protect the privacy of citizens. In the company of our case study, we have seen several examples of other processes how this could be done. This opportunity was not exploited by the municipality yet, and is a result of discussion on the application of the task automation best practice. Note that the task which is proposed to become automated here, the conventional feedback over a decision, is no part of the process in Figure 2.

4.2.3 Knock-out

Many processes within the service industry involve various subsequent checks, so-called *knock-outs*. If a knock-out is not satisfied, this puts a stop to the entire processing of this case [1]. In an EC situation for services there are two scenarios that might trigger a reconsideration of the ordering of these knock-outs. In a highly competitive B2C environment, it may be wise to first perform the knock-outs that have the highest probability of stopping the process. In this way, clients are informed as soon as possible about the outcome of the process. In a high-volume B2B situation, cost-effectiveness may be of such importance that knock-outs are ordered in a decreasing order of effort *and* in an increasing order of termination probability. In other words, the knock-out that has the most favourable ratio of expected knock-out probability versus the expected effort to check the condition should be pursued. Doing this will on average lead to the least costly process execution and the shortest lead time of a sequential process [1].

In the case under consideration where applications for building licenses are evaluated, four knock-out checks can be determined: (i) the evaluation by the inspection committee, (ii) the check against environmental planning regulations, (iii) the check against technical regulations and (iv) the check against the regulations for monuments. A negative result of one of these checks will result in a negative decision at the end and could therefore stop the process. Because of this, the application of the knock-out best practice could result in a more efficient resource utilization, a reduction of the lead time, or even both. The checks should be ordered in such a way that the step that has the most favourable ratio of expected knock-out probability versus the expected effort to check the condition should be carried out first. A different but viable ordering of the current checks on the basis of this best practice is depicted in Figure 3. The very time-consuming gathering of the inspection committee is now moved to the end. However, when looking at the existing process more closely (see Figure 2), it becomes clear that all checks are performed anyway, regardless of the outcome (positive or negative) or the order in which they are performed. The reason for this is that Dutch law requires governmental agencies to support each of

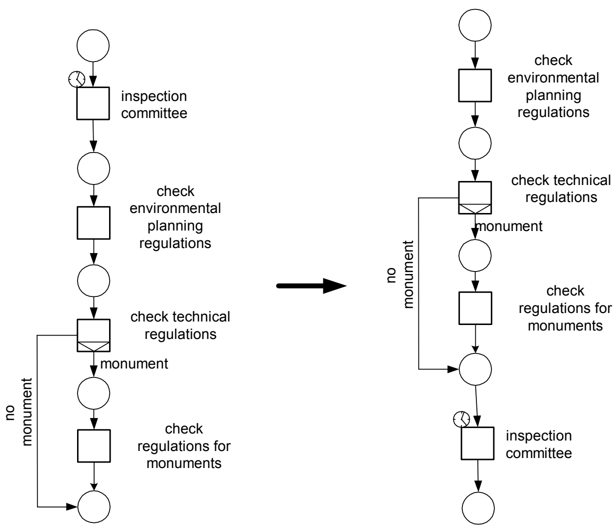

Figure 3: Knock-outs (before and after redesign)

their rejections by all arguments, i.e. by *all* outcomes of the checks. This is also reflected in the process models of Figure 3. Thus, we will not apply the knock-out principle here because of a legal constraint. On the other hand, this opens up for another routing rule: parallelism.

4.2.4 Parallelism

Any e-service process will almost inevitably involve considerable information processing. As technology to distribute and share information have become widely accepted (e.g. databases, groupware systems, e-mail), possibilities to introduce more concurrency within a business process increase. After all, information may be made available to different parties at the same time instead of having one party waiting for the other to complete his update on the single (paper) file. The most important effect of applying this best practice is that the lead time may be drastically reduced, a major benefit in the perspective of EC. Clearly, only tasks that do not depend on each other are candidates to be put in parallel.

Note that the availability of technology in itself is not sufficient for achieving the gains of parallelism. In the study we mentioned earlier [17], about 20 service processes were investigated in detail. Although the companies were selected in the study because of the adoption of workflow and document management systems, *none* of their processes were restructured such that some degree of parallelism was achieved. In other words, the new processes were just as sequential as the original ones. This once more emphasizes how process transformation is different from introducing new technology and that it requires special attention for e-services.

Whereas the knock-out rule focuses on the combination of resource utilization and lead time, parallelism focuses on reducing lead time and usually has a negative effect on resource utilization. In our case study, however, all checks are performed anyway, causing a fixed resource utilization. This characteristic makes parallelism very attractive: it opens possibilities for lead time reduction. To start with, checks for environmental planning regulations, technical regulations and monumental regulations can be done in parallel. Also the check by the inspection committee can be put in parallel, implying that the feedback to the applicant could disappear. This intermediary feedback is no longer necessary as lead times are considerably reduced anyhow. The result is shown in Figure 4.

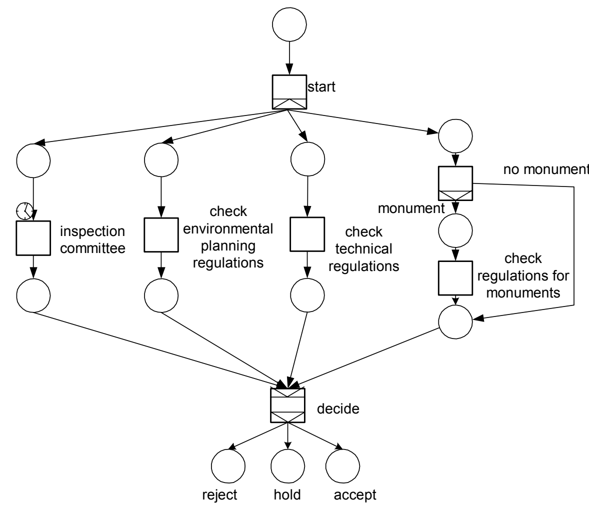

Figure 4: Parallelism

4.2.5 Case manager

Appointing a case manager within a process means that one person becomes responsible for the handling of a specific case. The case manager is responsible for the case, but he or she is not necessarily the (only) resource that will work on tasks for this case. The most important aim of this best practice is to improve upon the external quality of the process. The process will become more transparent from the viewpoint of a party that interacts with it, as the case manager provides a single point of contact. It may also have a positive effect on the internal quality of the process, as someone is accountable for correcting mistakes.

It is interesting to relate this best practice to a known characteristic of EC, and of the introduction of computers in general: A form of alienation is likely to take place between the people representing the various parties [20]. Several attempts are made to counter these effects, for example by automatic personalization of the interactions [18]. However, if the handling of a case really goes astray, then the best approach from a quality perspective is to devote human care to such a case in order not to aggravate the situation. Appointing a case manager may still be cost-effective if the ratio of care-taking cases remains low. Note that a variation of this best practice is the appointment of an account manager, who is responsible for all cases that involve a specific *party*.

In our case study, the application for a building license could also benefit from introducing a case manager. The case manager is able to track a particular case (the application), both when having the checks sequential and in parallel, and he may keep contact with the applicant, who has a single point of contact. Appointing a case manager does not change the process structure as such, but introduces a new role type. If the employee who acts as case manager for a particular case is not involved in one of the process steps of that case, this may have a negative effect on costs, i.e. resource utilization. However, if, e.g., the first person that handles the case will be appointed case manager, merely the lead time will be reduced.

4.2.6 Case types

The *case types* best practice can be formulated as follows: determine whether tasks are related to the same type of case and, if necessary, distinguish separate processes and case types [3][9];[19]. A real-life problem in transforming a business process into delivering e-services is that many subtle differences exist between individual cases. As a result, various alternative routings through a process must be supported. Incorporating all these paths in one uniform e-process may be extremely hard, though desirable from a maintenance point of view.

As a rule of thumb it can be stated that 80% or more of all cases follow the same routing, while the remaining 20% is responsible for the many variations on this routing. In an attempt to shorten the time-to-market of a new e-service, it could be attractive to focus on this majority of similar cases first. Cases that do not fit within the standard process must – for the time being – follow the conventional (non-EC) route. This may result in more coordination problems between e-process and conventional process and less possibilities for rearranging the process as a whole. This is a flexibility issue. (Note the similarity of focusing on the common case with the task automation best practice.)

When applying the case types best practices to the application process for building licenses, it could be profitable to distinguish between relatively simple and complex applications. Simple applications can be dealt with as formalities, particularly with respect to the inspection committee. The benefit may be that the inspection committee for both separate tracks may be composed differently and with a different frequency. This will particularly result in a noticeably faster processing time of the large numbers of simple applications, as these will not become "blocked" in time by preceding complex applications.

4.3 Proposed redesign

As a concrete outcome of the workshop, a process design was composed which combined the more feasible and attractive scenario's. From the start of the desk analysis, it was clear that the ten best practices that seemed applicable to our case study could not be applied at the same time. With respect to the feedback task(s), both task elimination and task automation seemed to be applicable. From a service perspective, it would be good to automate the task and to consider other steps in the process where this could be implemented at the same time, e.g. after each of the check steps. If as a consequence of other redesign best practices the lead time could be reduced considerably, task elimination would be attractive too.

For the knock-out rule we already concluded that we will not apply this rule in the case because of constraints in Dutch law. This opens the possibility to reduce the lead time by implementing the parallelism best practice. Two best practices seemed to be beneficial regardless of other decisions for the redesign: contact reduction and case manager. Applying contact reduction implies a change of role type: the communication in the beginning of the process could be improved by using a specialist, the general back office employee should be specially trained with respect to building applications. Secondly, a case manager could be assigned to a case as a kind of account manager, thus reducing lead time and improving quality and service. The municipality's officials considered it unlikely that the empower scenario, which they already partially implemented, could be pursued much further.

During the work shop, nothing conclusive could be said with respect to outsourcing and case-based work. Although these rules seemed applicable, the possibilities and implications should be investigated further, taking all internal and external constraints into account. The result of this overall evaluation of the applicable rules had led to one redesign, as depicted in Figure 5.

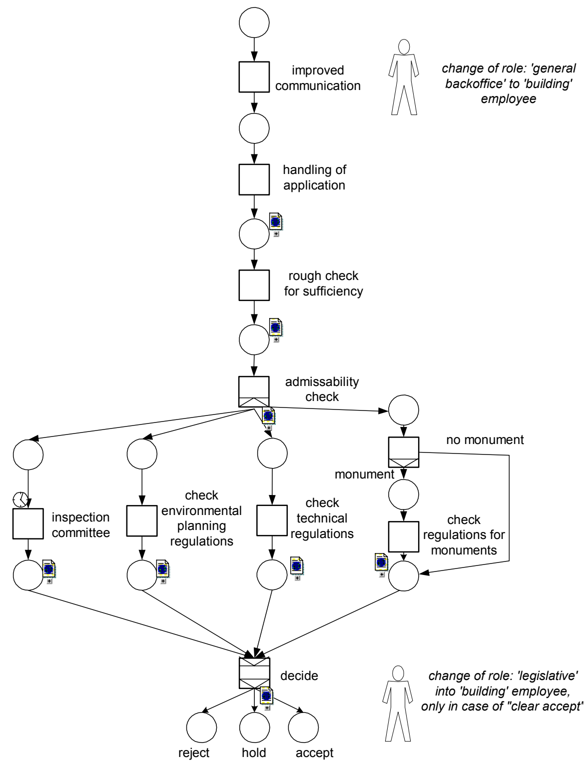

Figure 5 Proposed redesign 'application of a building licence'

5. CASE STUDY: BPR FOR A LARGE DUTCH SERVICE ORGANISATION

The Dutch service organisation under consideration serves both the private market and SMEs. The division where we carried out our case study employs several hundreds of people (about 400 fte) and offers more than 100 products. The organisation automated the processing of their products for about 90%. We focussed on one of the products for the private market.

5.1 Process description

In this section we describe the process under consideration in this case study. The process includes the distribution and processing of a customer request. Customers send their requests to the organisation, mainly by regular mail. At the organisation, the mail is opened and forwarded internally to the department responsible for distribution. The process that we considered in the case study starts with the opened postal item.

Requests are sorted by work flow and provided with a barcode (one operation). Requests are filmed when a sufficient number of requests have been collected for a particular workflow. After filming, the requests are counted and clustered into packages of ten requests (one operation). At the end of a working day the total number of requests per work flow is entered in the control system. The control system calculates the division of the packages over the sections, based on the entered numbers and the planned capacity per section. The next morning the packages are packed per section and transported to the sections. This part of the process is shown at the left-hand side of Figure 6.

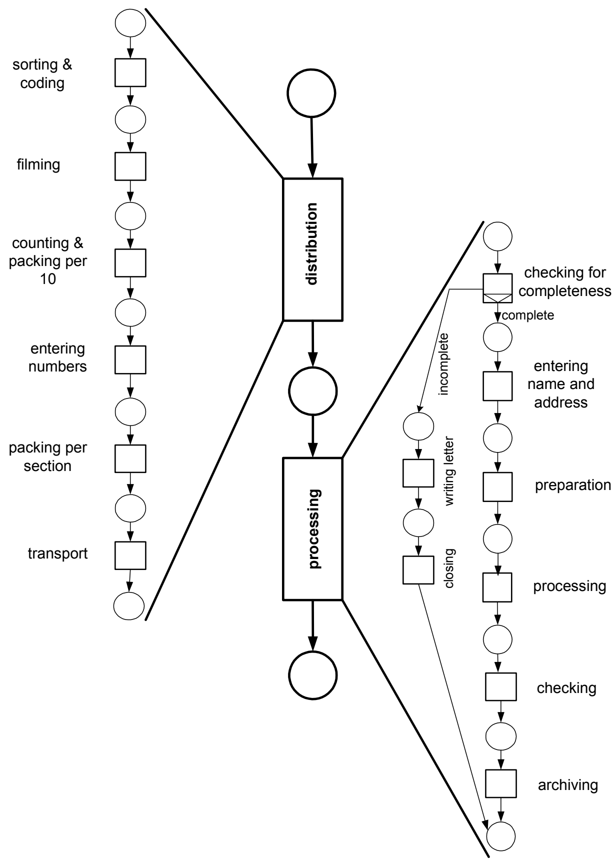

Figure 6 Handling of requests at the service organisation

After distribution, the (hard copy) requests are received in packages of ten at one of the sections. An employee performs each task for all the requests in a package, before he/she continues with the next task for this package. First the request is evaluated for completeness. If the request is incomplete, a letter is sent to the applicant and the request is closed. If the request is complete, the customers' name and address is entered into the system (new customer) or information is retrieved and/or updated (existing customer). Second, the processing of the request is prepared. When this step is completed for the entire package, the request is processed. Finally, the request has to be checked and archived by a second employee. This second part of the process is shown at the right-hand side of Figure 6.

In the current process electronic requests are printed and further handled as regular mail. The distribution and processing will take at least two days. More and more, customers will use the internet instead of regular mail, because sending a request by the Internet is easier and faster than sending it by regular mail. Customers expect their e-request to be handled fast. The organisation should change the distribution process, because currently the distribution of a request takes about one day which is not in line with customers' expectations. BPR best practices were used to redesign the distribution process. Three best practices seemed relevant and these best practices and the redesign of the distribution process will be discussed in subsection 5.2. The redesign has been quantified and compared with the current situation. With this comparison the benefits due to the application of the used best practices could be evaluated (subsection 5.3).

5.2 BPR best practices

5.2.1 Task automation

Automating an activity may reduce the time needed for the execution of the activity. Often technology available through machines and computers works faster and with less failure compared to humans [14]. Note that this rule may require parallel archives of printed materials for back-up purposes for some crucial materials in view of the volatility of the electronic media.

In the current distribution process the handling of large amounts of paper seems to have a retarding effect. Next to this, e-requests are printed thus adding an extra task. Task automation could be helpful in resolving this problem by making the process suitable for the digital handling of requests. An e-request would enter the process directly, while a mail request would require an extra step, i.e. to digitalize the request with a scanning device. With digital requests the task 'sorting & coding' could be automated. Further handling of the digital requests could be done with WFM technology leading to the automation of 'counting' and 'transport'.

5.2.2 Task elimination

Deleting unnecessary tasks or activities from a business process could be an effective way to make a process faster and to reduce the costs of the process [14].

In the digital process resulting from task automation, some tasks become unnecessary. The task 'filming' is performed to make a filmed archive, but with the storage of the scanned document this task would be superfluous. 'Entering of numbers' would be unnecessary, because counting is automated. Tasks 'packing per 10' and 'packing per section' are unnecessary, because digital requests do not have to be packed for ease of handling.

5.2.3 Case-based work

Many service processes are essentially case-based and make-to-order [16], although the actual implementation of the process may possess several features that are on bad terms with these concepts. Examples are the piling up of work items in batches and periodic activities, depending on computer systems which are only available for processing at specific times. Removing such constraints may significantly speed up the handling of cases [16]. Specifically with respect to EC, such delays interfere with competitiveness and customer satisfaction. However, with batch processing economies of scale can be accomplished.

In the current situation four tasks are performed in batches: filming, counting & packing per 10, packing per section and transport. 'Filming' is performed in batches, because the filming needs to be done for each workflow separately. To avoid the need for batches the filming should be performed before the separation into workflows. A restriction on this solution is that the identification of a filmed document is done by the barcode on the document. So 'filming' should always be preceded by 'sorting & coding'. However, this would change if 'filming' is replaced by 'scanning', thus avoiding the piling up of work items in batches. The tasks 'counting' and 'transport' could be automated with WFM technology. The tasks 'packing per 10' and 'packing per section' could be eliminated. Doing so, no task would require batch handling. In the current situation processing of the requests on the sections is delayed until the next day since the control system performs the calculation of the division of the requests over night. With the use of WFM technology this division could be avoided, because the digital requests can be put on a department-wide work list.

5.2.4 Redesign

The service organisation is considering the introduction of WFM technology after redesigning the process for handling of e-requests [17]. Therefore, the momentum of changing processes can be used to integrally redesign the process, taking both WFM and EC into account. The best practices discussed in the previous subsection can be used as a guideline. This results leads to the following redesign. The redesigned process starts with 'scanning' mail requests (manual for regular mail and automatically for e-requests). After this all requests are 'sorted & coded', 'counted' and 'transported'. The process will be supported with WFM technology. The proposed redesign is shown in Figure 7.

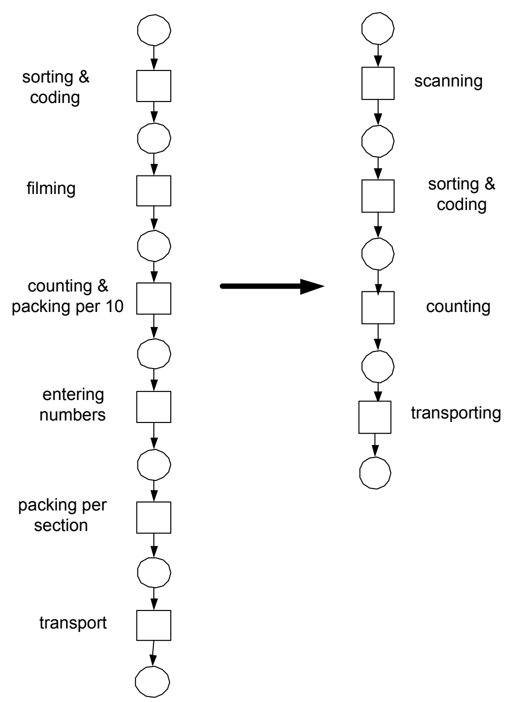

Figure 7 Proposed redesign for the distribution process

5.3 Lead times and comparison

In this section the lead time of both the current process and the redesigned process will be described and compared. This analysis leads to a conclusion on the impact of the applied best practices.

In the current distribution process, processing times appeared to be very short and constant. Between tasks, requests wait until there are enough requests processed to fill a batch. The last tasks 'packing per section' and 'transport' appeared to happen only once a day. The lead time was the difference between the arrival time of the mail (09:00) and the end of the transportation the next day (08:15). Distribution of a request thus took almost one day: 7 hours and 15 minutes. The studied process was handled by four full time employees and the average number of requests handled on a day was 2800.

In the redesigned distribution process four tasks are considered, of which the processing times are still very short and constant. At the service organisation 'scanning' and automated 'sorting & coding' is already in use at other divisions; their experience was used to estimate the processing time of 'scanning' (7 sec) and 'sorting & coding' (14 sec.). The tasks 'counting' and 'transport' are automated and don't take time. The model is free from waiting times caused by batch processing, because every request is handled individually. The average lead time of the redesigned process and its variance are calculated. Two assumptions were made for the calculation: (i) the process includes one scanning machine and three sort & code machines and (ii) the process handles 2800 requests a day. Because of the number of sort & code machines, this task starts immediately after finishing the scanning of a request.

In the redesigned process request *n* should wait until request *n-1* has been scanned, leading to a waiting time of (*n-1*)*7 sec. After this, request *n* is scanned and sorted & coded consecutively. The lead time of request *n* is (*n-1*)*7 sec waiting time + 7 sec. for scanning + 14 sec. for sorting & coding. For the discrete variable lead time we calculated the average lead time (2 hours and 45 min.) and standard deviation (95 min.) [13]. Today, most requests still enter the process by regular mail. For the calculation a worst case scenario was used assuming all requests are received this way and thus required scanning. Depending on the number of e-requests entering the process in the future the possible average lead time will be shorter than the predicted average lead time.

Comparing the lead time of the redesign with the lead time of the current process shows that the redesigned process handles requests much faster (7h15 versus 2h45) than the current process. In this case study the use of case based work avoids waiting times due to batch processing. Task automation leads to shorter processing times for some tasks and to elimination of other tasks. In conclusion we can say that the BPR best practices were a helpful guide to redesign the distribution process, resulting in a considerable reduction of the lead time.

6. CONCLUSION

We have argued that the success of EC within the service industry can be positively affected by the sensible application of BPR. On the basis of essential performance criteria for EC, we summarized the most promising BPR best practices.

Furthermore we carried out two case studies. The first case study showed the applicability of the best practices. In this particular case study already 10 out of 13 appeared to be applicable. The second case study was much more limited in scope. In this case study three best practices seemed to be valuable. To support this idea we calculated the lead times of a case in the current process and in the process redesigned with these best practices, and we indeed found a significant improvement. Although the number of two case studies is too limited to justify broad generalizations, it seems that a structured use of a list of BPR best practices is helpful in distinguishing redesign alternatives to an existing business process.

We see a number of potential area's for future research. Process (re)design by nature has many characteristics of an art. Application of redesign heuristics reduces this effect, though cannot take away the nature of this art. An additional means to reduce this effect is to quantify of the effects of a redesign. Comparable to the calculations for the second case, improvements as a result of a particular redesign rule should be quantified. This requires additional effort, e.g. using simulation techniques. Furthermore, in the first case study we have concluded that several restrictions in the environment of this process may influence applicability of a redesign rule, e.g. outsourcing limitations or country/organization specific limitations. Further research should aim to complete this overview. Additionally, we continue our work to clearly define the scope of applicability of our approach.

This paper aims to contribute to a broader awareness of the business process that is the context of any EC effort. In the end, it is the performance of the entire process that will determine the effectiveness and success of EC. The extra effort to reconsider the process that is the subject of EC is presumably well worth it. Especially in the setting of service delivery, there is often considerable freedom in rearranging the process because of the lack of physical constraints. Neglecting the BPR knowledge accumulated over the past decade would really be a missed opportunity for electronic commerce.

7. ACKNOWLEDGMENTS

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8. REFERENCES

[1] Aalst, W. P. M. v. d., "Reengineering Knock-out Processes," *Decision Support Systems*, vol. 30, no. 4, pp. 451-468, 2000.

[2] Barnes, D., Hinton, M., and Mieczkowska, S. Developing a framework to investigate the impact of E-commerce on the management of internal business processes. *Knowledge and Process Management* 2002;9(3):133-142.

[3] Berg, A. and Pottjewijd, P., *Workflow: Continuous Improvement by Integral Process Management* Schoonhoven: Academic Service (in Dutch), 1997.

[4] Champy J. *X-engineering the corporation: reinventing your business in the digital age*. New York: Warner Books, 2002

[5] Chang, T.S. and Ping Li, P. How to succeed in e-business by taking the Haier road. *Competitivenss Review* 2003;13(2):34-40.

[6] Dumas, M., O'Sullivan, J., Heravizadeh, M., Edmond, D. and ter Hofstede, A. *Towards a semantic framework for service description.* In: Proceedings of the 9th international conference on database semantics, Hong Kong. Deventer: Kluwer Academic Publishers, 2001.

[7] Gloor, P.A. *Making the e-business transformation*. London: Springer Verlag, 2000.

[8] Hall, J. *Are your processes fit for e-commerce?* Management Services 2000;44(4): 12-16.

[9] Hammer, M. and Champy, J., *Reengineering the Corporation; a manifesto for Business Revolution* New York: Harper Business, 1993.

[10] Jansen-Vullers, M.H. and Reijers, H.A. *Business Process Redesign for effective e-commerce processes in the service industry,* BETA technical report, Eindhoven University of Technology, 2003.

[11] Jelassi, T. and Leenen, S. An E-Commerce Sales Model for Manufacturing Companies. *European Management Journal* 2003;21(1):38-47.

[12] Krzywonos, R. What happens after the "BUY" button is hit: Managing the performance integration of the e-business. *Communication News* July 2000.

[13] Montgomery, D.C. and Runger, G.C. *Applied Statistics and Probability for Engineers*. 2nd ed. New York: John Wiley, 1999.

[14] McCormack, K. Business Process orientation: do you have it? *Quality Progress* 2001;34(1): 51-58.

[15] Peppard, J. and Rowland, P. *The essence of business process re-engineering.* New York: Prentice Hall, 1995.

[16] Reijers, H.A. *Design and control of workflow processes: Business Process Management for the service industry*. Berlin: Springer Verlag, 2003.

[17] Reijers, H. A., *Performance Improvement by Workflow Management Systems: Preliminary Results From an Empirical Study* in: Proceedings of the 6th International Conference on Enterprise Information Systems (ICEIS 2004), accepted for publication, 2004.

[18] Rowley, J. and Slack, F., "Leveraging customer knowledge - profiling and personalisation in e-business," *International Journal of Retail & Distribution Management*, vol. 29, no. 9, pp. 409-416, 2001.

[19] Rupp, R.O. and Russell, J.R. The golden rules of process redesign. *Quality Progress* 1994;27(12): 85-92.

[20] Sheridan, T. B., Vamos, T., and Aida, S., "Adapting automation to man, culture and society," *Automatica*, vol. 19, no. 6, pp. 605-612, Nov. 1983.

[21] Srinivasan, S. S., Anderson, R., and Ponnavolu, K., "Customer Loyalty in e-commerce: an exploration of its antecedents and consequences," *Journal of Retailing*, vol. 78, no. 1, pp. 41-50, 2002