Optimizing the processing of purchasing invoices

BSc thesis Industrial Engineering and management

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Preface

This report is the result of my bachelor graduation thesis in the course Industrial Engineering and Management. The research was conducted at Benchmark Electronics in Almelo. For my graduation I explored options to improve the processing of purchasing invoices.

I would like to thank Devrim Yazan and Guido van Capelleveen, my internal supervisors at the University of Twente. Their supervision and feedback greatly improved the quality of this report and the research itself.

Next, I would like to thank the employees from Benchmark involved in my research and especially my external supervisor, Ernst-Jan Harmsen. Thank you for your time and effort to help me with this research. Your insightful feedback and tips were always useful and I have enjoyed working with you.

I would also like to thank my family and friends for supporting me in the rough times that occurred during this period.

Jasper Egberink, 19-06-2020

Management summary

Context
This research took place at the finance department of Benchmark Electronics B.V. in Almelo. At this department, purchasing invoices are approved, processed and paid. The approval is done by verifying receival of the goods and the price and amount on the invoice. If these are correct, the invoice is posted in the ERP system and paid by the head of the finance department.

Method
The approval and posting of the invoices is currently done manually. This is the core problem that will be solved with this research. The manual approval and posting causes several other problems. The process is time consuming, prone to errors and hard to monitor. These are all problems that influence the costs of the process.
In order to solve the core problem, the process was first analysed and mapped to make sure that a fitting solution will be implemented. After this, KPIs were constructed to measure the performance of the current process and to enable accurate evaluation of the solution found in this research. After the process was analysed, the criteria and constraints for the possible solutions were defined. Then a literature study was done to find solutions that met the constraints.
After the literature study, two suppliers remained that had a fitting solution to improve the process at Benchmark, these will be called supplier A and B. The expected results on the selection criteria were compared to select the best solutions. To compare the estimated financial results of both solutions, a business case was made for each supplier. In these business cases, the costs and benefits were estimated for a timespan of 7 years and the financial results after these 7 years were calculated.

Conclusions and recommendations
The supplier that fits the purchase-to-pay process of Benchmark the best is supplier B. Supplier B is more experienced with the ERP-system Benchmark is currently using, which makes the solution more reliable.
The first recommendation for Benchmark is to meet for a second time with both suppliers. Because of limited time to perform this study, each supplier visited Benchmark once to present their solution. The selection of a supplier is more reliable if each supplier is able to give more clarification on their proposed solution in a second meeting.
The process will be improved after a solution is implemented, but the process will still be open for more improvements after this. The recommendation for Benchmark is to strive for constant improvement of the process by testing and implementing further automation solutions, by implementing a no-PO no-pay culture to make the processing of the invoices easier and by identifying and improving remaining problems in the process that were not explored in this research.

Contents

Terminology

600 invoices	invoices with purchase order
610 invoices	invoices without purchase order
AP	accounts payable
ERP	enterprise resource planning
FTE	full time equivalent
KPI	key performance indicator
OCR	optical character recognition
PO	purchase order

1. Introduction

1.1 Introduction to the company

This research will take place at Benchmark Electronics B.V. in Almelo. Benchmark Electronics is part of Benchmark Inc. which is an electronics company with sites in Northern America, Europe and Asia. Benchmark Inc. is also located in Almelo and at this site, mostly measuring- and communication equipment is produced. The research will be performed at the finance department at the Benchmark location in Almelo.

1.2 Description of the research

Benchmark receives roughly 26.000 invoices yearly from suppliers. These invoices can be categorized into two types of invoices: 21.000 production related invoices (600 invoices) and 5000 remaining invoices (610 invoices). The procure-to-pay process of these invoices is different and will be explained in 2.1.

The production related invoices result from procurements that are necessary for production. These invoices may come in when for example raw materials or working equipment is ordered. The complete description of the P2P process of 600 invoices is given in section 2.1.1.

Remaining invoices are invoices without a matching purchase order in the ERP-system. These invoices result from unanticipated and unregistered procurements. 610 Invoices come in when for example employees order food or when the contract labour for services is invoiced. The complete description of the P2P process of 610 invoices is given in section 2.1.2.

The finance department of Benchmark mainly processes both types of invoices manually. They are manually approved and posted in the ERP-system. This makes the process costly, difficult to monitor and error-sensitive. In this research, improvement options for the process will be explored.

1.3 Problem identification

In order to do a problem identification, research to the current process of posting and approving invoices was done. This research was done in collaboration with the employees involved in the process. These people explained and showed the current process of posting and approving invoices. After this, the problems with this process were discussed with the employees involved in it, which resulted in a more extensive understanding of the current problems. After a thorough understanding of the process and its problems was achieved, a problem cluster was made. This problem cluster can be found below in figure 1.

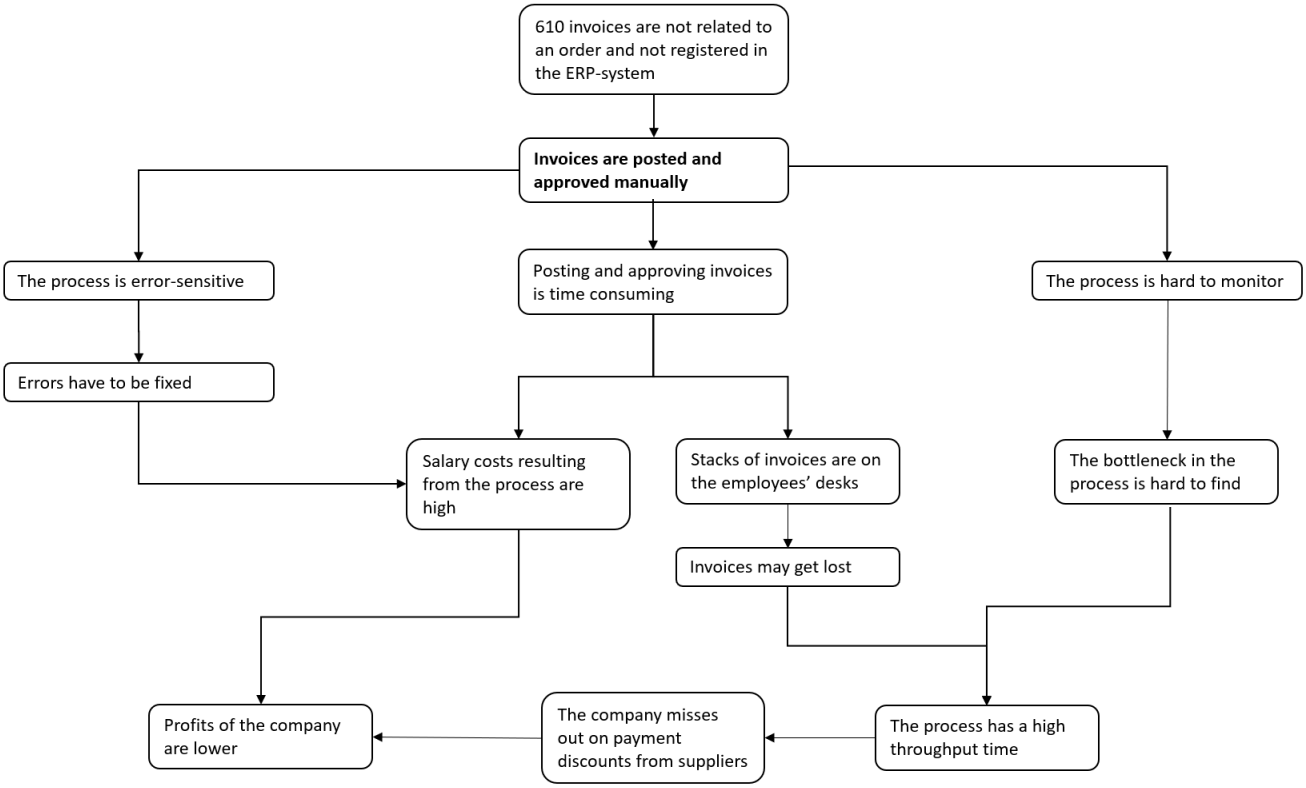

Figure 1: Problem cluster

The core problem, that will be improved in this research is: *Invoices are posted and approved manually.* As described in the problem cluster, this core problem has many effects and ultimately, for the company the most important effect is that it results in lower profits of the company.

Solving this core problem is not the only possible approach to improve the process. One of the alternative approaches would be to reduce the number of 610 invoices. 600 invoices are processed faster than 610 invoices, so reducing the number of 610 invoices would save money for the company. However, the company receives only 5000 610 invoices per year, while they receive 21000 600 invoices per year. This means that reducing the number of 610 invoices would result in less significant savings for the company. Also, the company is already exploring this option and for certain invoices it is simply not possible within the current regulations to change the type to 600 invoices. Thus, this option will not be explored broadly in this research.

Another option to cut costs is to reduce the total number of invoices. This can be done by making arrangements with the suppliers to send periodic invoices. This would mean that the Benchmark receives for example a monthly invoice for each supplier. With this solution, the total number of invoices would be reduced and it would take less time to process the invoices. However, the company has already implemented this solution and is still constantly trying to reduce the number of invoices by making these arrangements. Thus, the reduction of the total number of invoices will not be part of this research.

The problem that remains is the core problem: *Invoices are posted and approved manually.* This problem has not been researched by the company. The core problem is the cause of most negative effects in the problem cluster and solving this core problem can improve the performance of the process significantly. A few of the effects shown in the problem cluster will be measuring variables for the process. With these variables, the company can test if the solution has resulted in improvement of the process.

1.3 Measuring variables of the process (systematic literature review)

To find out which measuring variables can be used to measure the performance of the process, a systematic literature review was done. The knowledge question for this literature review is: How can the performance of the process of posting and approving invoices be measured?

In the available literature, many possible key performance indicators (KPIs) can be found to measure the performance of invoice processing by the accounts payable (AP) department. The KPIs are selected by first determining if they could be applied on the specific process the research focused on, after this, the duplicates were deleted and at last, it was reviewed if the KPIs are actually useful to measure the performance of this process. The KPIs that remained are the following:

1. Costs per invoice
2. Number of invoices processed per year per full time equivalent (FTE)
3. Cycle time of posting and approving process
4. Captured discount rate
5. Exception rate

The first KPI, costs per invoice, is a logical KPI to measure the performance of the process. The company strives to increase profits by improving the purchase-to-pay process. In this case, the process only costs money without any complementing income. This means that the only way to increase profits is by reducing the costs of the process. Thus, the average costs per invoice are a good way to measure improvements.

In the reviewed literature, it is clear that the highest percentage of the costs per invoice is from human labour for a manual purchase-to-pay process. If less human labour is needed to process invoices, this means that the costs per invoice will drop too. Therefore, if the amount of invoices processed per FTE is higher, the total costs are lower, which contributes to an increase of the profits.

The third and fourth KPI are highly related. A high cycle time will most of the time result in a lower captured discount rate. This is because the company only captures a discount if an invoice is paid within a predefined timeframe. If the payment is done later, the discount will be lowered or removed. However, if the cycle time is relatively low and the captured discount rate is low, the low discount rate is not caused by the process of posting and approving the invoices. This would mean that there is another process within the company that is not working optimally. If that is the case, these KPIs can help identify the problem and the company can improve the process, so it is important to measure and compare both KPIs.

In the fifth KPI, the exception rate is calculated by counting the number of invoices where some discrepancy has occurred (for example, the actual amount on the invoice does not match the amount on the PO). This amount of invoices is divided by the total amount of invoices. The invoices with an exception are more costly than regular invoices, as the discrepancy has to be found and fixed by an employee. Therefore, these invoices generally take more time to process which results in higher costs. The performance of the AP department can be improved by reducing the exception rate.

For the systematic literature review, the sources by Brem (2015), Conto (2017) and PayStream (2014) are used.

1.4 Data gathering methods

Costs per invoice

The costs per invoice consist of many different elements. Some of these elements are tangible and could be calculated exactly (for example: paper costs or costs of envelopes). However, many of the elements influencing the costs per invoice are intangible and difficult to measure. Examples of these elements are costs of the ERP-system (this system is not solely used for processing invoices) or supplier dissatisfaction due to late payments. This results in the fact that the costs per invoice can hardly be measured with only quantitative data gathering methods. Because of this, the costs will be estimated in collaboration with the employees involved in the process. The elements for which data is already available will be calculated using the quantitative data.

Processed invoices per year per FTE

This KPI can be calculated by using the available data within the HR system regarding the hours worked by the employees involved in the process. This amount of time spent on the process can be divided by the number of invoices processed yearly, which is available in the ERP-system.

Captured discount rate

For this KPI, data is already available in the current databases of the company. This data will be used to calculate the previously captured discount rate and can also be used to calculate future rates.

Remaining KPIs

One of the reasons the company wants to improve the process is because there are little monitoring possibilities in the current, manual, process. The company knows that the cycle time can be reduced, but does not have insight in the cycle time of the current process. This also counts for the exception rate and partially for the costs per invoice.

One of the criteria for a solution will be the monitoring possibilities, as the company had already decided that this element of the process should be improved. After the solution is implemented, the cycle time, exception rate and probably the costs per invoice can be calculated more precisely. Yet, at the moment these three KPIs cannot be calculated accurately at the moment because of the limited monitoring options.

1.5 Remaining knowledge questions

After answering the first knowledge question with use of a systematic literature review, two knowledge question remain which will be answered in the following sections. These two knowledge questions can be divided into subquestions, which cover all elements of these knowledge questions. In section 1.5, the knowledge questions and its subquestions are specified and the approaches to answer these questions are given in section 1.6.

1.5.1 What does the current process look like?

- What are the key tasks in the current process?
- In what order are the key tasks performed?
- What is the performance of the current process, according to the KPIs?
- What are the biggest problems in the current process?

The first two subquestions mainly focus on the design of the current process. The knowledge is already required and the questions will be answered in section 2. The approach to answer the last two subquestions is given in 1.6

1.5.2 What are possible solutions to improve the process?

- Which criteria and conditions do the solutions have to meet?
- In which fields could be viable solutions?
- Which specific solutions can be found in these fields?

1.6 Problem solving approach

1. Measure the KPIs of the current process

   The first step of the research involves measuring the KPIs that are defined in 1.4. These measurements will be done according to the techniques that are also mentioned in 1.4. Measurement of the KPIs might help with weighing the criteria in the next step of the research and of course gives insight in the biggest problems in the current process.

2. Define criteria and constraints of the solutions

   In order to find a fitting solution to the problem, the criteria and constraints that the solution should match have to be explored and defined. Some of these have already been defined by the employees of Benchmark, but the employees might have missed important criteria/constraints. It is important these missed criteria/constraints are added to ensure that the best possible solution is implemented.
   In order to find these criteria/constraints, the criteria/constraints that are already clear are defined and suggestions for other possible criteria/constraints will be added. The people involved in the process will be instructed to think of criteria/constraints themselves. The list of criteria/constraints will be updated after all employees have suggested their additional criteria/constraints. After this, the concept list will be updated and have one final check by the people involved and the list is finished.

3. Think about possible solution fields

   In order to find the best fitting solution to the core problem, the research should aim to review all the plausible existing solutions. By doing this, there is a smaller probability that the company implements a solution that is not optimal or misses out on good solutions. To include as many solutions as possible, the team will think of potential fields in which there are solutions (for example using digital invoices, or scanning the current invoices).

4. Perform literature study on existing solutions

   After defining the fields in which there are potential solutions, a literature study will be done in order to find actual, specific solutions. In this literature study, the (dis)advantages that are given with each solution will be listed. If it is clear from the literature that a solution already has too many disadvantages, this solution will be discussed with the stakeholders of the process to find out if this solutions should be included in the following steps of the research.

5. Estimate the effect of the solutions on KPIs and criteria

   The effects of the solutions that remain after the literature study will be tested. An estimation of the effects on the KPIs and criteria will be done. This step of the research might be important for the selection process of the research, as the goal of the company is to improve the results of these KPIs and thus, its profits.

6. Select solution

   The last step of the research is to select a fitting solution to the core problem. This will be done by reviewing the effects on the previously constructed list of criteria for the solutions. The results from this selection process will be discussed with the stakeholders of the process in order to find out if they agree with the results and the argumentation for this selection.

1.7 Intended deliverables

After all of the steps of the research have been executed, a conclusion can be drawn on which solution is expected to be the best solution to the core problem. The deliverables of this study include an advice on a solution to be implemented by the company and an argumentation on why this solution is the best solution. This argumentation consists of the criteria that have been constructed in collaboration with the employees involved in the process and the scores of each solution.

2. Literature review

2.1 Automation of the purchase-to-pay process

The purchase-to-pay process consists of two different departments, purchasing and accounts payable. Benchmark aims to automate and improve the accounts payable process with this research. The exact process varies between organizations and the explanation of the purchase-to-pay process of Benchmark is reviewed in chapter 3. According to Murphy (2012) the purchase-to-pay process involves creation and authorization of purchase orders, provision of the PO to the matching supplier, goods receival, authorization of invoices and invoice payment. These tasks consume a lot of time and effort (Palmer & Gupta, 2011) and are often regarded as non-value adding tasks (Jung et. al. 2006). This makes the process attractive and often profitable to automate.

According to Doxey (2012) automating the accounts payable process consists of the following components:

- E-invoicing: Receiving and processing digital invoices.
- Paper invoice conversion: converting paper invoices to the required digital format.
- Automated invoice matching: Matching the invoice with the PO and receipt.
- Intelligent non-PO invoice processing: routing of non-PO invoices to the appropriate approvers.
- ERP integration
- Electronic payments
- Supplier communication portals

All of these components are important for a smooth process and have to be well integrated in the automated process.

Automation of accounts payable will often result in operational advantages and cost savings. According to Lamon (2009) automation of the accounts payable can have the following effects:

- Leveraging of early payment discounts
- More invoice information
- Paper use reduction
- Reduction of storage costs
- More monitoring on spending
- Possibility of supplier evaluation

2.2 Supplier selection methodology

The selection of a supplier will be done by establishing selection criteria and estimating the results on these criteria. As stated in Wind & Robinson (1966) it is likely that trade-offs exist between the results of these criteria. For example, if the price of a supplier is lower, the quality might also be lower. The multiobjective approach presented by Weber et. al. (1993), presents the different available solutions in combination with their benefits and trade-offs. Instead of making a selection purely based on the selection tool, this selection process evaluates each solution and requires the expertise of the people involved in the process to make the final decision based on the benefits and trade-offs. An alternative selection procedure could be the AHP selection tool. According to Bayazit et. al. (2006) AHP can help structuring the decision making process by establishing decision criteria and by levelling them in a hierarchy. This structures the perceptions, feelings and judgments of people about multiple solutions which helps making an objective decision.

In this research, parts of both selection procedures will be used. In section 2.3 will be explained that employees might build up organizational change cynicism, which could influence the decision making process. However, Benchmark relies on the expertise of employees involved in the process in order to make a good decision. For this reason, selection criteria will be established and levelled in a hierarchy such as in the AHP decision making process. However, all suppliers will be presented in combination with their benefits and trade-offs to make sure the managers can make an informed final decision. Both decision making processes are combined to prevent bias in the judgment of employees as much as possible.

2.3 Employee involvement

In this project, changes will be made to the current process in order to improve it. As stated in Brown & Cregan (2008) change can have multiple positive and negative effects on employees of an organization and one of the main negative effects is organizational change cynicism (OCC). While employee involvement is key in successfully managing change (Sims, 2002) The risk of OCC is high in this project, because the employees involved in the current process risk losing their job by improving the process. OCC has negative effect on organizational commitment, organizational citizenship behaviour, and job satisfaction (Abraham, 2000). This means that Benchmark benefits from a change process that prevents OCC as much as possible. Brown & Cregan state that preventing OCC can be accomplished by establishing a participative work climate, such as an information-sharing climate or a decision-making climate for employees.

To reduce the effects of OCC, Benchmark will involve the employees mostly by creating an information-sharing climate. This means that the employees will mostly be informed about the changes that will be made and their effects. Sometimes a decision-making climate will be created for the employees. The managers will obviously make the final decisions, but this will be done in consultation with the employees involved in the process. By creating this climate, Benchmark will benefit from reduction of potential OCC and by using the expertise of the employees about the process to improve the decision-making process.

2.4 Clarification of source selection

Search terms	Source	Useful articles found	Included articles	Excluded articles
Vendor selection method Supplier selection method AHP Selection AHP supplier selection	UT library	A purchasing decision. Bayazit, Karpak & Yagci (2006) Vendor selection criteria and methods. Weber, Current & Benton (1991) Vendor selection: Strategic choices. McKinley (1990)	A purchasing decision. Bayazit, Karpak & Yagci (2006) Vendor selection criteria and methods. Weber, Current & Benton (1991)	Vendor selection: Strategic choices. McKinley (1990) Vendor selection using AHP. UmaDevi, Elango & Rajesh (2012)
Vendor selection Supplier selection AHP selection AHP supplier selection	Google scholar	A purchasing decision. Bayazit, Karpak & Yagci (2006) Vendor selection criteria and methods. Weber, Current & Benton (1991) Vendor selection: Strategic choices. McKinley (1990) The determinants of vendor selection. Wind & Robinson (1968) Supplier selection using AHP methodology (2014)	A purchasing decision. Bayazit, Karpak & Yagci (2006) Vendor selection criteria and methods. Weber, Current & Benton (1991) The determinants of vendor selection. Wind & Robinson (1968)	Vendor selection: Strategic choices. McKinley (1990) Supplier selection using AHP methodology (2014)
Change management Change cynicism Change employee involvement Automation effects Automation effects performance	UT library	A field investigation of multilevel cynicism towards change. DeCelles, Tesluk & Taxman (2013) Organizational cynicism. Abraham (2000) A communication model of employee cynicism toward organizational change. Qian & Daniels (2008)	Organizational cynicism. Abraham (2000) Changing the way we manage change Sims (2002)	A field investigation of multilevel cynicism towards change. DeCelles, Tesluk & Taxman (2013) A communication model of employee cynicism toward organizational change. Qian & Daniels (2008)
Change management Change cynicism Change employee involvement Automation effects	Google scholar	Organizational change cynicism Brown & Cregan (2008) Organizational cynicism. Abraham (2000) A communication model of employee cynicism toward organizational change. Qian & Daniels (2008)	Organizational change cynicism Brown & Cregan (2008) Organizational cynicism. Abraham (2000)	A communication model of employee cynicism toward organizational change. Qian & Daniels (2008)

Automation effects performance				
Purchase-to-pay automation	Google scholar	The evolution of the procure-to-pay process Doxey (2012)	The evolution of the procure-to-pay process Doxey (2012)	
	From references of other sources	Standards-based approaches to B2B workflow integration. Jung, Kim, Kang (2006) Accounts payable: three pathways to process efficiency. Lamon (2009) Murphy (2012). Electronic invoice authorization: Murphy (2012). Technology-driven convergence of business processes in the acquisition cycle. Palmer & Gupta (2011)	Standards-based approaches to B2B workflow integration. Jung, Kim, Kang (2006) Accounts payable: three pathways to process efficiency. Lamon (2009) Murphy (2012). Electronic invoice authorization: Murphy (2012). Technology-driven convergence of business processes in the acquisition cycle. Palmer & Gupta (2011)	

Table 1: clarification of sources

3. Current processes

3.1 Description of the processes

3.1.1 Production related invoices

The production related (600) invoices are invoices that result from procurements necessary for production. These procurements include for example raw materials and working equipment. Before these procurements are done, a purchase order (PO) is made. This PO has to be approved according to the approval policy of the company, most procurements have to be approved by a purchaser. After a PO has been made and approved, the product is ordered and the PO is registered in the ERP system. When the goods are received at the warehouse, the quantity is compared to the quantity on the PO and if the quantity is within the defined margins and the quality of the goods is sufficient, a receipt is registered in the ERP-system. After this, the supplier sends an invoice to Benchmark. After the invoice has been received at the administration of Benchmark, its contents are approved by an administrative clerk. This approval after receipt is done by performing a three-way-match. The price and quantity on the invoice is matched with the price and quantity on the PO and receipt. If all amounts match, the invoice is approved and posted into the ERP-system by the administrative clerk. After the invoice is posted, it is open for payment which is done twice a week. The process of 600 invoices can be seen in the figure below.

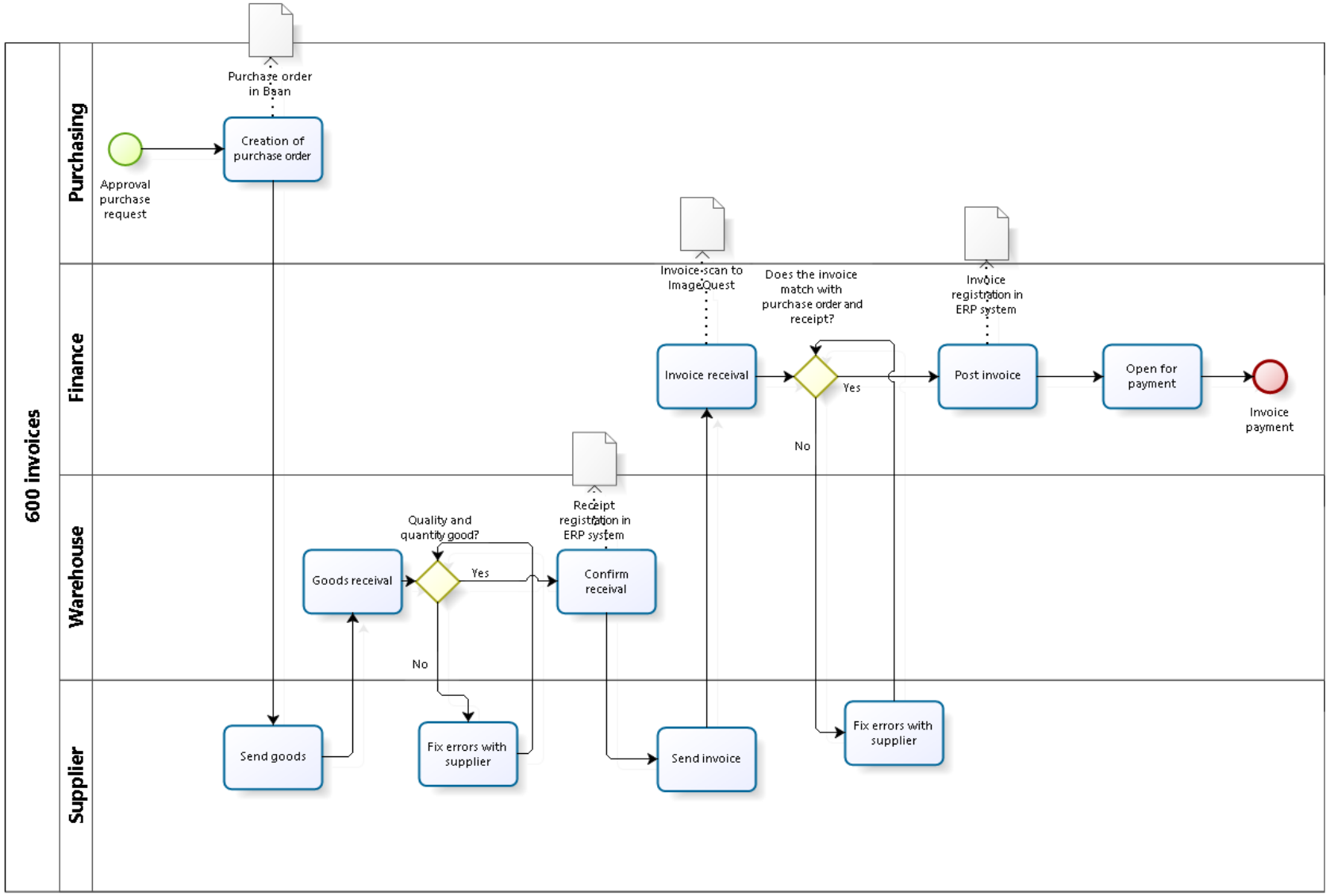

Figure 2: Process map 600 invoices

3.1.2 Remaining invoices

The process of 610 invoices is slightly different from the process of 600 invoices. These processes are different because 610 invoices do not result from an order and thus cannot be linked to a PO in the ERP-system. These invoices result from goods or services which were not registered beforehand in the ERP-system. When these invoices are received at the finance department, the contents of the invoices first have to be approved by the budget holder of the department where the costs were made. After this, the contents of the invoice have to be approved by the administrative clerk. Both approvals are not done by a three-way-match as with the 600 invoices, the price and amount are checked by the approver. Clearly, this approval is not as thorough as the approval of 600 invoices. After the approval, the data of the invoice is registered in the ERP-system and the invoice is open for payment.

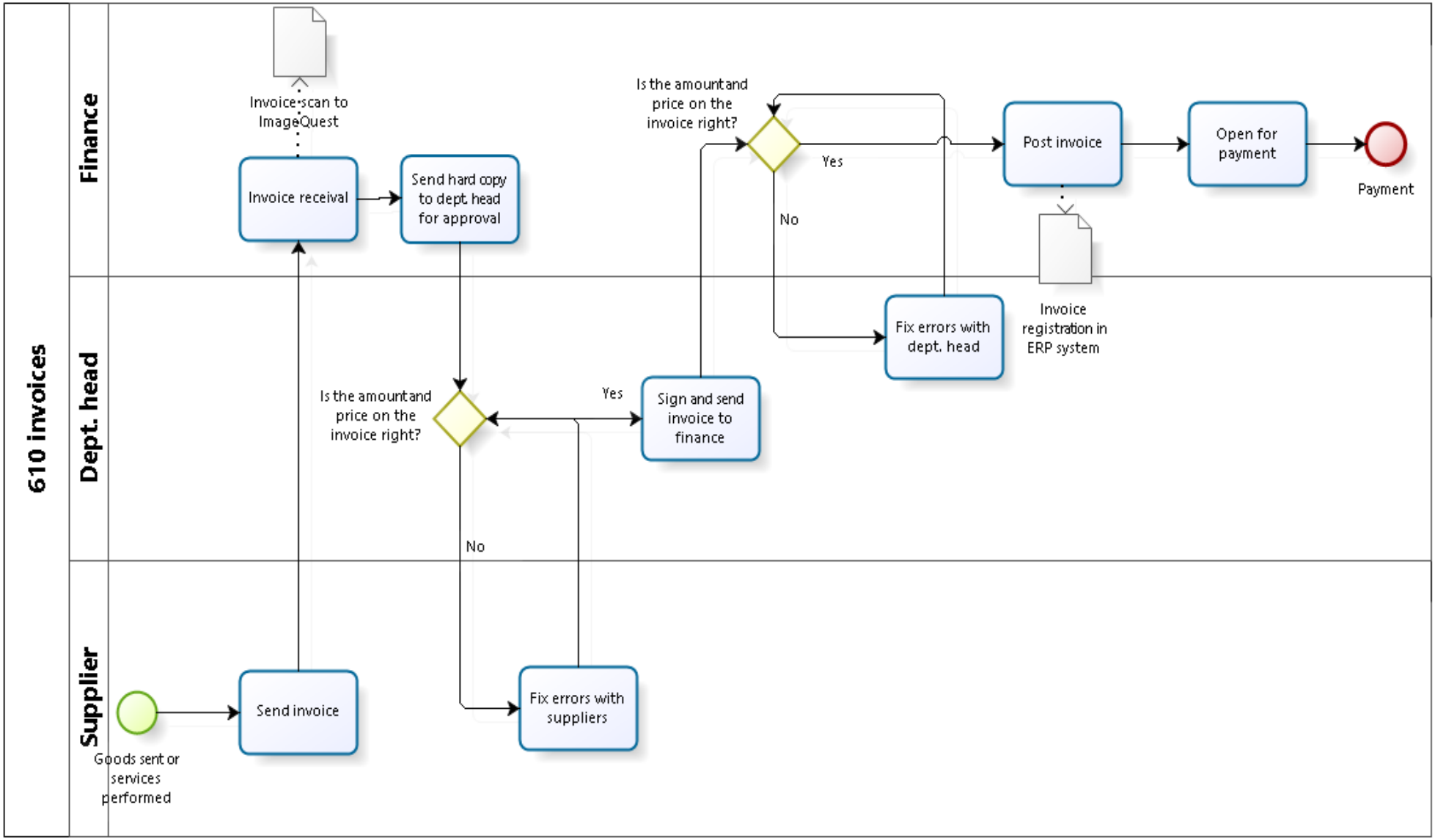

Figure 3: Process map 610 invoices

3.2 KPI performances

3.2.1 AP labour costs per invoice

The labour from employees of the accounts payable (AP) department cover a great deal of the total costs per invoice and are possibly the biggest savings account when a solution is implemented (Aberdeen 2011). These labour costs are calculated by using the following formula:

AP labour costs per invoice = Total AP labour costs per year / Number of invoices per year

Before calculating the labour costs per invoice, the total number of invoices was calculated by using available data from the ERP-system of the company. The company processes 26.432 invoices yearly. By filling in the formula, the AP labour costs per invoice can be calculated:
AP labour costs per invoice = €116.400 / 26.432 = €4,46 per invoice.

3.2.2 Processed invoices per year per FTE

This KPI is calculated by using the following formula:

Invoices per year per FTE = Yearly number of invoices / Total number of FTE

The yearly number of invoices was already given in 2.2.1 and is 26.432. The total number of FTE is registered at the AP department of the company. The number of employees processing invoices is the equivalent of 2,3 FTE. This results in the following number of invoices per year per FTE:
Invoices per year per FTE = 26.432 / 2,3 = 11.500 invoices per year per FTE

3.2.3 Captured early payment discount

The captured discount rate is calculable with available data from the ERP-system of the company. In 2018 Benchmark realized a captured discount rate of 66% which is €183.000, this means that €128.000 in discounts was missed.
There are multiple possible reasons for these missed discounts and one of these reasons is quite important when a solution will be implemented. This has to do with the payment policy of the company. In order to improve the quarterly results of Benchmark Incorporated, all Benchmark locations stall their outgoing payments in the last month of the quarter. This means that no invoice will be paid in these months and the discounts will not be captured. This policy will not change by improving the administration process, so the discounts at the end of the quarter are left out of the discount rate.
Without the discounts at the end of the quarter, Benchmark still misses out on €67.000 worth of discounts and realizes a captured discount rate of 75%. This discount rate is better, because in the last month of the quarter, almost all discounts are missed, which negatively affects the captured discount rate.

3.3 Performance analysis

The first KPI, costs per invoice, was compared to the average costs per invoice available in current literature. However, there are many possible ways to calculate these costs per invoice. This research focuses on labour costs to measure this KPI, because these costs can reliably be calculated and are most relevant for the improvement of the process. In the current literature, there are many different intangible costs that are often included in the costs per invoice. These include for example the costs of the working space, equipment, the use of an ERP system and help from other departments. According to Abbyy (2015), the average costs per invoice for manual processes is $9,60 while the best performing manual processes realize $4 per invoice. However, the best performing automated processes realize less than $2 per invoice.
Considering that only the labour costs of the process at Benchmark are €4,46, a lot of money can be saved by improving the process and aiming to perform at $2,- per invoice. In short, this KPI shows that there is room for savings by improving the administration process for invoices.

The second KPI, number of invoices processed per year per FTE, is indirectly also a measure for the costs of the process. The current score on this KPI by Benchmark is 11.500 invoices per FTE per year. According to iPayables (2017) the average amount of invoices processed per month per FTE is 906 for a manual process. Benchmark realizes 958 processed invoices per FTE per month. This means that the performance is better than the average performance of a manual process. However, this source also states that the average amount of invoices processed per month per FTE is 3.821 for an OCR based process and 10.387 per month per FTE for an electronic invoicing process (these processes will be explained in section 3).
If the performance by Benchmark on the first two KPIs is compared to the possible performances based on the literature, it becomes clear that Benchmark does perform above average for a manual process. It also becomes clear that the performance can improve a lot if a fitting solution is implemented.

The last KPI that measures the performance of the current process is the captured discount rate. As explained in 2.2.3, the overall captured discount rate is 66%. However, this discount rate is not as relevant as the discount rate in the first two months of the quarters, because payments are delayed at the end of the quarter. The discount rate captured in the beginning of the quarters is 75% and the total missed discounts in these periods in 2018 was €67.000.
According to Aberdeen (2012), the captured early payment discount of best performing businesses is 90% and average performing businesses realize a captured discount rate of 47%. This means that Benchmark is performing above average according to the literature. However, if Benchmark would be among the best performing businesses and realize a discount rate of 90%, the yearly captured discount would be roughly €40.000 more than with the current process. In short, Benchmark could potentially save €40.000 yearly on this KPI if their performance would improve.

In 1.4, two KPIs (exception rate and cycle time) were defined to measure the processing of invoices by the AP department at Benchmark. However the necessary information to calculate these KPIs is missing. The performance of Benchmark can improve much when these KPIs are being measured. For example, the exception rate can be used to find suppliers whose invoices often contain mistakes and these mistakes can be reduced. The cycle time can be used to monitor which part of the process causes the most missed discounts and to solve problems in this part of the process.

4. Possible solutions

4.1 Available solution fields

In 3.1.1 and 3.1.2 the available solution fields for 600 invoices are explained. In 3.1.3 and 3.1.4 the automation solutions for the process of 610 invoices are given.

4.1.1 Electronic scanning solutions (600 invoices)

The first solution field that is useful for automation of invoice processing is the field of scanning solutions. These solutions use either template- or OCR-based scanning. When an invoice arrives at the finance department of Benchmark, the software can read information from a PDF-file of the invoice. The information is used to identify the corresponding PO and receipt with the invoice. The PO and receipt are used to perform a three-way-match to approve the price and quantity on the invoice. If the three-way-match is unsuccessful, the invoice is sent to the purchasing employee who placed the order to fix the errors with the supplier. After the invoice is matched, the information is registered in the ERP-system automatically and the invoice is opened for payment.

These scanning solutions can safe much work of administrative employees. The software system can automatically collect information from the invoice and perform a three-way-match. Only the payment has to be done manually whereas the old process requires all of these tasks to be performed manually. Furthermore, the system can prevent lost invoices, because the invoices do not end up on the desk of an administrative employee, but are instantly processed by the software system. This will also reduce the cycle time of the process, because the invoices are instantly processed instead of being processed one by one by an employee.

There are two different types of scanning solutions: Template-based scanning and OCR-based scanning (Optical Character Recognition). The template-based scanning reads the information using the position of the data on the invoice. In order to use this scanning solution, the position of the data first has to be put into the software system manually for every supplier, because suppliers use different templates for their invoices.
OCR-based scanning uses a self-improvement algorithm to scan the information from the invoice. At the beginning it uses certain keywords (such as purchase order, invoice ID etc.) to find the necessary information. If mistakes are found in this software, they can be fixed manually in order to improve the software.
An OCR-based solution would safe more time, because it is not needed to set up templates for different suppliers. This would be a time consuming task, because Benchmark works with many suppliers who would all need their own template.

4.1.2 E-invoicing (600 invoices)

The second solution to improve the purchase-to-pay process is electronic invoicing (e-invoicing), e-invoicing solutions are more automated than scanning solutions and will likely result in a further reduction of costs. E-invoices work with an electronic document (most often an XML-file). The necessary information is stored with code language in this document by a supplier and can instantly be sent to and read by the system of Benchmark. The system registers the information of the invoice and, most of the times, approval is not necessary because the supplier and Benchmark use the same system. If any approval is needed, the software system automatically sends the invoice to the right approver(s). After approval, the invoice is opened for payment and the process is finished after the payment is done.

The advantages of an e-invoicing solution over a scanning solution is that no scanning software is needed to read information from the invoice. As the invoice is sent in an XML-file, the data can instantly be read by the system of Benchmark. This would make the system more precise, because an OCR based solution does not always have full accuracy of the read data (Sahu, 2017) and a template based solution also does not have full accuracy, as suppliers may change the format of their invoice. However, an e-invoicing solution uses software to read the information stored in code on the electronic file, which would realize almost full accuracy. Furthermore, the supplier and Benchmark use the same software system, so there is a low probability of errors on the invoices.

4.1.3 Scan and workflow (610 invoices)

A scan and workflow solution for 610 invoices is very similar to a scanning solution for 600 invoices. A scan and workflow solution, again, scans the necessary information from the invoice using either OCR-software or templates. However, 610 invoices have to be approved by one or more department heads. To optimize this approval process, a workflow can be prepared per supplier or product. Based on the supplier or product, the scanned invoice will automatically follow this workflow of approvers until every required person has approved the invoice. Also, this workflow is monitored by the program.

The advantages of a scan and workflow process over a manual process is that the scan and workflow process is monitored more. The time for approval is measured and this enables the finance department to find out which employees take the most time to approve an invoice. This means that the additional monitoring helps the finance department to fix bottlenecks and reduce the cycle time of the approval process.

4.1.4 Contract module (610 invoices)

The second solution to the process of 610 invoices is a contract module within the software system. In this contract module, the finance department can specify how much money can be spent on certain ledger accounts. This amount can be specified per month and/or per year. If this amount is put into the system, the software system will keep track of the money spent on these ledger accounts and predict if the predefined amount is exceeded. If the predefined amount for a ledger account is not expected to be exceeded, the system will approve the incoming invoices on that ledger account automatically. However, if the amount of money spent on a ledger account is too much, the system will warn the department heads related to the account and keep track of the money manually.

The advantage of a contract module over a scan and workflow solution is that less human labour is needed. The 610 invoices are approved automatically if the amount is retained within certain margins. However, this could mean that there is less control over the money spent, because not every invoice is checked and approved by a department head.

4.2 Preferences of Benchmark

4.2.1 Ideal process

In order to find a fitting solution for Benchmark, the ideal process from the perspective of Benchmark was constructed. In collaboration with the employees involved in the process, the following process map was made to describe the ideal process for Benchmark. This was done by explaining the possible solutions given in 3.1 to the employees and selecting the ideal solutions for the process of Benchmark.

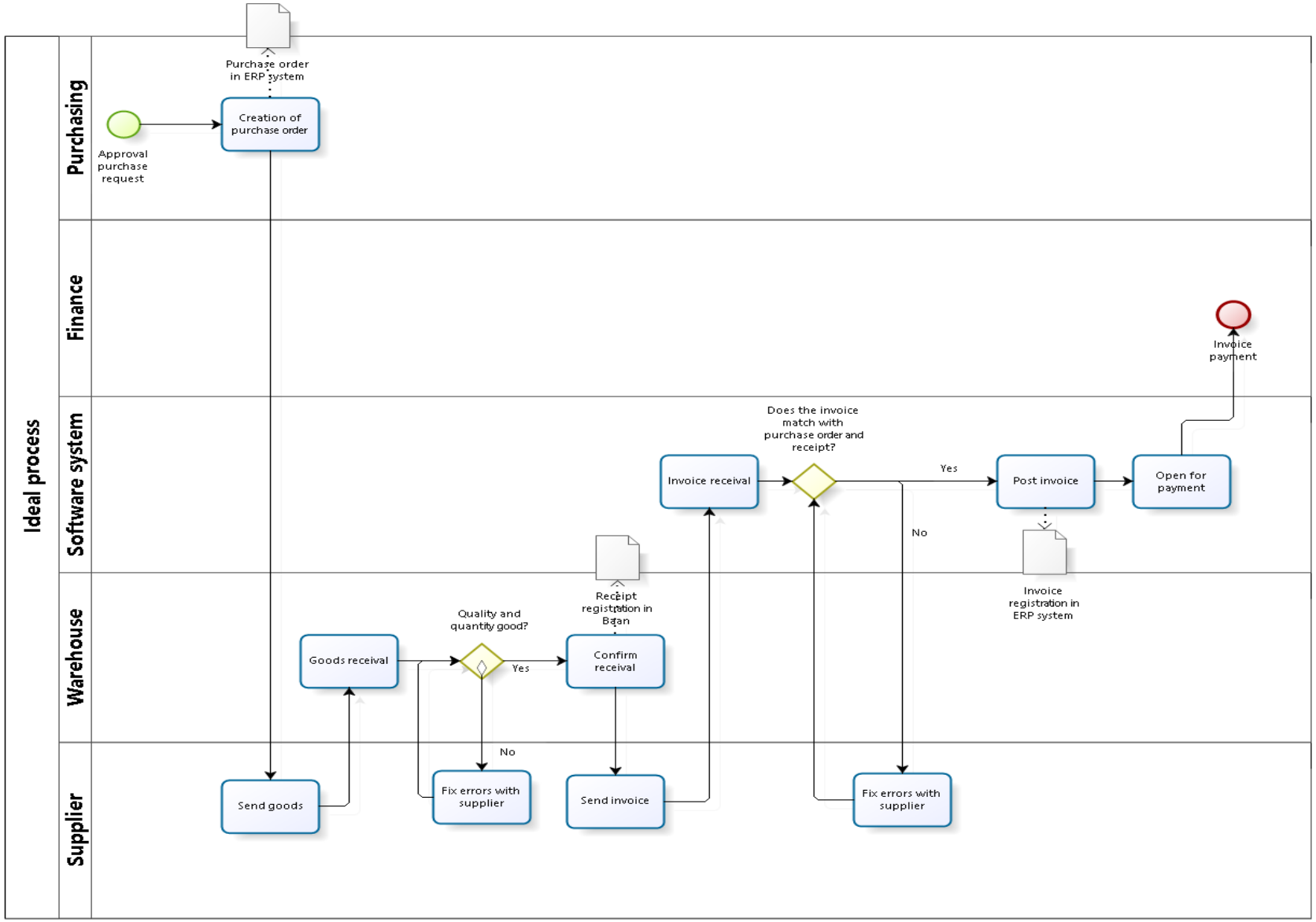

Figure 4: Process map ideal process for Benchmar

In figure 4 the ideal process for Benchmark is shown in a process map. In this process, the only task that finance has to perform is the payment. This is because regulations from the corporate company in the USA obligate payment to be done by a controller at the finance department. All other tasks are taken over by the new software system or purchasing.

When discussing the ideal process with employees of the finance department, it was stated that in the ideal situation there are no 610 invoices. Benchmark prefers 600 invoices, because there is more control over the purchases resulting in these invoices, because an approval of the PO has to be made before the order is placed by the purchasing department. With 610 invoices, the approval is mostly done after the purchase is made which makes it much harder to control the amount of money spent. Furthermore, 600 invoices are generally easier to process for a software system as well as employees, because a three-way-match can be performed to approve the price and quantity on the invoice. For these two reasons, Benchmark prefers 600 invoices.

To increase the ratio of 600 invoices, the finance department will start implementing a no-PO no-pay policy when a software system is implemented. A no-PO no-pay policy will require a PO for (almost) every invoice before payment can be done. Only exceptional purchases and purchases with a very low price will not require a PO. If the finance department does receive an invoice without a PO, the purchasing department will be responsible to make a PO and make sure it is correct. The no-PO no-pay culture has been established in a meeting with the head of purchasing and the head of the finance department. Both agreed that a no-PO no-pay culture would improve the process and the control over purchases made.

This process will be ideal for Benchmark, because the amount of human labour of the finance department is minimized. Only payment is structurally done by the controller of Benchmark and in the case of errors, an employee might be needed to help fix it. With this solution, the majority of the tasks performed by the finance department shifts from repetitive tasks (processing stacks of invoices) to service tasks for other departments and analysing the financial developments within Benchmark. This means that the employees of the finance department can focus more on constant improvement of the process.

4.2.2 Constraints for software suppliers

Before searching for suitable suppliers for a software system, the supplier constraints were discussed with the finance employees involved in the process. If these constraints are not met, the supplier is not suitable to supply a fitting software system to improve Benchmarks process and will not included in the selection process. The constraints for the software suppliers are the following:

1) *The supplier must supply a software system that is compatible with Baan V (current ERP system) and Infor LN (expected to be implemented within 2 years).*
   If this constraint is not met, the software system would not improve the current process much, because Baan V is integrated in almost all business processes at Benchmark, so the software system should also be compatible with Baan V. For the same reason it should be compatible with Infor LN, because Benchmark will make a switch to this ERP-system.
2) *The supplier must be Dutch.*
   This constraint is made for practical reasons. If the software supplier is not Dutch, it would be too hard for Benchmark to work together with the software supplier and the savings from this system are expected to be lower.
3) *The investment must be earned back within a maximum of 2.5 years*
   This constraint is made for all investments within Benchmark. It is set up by the corporate company and must be met for the investment to be accepted.

4.3 Available software suppliers

After the preferences of Benchmark and the constraints for software suppliers were defined, the suitable software suppliers were selected. Two potential software suppliers remained that met the constraints, these two suppliers will be mentioned as supplier A and B. In the next section, the similarities and differences of the two software suppliers will be given.

4.3.1 Description of software suppliers

Supplier A offers solutions for multiple levels of automation and has given Benchmark an advice for a solution design based on the current process. The first solution step that would be implemented is that 600 invoices are processed using an OCR-scanning solution. The process of 610 invoices can be improved using both a contract module and a scan and workflow solution. In order to enable improvement of the process, multiple monitoring options are offered within the software system.
Supplier A also advised to strive for further automation after these solutions are implemented and optimized. The process can be further automated using an e-invoicing solution for 600 invoices. Currently, supplier A offers software that can process multiple formats of e-invoices to improve convenience of the software. However, the company focuses on using Peppol as an e-invoicing format. Peppol is a European e-invoicing network that has started from 1 September 2012 (Peppol, 2012).

Supplier B offers roughly the same software package as supplier A. This software system also includes an OCR-scanning solution, a contract module and a scan and workflow solution. The functionality of these solutions is roughly the same as the solution of supplier A. However, there are important differences that will also be taken into account in the selection process.

4.3.2 Important differences between software suppliers

The first difference is that supplier B is not focused on using Peppol as a form of e-invoicing. This was later discussed with the employees of Benchmark, who are sceptical of the Peppol system as it is newer than most other e-invoicing solutions and is not used much by other companies with e-invoicing solutions.

The second difference is that supplier B has more experience with the Baan- and Infor ERP-systems. This company has more clients using Baan and Infor than supplier A, which means that supplier B can offer a more compatible solution with Baan. This is an important difference as the functioning of the system depends heavily on the compatibility with Baan. This means that the risk of problems with the link to Baan and Infor LN is higher for the software of supplier A.

The last important difference is the price of the software systems. Supplier A offers their software system at a one time investment of €45.890,- and yearly recurring costs of €4.998,-. Supplier B offers the software system at a one time investment of €20.776,- and yearly recurring costs of €22.460,-. The effects of these different cost structures are taken into account in the selection process.

5. Selection process

5.1 Selection criteria

To select a fitting solution to improve the process at Benchmark, selection criteria were formed in collaboration with the employees involved in the process. For both software suppliers, the estimated result of each criterium is compared. Based on these results, an advise for the solution to be implemented is given. The criteria and their importance are explained in the section below.

Outcome business cases

Two business cases were constructed to assess the expected financial outcome of both solutions. These business cases compare the expected financial results over a period of 7 years. In this period the expected costs and benefits of both solutions were used to calculate the total ROI (return on investment), the resulting cashflow at the end of this period and the payback period, which should be less than 2,5 years.

Level of experience with Baan ERP-systems

It is a constraint that the software supplier can offer a system that is at least compatible with Baan. However, the level of experience with Baan influences the functioning of the software systems. If the software supplier is experienced with Baan, it is more likely that the system will work better and result in more profit for the company. The experience with Baan is also an indicator of the volatility of the financial results. If the experience is higher, the probability of unexpected problems is lower and the financial outcome is more predictable.

Volatility of expected financial results

The outcome of the business cases is merely an estimation of the financial results, but there are a lot of uncertainties that might influence the financial results. So, to test the financial results of both systems properly, the volatility of the outcome should also be taken into account.

Data gathering and monitoring options

A software system will be implemented to improve the current process, but after this implementation the process will not be optimal and is still open for improvements. Part of these improvements can be realized by having better monitoring options for the process. These monitoring options can be used to realize constant improvement of the process by analysing the gathered data regularly. Furthermore, Benchmark would be able to measure the two KPIs defined in 1.4 (exception rate and cycle time) that cannot be measured currently. If these KPIs can be measured, more problems in the process can be found and solved.

Possibilities for further automation

Another way to improve the process more after the current improvement is by implementing further automation solutions. It would be most practical if these solutions were implemented by the same supplier. For this reason, the possibilities for further automation a software supplier offers is included in the selection criteria.

User friendliness of the solution

For the solution to work, it is vital that the employees working with it are able to understand the software and work properly with it. Therefore, user friendliness is a criterium to determine if the employees are able to work sufficiently with the software that will be implemented.

Service after implementation
The improvement process is not finished after implementation of a software system. The process will not be optimal and further improvement will likely require cooperation with the software. If the software supplier offers better service after implementation, this will help further improvement of the process after implementation of the software system.

Environmental impact
In the current process roughly one pack of 500 A4 sheets of paper per week is used. This paper is 80g/m^2 according to the packaging, which means that one sheet of A4 paper weighs 5 grams. The yearly amount of paper used is 5*500*52=130.000 grams which is 130 kilograms. According to the American Forest and Paper Association (2009) 1 tonne of paper produces a total of 1.194 kg of CO_2 in its lifecycle. This adds up to 0,13*1.194=155,22 kg of CO_2 emitted yearly from the paper used in the current process. By using a software system, Benchmark can reduce the impact on the environment, because most of this paper usage will be eliminated. The electricity costs were not taken into account in this calculation, because the computers, servers and printers will not run significantly more or less after the implementation of a software system. At the moment, most electrical devices run all day, so this will not change significantly if a software system is implemented.

5.2 Explanation and outcome business cases
The business cases are established to estimate the financial effects of the solutions of both software suppliers. In these business cases, the total costs and benefits are estimated over a time frame of 7 years. These estimations were made in collaboration with the employees involved in the process. The business case uses a time frame of 7 years, because this is the standard method for bigger investments (investments above €10.000) at Benchmark. Both business cases can be found in the appendix.

5.2.1 External implementation costs
Before constructing the business cases, both software suppliers visited Benchmark to make a proposal on the initial software system to be implemented and to discuss the total costs that this will result in. The external costs in the business cases were derived from these proposals.. The total implementation costs are €40.900,- for supplier A and €20.776,- for supplier B.

5.2.2 Internal implementation costs
The proposals also stated that all employees intensely using the software system need a training day. For this training day, an assumption was made that the average salary is €38,50 an hour for these employees and that 25 people need this training day. Furthermore, the software suppliers estimated that the implementation will cost 13,75 days to implement a system. To calculate the internal costs, an assumption was made that half of these 13,75 days, an employee from Benchmark was needed to offer support with this implementation. With these two assumptions, the total internal costs add up to €9.812,- for both software suppliers. Note that this amount is an estimation and may be different if the system is actually implemented.

5.2.3 Yearly recurring costs
The yearly recurring costs for both software suppliers consist of after-implementation service. This includes for example updates of the system, fixing bugs and resolving downtime. The recurring costs only consist of the costs both software suppliers charge for their after-implementation service. This comes to a total of €4.998,- for supplier A and €22.460,- for supplier B.

5.2.4 Reduction of labour costs and missed discounts

The two most important savings are reduction in labour costs and in missed discounts (Aberdeen, 2011). These are the two savings that are used in the business cases. There are more aspects that will result in savings after implementation of a software system. However, these are either not big enough to make a significant impact or they cannot be estimated with enough reliability.
The head of the finance department made clear that when a software system was implemented, a flexible employee working 0,5 FTE would be fired to start reducing costs from the beginning. These costs are €25.352,- yearly, so for both software suppliers, the reduction of labour costs will be €25.352 from year one.

For supplier A, the reduction of labour costs is estimated to rise to 0,8 FTE. The cost reduction will gradually add up to a total of €38.700. This will not be the total cost reduction from year 1, because the employees have to get used to the software system and the process has to be adjusted to work well.
For supplier B, the reduction of labour costs is estimated to rise to 1,0 FTE. The reduction is estimated to be higher, because the employees of the finance department agreed that the software system is expected to work better. This is because supplier B has more experience with the Baan ERP-system. The total reduction of labour costs will add up to €47.599.
Both of these estimations were made in collaboration with the head of the finance department.

The reduction of missed discounts was estimated in collaboration with the head of the finance department. However, this estimation is prone to a lot of volatility, because it is dependent on many factors that cannot be predicted. The amount of money saved by this reduction is estimated to be the same for both software suppliers. The reason for this is that the reduction of the missed discounts is mostly dependent on the monitoring options the software suppliers offer and both software suppliers offer almost the same monitoring options with their software packages. The total reduction of missed discounts is estimated to start at €10.000 and add up to a total of €30.000 after 6 years.

5.2.5 Outcome of both business cases

The outcome of the business cases is calculated using three indicators: Total cumulative cashflow, ROI and payback period. The results on the indicators are given in table 1.
The cumulative cashflow was calculated by first computing the annual cashflow using the following formula:

annual cashflow = annual savings – annual costs.

The total cashflow was calculated by adding up the annual cashflows for all 7 years.

The ROI was calculated using the following formula:

ROI = Total cashflow / total investment

The payback period was calculated by determining the first year in which the total cumulative cashflow was above 0. After this the average rise in cumulative cashflow was calculated for that specific year and this was used to narrow the solution to two decimals.

	Supplier A	Supplier B
Total cash flow	335.000	280.000
Payback period	1,38 years	1,30 years
ROI	660%	922%

Table 2: outcome of business cases

5.3 Estimated results for criteria

Criterium	Result supplier A	Result supplier B
Outcome business case	The estimated outcome of the business case is slightly better for supplier A, as the total cashflow is higher after 7 years, which means that the investment will save more money. However, the payback period and ROI are worse for supplier A	The outcome of the business case is slightly less positive for supplier B, because the total cash flow is lower after 7 years. The payback period and ROI are better for supplier B, because the initial investment is lower than for supplier A. However, this does not result in a higher cashflow due to the higher recurring costs for supplier B.
Experience with Baan/Infor ERP-systems	Supplier A does not have much experience with Baan/Infor compared to supplier B. The company currently has 4 clients using a version of a Baan ERP-system and have not yet worked with Baan 5, which Benchmark is currently using.	Supplier B has more experience with Baan/Infor ERP-systems. They have standard software formats fitting to Baan 5 and Infor LN and have more and bigger clients using a Baan ERP-system.
Volatility financial results	Because of the lack of experience with Baan, the expected volatility of the financial results of supplier A software is higher. The employees expect more problems with the compatibility and functioning of the software system of supplier A. This may have major financial consequences, so the actual cashflow after 7 years might be much lower than estimated if big problems occur.	Because of the higher level of experience supplier B has with Baan ERP-systems, the employees expect less problems with the functioning of this software. It is still possible that problems occur, but the probability and scale of these problems are much lower. This results in a lower volatility of the financial results after implementing the software system of supplier B.
Monitoring options	There is no significant difference in the monitoring options of both software systems.	There is no significant difference in the monitoring options of both software systems.
Possibilities further automation	Supplier A offers E-invoicing solutions after the implementation of the first software system for further automation. However, they focus on E-invoicing using the Peppol format. The employees of Benchmark are doubtful about this E-invoicing format and would rather use, for example, an XML-file because Peppol is a relatively new format and is not used by many other companies.	Supplier B also offers E-invoicing solutions after implementing the first software system. However, this company offers multiple formats and will consider working with Peppol once there is more interest from other companies in this format. For this reason, supplier B scores higher on this criterium.

User friendliness	Both software suppliers demonstrated a demo version of their software system. The employees that are going to work with the system thought the system of supplier A was slightly less user friendly than that of supplier B.	Both software suppliers demonstrated a demo version of their software system. The employees that are going to work with the system thought the system of supplier B was slightly more user friendly than that of supplier A.
Service after implementation	Supplier A offers the service that any problem or downtime is fixed quickly. Furthermore, because the company is relatively small, their customer service is highly personal and often quick. At last, they offer help if Benchmark decides to implement further automation steps.	Supplier B also offers service for downtime. Because supplier B is a bigger company, the customer service might be less personal and slower, but this is not certain. Furthermore, supplier B offers their help with further improvement of the process after implementation. Their expertise on purchase-to-pay processes might help Benchmark with the further improvement of the process.
Reduction environmental impact	It was previously calculated that the paper Benchmark uses emits a total of 155 kg of CO_2 yearly. An assumption was made that paper usage can be cut by 90% by implementing a software system. This would mean a reduction of 140 kg CO_2. The outcome on this criterium is estimated to be the same for both software suppliers because the functioning of the systems is comparable.	It was previously calculated that the paper Benchmark uses emits a total of 155 kg of CO_2 yearly. An assumption was made that paper usage can be cut by 90% by implementing a software system. This would mean a reduction of 140 kg CO_2. The outcome on this criterium is estimated to be the same for both software suppliers because the functioning of the systems is comparable.

Table 3: scores on selection criteria

6. Discussion, conclusion and recommendations

6.1 Discussion

First, due to the time limit of the research, both software suppliers have only visited Benchmark once to present their solutions. While these meetings were useful, there are possibly missing points of information that have not been taken into account. Therefore, the advice for Benchmark is to let each software supplier visit at least once more before making the final decision for a software supplier.

Secondly, no reference companies have been visited to test the actual functioning and user friendliness of the systems. The results on the selection criteria have solely been based on the visit of the software suppliers. Because these visits were done by sales experts, the results on the selection criteria might be biased. To gain knowledge about the actual performance of the software systems, the advice is to visit one or multiple reference companies using Baan 5 or Infor LN. This should also be done before the final decision to implement one of the systems.

In the selection process, no actual scores were used on the selection criteria. The final decision has been made by ordering the criteria on their importance and by estimating the results on the selection criteria. From this, it was clear that the solution of supplier B is more in line with the most important criteria for Benchmark. However, a selection process using scores is more reliable, because the results are quantified, which reduces the bias in selecting a solution.

Much of the literature that was used to compare Benchmark's purchase to pay process to the process of other companies comes from the US. While comparing this data is necessary to assess the differences, some of these differences might result from the fact that the companies are in the US. The reader should take into account that the differences do not result purely from differences in the process, but also differences in the working environment.

Finally, this research used average values for, for example, salaries, productivity and improvement of functionality. However, the purchase-to-pay process highly relies on human labour. Human labour is done differently by most of the employees and their results may differ from the average results. It is hard to measure, for example, the productivity of humans. When reading about the measurements of these aspects, the reader should take into account that these values are not a perfect representation of reality, but the best possible representation within the boundaries of the research.

6.2 Conclusion

The core problem of this research was that purchasing invoices are posted and approved manually at Benchmark. This core problem results in many other problems and ultimately in lower profits for Benchmark. In order to solve this problem, research was done to find fitting solutions and suitable software suppliers to improve the process of posting and approving invoices. Selection criteria were formed to select the best solution for Benchmark which resulted in the following conclusion.

Based on the selection criteria, the best supplier for a software system to improve the process at Benchmark is supplier B. Although their result on the business case is slightly less positive than the result of supplier A, the software from supplier B is expected to be more reliable because of their experience with Baan ERP-systems. The scores on the other criteria show multiple differences with supplier A and on most of the criteria supplier B scores equally well or better than supplier A. The only criterium where supplier A clearly has a better score is the outcome of the business case. However, the actual result might turn out worse because of their lower reliability. From this, it can be concluded that the software from supplier B is expected to be a better investment for Benchmark.

The first software system to be implemented will include an OCR based scanning solution, a contract module and a scan-and-workflow solution to improve the process of both 600 and 610 invoices. Supplier B also offers an e-invoicing solution for further automation. The advice is to first implement the initial solution and when this solution is implemented and working accordingly, Benchmark can start experimenting with e-invoicing to further improve the performance of the purchase-to-pay process.

6.3 Recommendations

The purchase-to-pay process is not ideal after implementation of a software system and is still open for many improvements. These improvements can mostly be realized if the employees strive for constant improvement. One advantage of the software system is that the work that is done will be less focused on repetitive tasks and can be more focused on further improvement of the process. The following actions will improve the purchase-to-pay process more after the implementation of a software system:

The first action that is recommended to Benchmark is to start implementing a no-PO no pay culture into the purchase-to-pay process. By implementing this culture, most 610 invoices will change into 600 invoices. The 600 invoices require more control before the procurement is made. If a PO is needed for every invoice, all procurements should at least be approved by a purchaser or budgetholder, before the product can be ordered. The approval beforehand results in more control over the money spent on procurements. Furthermore, 600 invoices are easier to process by the finance department, because they can be approved using a three-way-match. After the implementation of a software system, most of the three-way-matches will be done automatically, so this will result in reduction of human labour.

The second action that is recommended to Benchmark is to start measuring the exception rate and the cycle time from invoice receival until payment. The exception rate is important, because exceptional invoices are mostly invoices where a mistake is made. By analysing these invoices, common mistakes can be found and solved. The cycle time is an important KPI to measure, because bottlenecks can be found using the cycle time. If the process lags at a specific point or employee, this bottleneck can be found and resolved.

To improve the process more after implementation, Benchmark can start experimenting with e-invoicing after a successful implementation of the initial software system. E-invoicing will likely result in a better performance of the process, because it is a more automated solution. Because the whole process with e-invoices is automated, the possibility of errors is lower than with the initial software system, resulting in better performance in the process.

During this research, the corporate company in the US have shown interest in automating the process of posting and approving invoices at other Benchmark locations. Within the period this research was done, a project has been constructed where the options of automation of this process are explored. Clearly, this research can help with exploring different options and selecting a fitting one. It is recommended to the corporate company to make use of this research in the project and exploring each option in great detail. After this is done, it is recommended to let one location run as a pilot and to implement the solution at multiple locations if the outcome is positive.

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Appendices

Business case supplier A

Investment Expenses:	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Total
User rights initial investment	€ 20.000	€ -	€ -	€ -	€ -	€ -	€ -	€ 20.000
Outside Installation Expenses	€ 20.900	€ -	€ -	€ -	€ -	€ -	€ -	€ 20.900
Internal Installation Expenses	€ 9.812	€ -	€ -	€ -	€ -	€ -	€ -	€ 9.812
Subtotal - Investment Expenses	€ 50.712	€ -	€ -	€ -	€ -	€ -	€ -	€ 50.712
Recurring Expenses:								
User rights	€ 4.998	€ 4.998	€ 4.998	€ 4.998	€ 4.998	€ 4.998	€ 4.998	€ 34.986
Subtotal- Recurring Expenses	€ 4.998	€ 4.998	€ 4.998	€ 4.998	€ 4.998	€ 4.998	€ 4.998	€ 34.986
Total Investment & Recurring Expenses	**€ 55.710**	**€ 4.998**	**€ 4.998**	**€ 4.998**	**€ 4.998**	**€ 4.998**	**€ 4.998**	**€ 85.698**
Projected Savings:	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Total**
0,5 FTE from year 1 rising to 0,8 FTE in year 4	€ 25.352	€ 34.251	€ 36.476	€ 38.700	€ 38.700	€ 38.700	€ 38.700	€ 250.881
Reduction of missed discounts	€ 10.000	€ 20.000	€ 24.000	€ 27.000	€ 29.000	€ 30.000	€ 30.000	€ 170.000
Total Projected Savings	**€ 35.352**	**€ 54.251**	**€ 60.476**	**€ 65.700**	**€ 67.700**	**€ 68.700**	**€ 68.700**	**€ 420.881**
Annual Cash Flow	**€ - 20.358**	**€ 49.253**	**€ 55.478**	**€ 60.702**	**€ 62.702**	**€ 63.702**	**€ 63.702**	**€ 335.183**
Cumulative Cash Flow	**€ - 20.358**	**€ 28.895**	**€ 84.373**	**€ 145.075**	**€ 207.778**	**€ 271.480**	**€ 335.183**	
Payback Period	**1,38 Years**							
ROI	- 40,1%							**660,9%**
Depreciable Life / Investment Life (Years)								5,0

Table 4: business case supplier A

Business case supplier B

Investment Expenses:	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Total**
Outside Installation Expenses	€ 20.776	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 20.776
Internal Installation Expenses	€ 9.812	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 9.812
Subtotal - Investment Expenses	€ 30.588	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 30.588
Recurring Expenses:								
Update and maintenance service	€ 1.260	€ 1.260	€ 1.260	€ 1.260	€ 1.260	€ 1.260	€ 1.260	€ 8.820
Database usage	€ 3.975	€ 3.975	€ 3.975	€ 3.975	€ 3.975	€ 3.975	€ 3.975	€ 27.825
User rights	€ 17.225	€ 17.225	€ 17.225	€ 17.225	€ 17.225	€ 17.225	€ 17.225	€ 120.575
Subtotal- Recurring Expenses	€ 22.460	€ 22.460	€ 22.460	€ 22.460	€ 22.460	€ 22.460	€ 22.460	€ 157.220
Total Investment & Recurring Expenses	**€ 53.048**	**€ 22.460**	**€ 22.460**	**€ 22.460**	**€ 22.460**	**€ 22.460**	**€ 22.460**	**€ 187.808**
Projected Savings:	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Total**
0,5 FTE from year 1 rising to 1 FTE in year 4	€ 25.352	€ 38.700	€ 45.375	€ 47.599	€ 47.599	€ 47.599	€ 47.599	€ 299.824
Reduction of missed discounts	€ 10.000	€ 20.000	€ 24.000	€ 27.000	€ 29.000	€ 30.000	€ 30.000	€ 170.000
Total Projected Savings	**€ 35.352**	**€ 58.700**	**€ 69.375**	**€ 74.599**	**€ 76.599**	**€ 77.599**	**€ 77.599**	**€ 469.824**
tab	**€ -17.696**	**€ 36.240**	**€ 46.915**	**€ 52.139**	**€ 54.139**	**€ 55.139**	**€ 55.139**	**€ 282.016**
Cumulative Cash Flow	**€ -17.696**	**€ 18.544**	**€ 65.459**	**€ 117.598**	**€ 171.737**	**€ 226.877**	**€ 282.016**	
Payback Period	**1,3 Years**							
ROI	-57,9%							**922,0%**
Depreciable Life / Investment Life (Years)								5,0
Annualized ROI								**20,1%**

Table 6: Business case supplier B

Data clarification

Data type	Derived from available data	Calculated
Number of 600 invoices	21.000	
Number of 610 invoices	5.000	
Labour costs per invoice		€116.400/26.432=€4,46
Processed invoices per year per FTE		26.432/2,3=11.500
Total captured discount	66%	
Captured discount Q1 and Q2	75%	
Total missed discount Q1 and Q2	€67.000,-	
One time investment supplier A	€45.890,-	
One time investment supplier B	€20.776,-	
Recurring costs supplier A	€4.998,-	
Recurring costs supplier B	€22.460,-	
Internal costs for implementation		0,5*13,75*€38,50=€9.812,-
Estimated benefits business cases		For calculations see 4.2.4
CO_2 emission by paper in current process		0,13*1194=155.22 kg

Table 6: Data clarification