




# Digital Case Study: Augmented Process Analysis and Optimization

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**Abstract.** We have developed a new approach for teaching business process analysis and optimization based on a digital case study. The case study has been elaborated in cooperation with a production company for compression wear, guided by the concept of action research and the ambition that students can virtually immerse themselves into the company's order-to-cash process. For this purpose, associated process documentation, stations of an order flow, interviews with employees and time stamps of process instances have been made available for students on the educational platform Moodle. The students cooperate in teams analyzing and optimizing the order-to-cash process with the objective to qualify for a consecutive consulting assignment. To gradually increase the level of complexity the students are guided through three phases of analysis building upon one another, being enabled by an interactive guide implemented with the Moodle plugin H5P. The fourth and final phase constitutes an open challenge in which the teams leverage all the information previously collected to identify optimization potential. They summarize their recommendations in a report addressed to a company representative. Feedback of students confirms a well-designed learning path as well as high practical relevance of this new education environment. The structure of the case applies action research at different difficulty levels and can directly be transferred to other companies regardless their business activity or industry. In a planned revision it will be examined how the Moodle plug-in "Level up" can be used to intensify the gamification aspect throughout the assignment.

**Keywords:** Order-to-cash · action research · augmented analysis · case study · problem-based learning · interactive

## 1 Initial Situation

Analyzing and optimizing business processes in a real environment requires profound skills in data collection techniques [4]. However, existing case studies are based on text descriptions and thus fall short in teaching data collection techniques, as all relevant data is already at hand. In addition, practical examples are greatly simplified for teaching in class with the result that assignments concentrate on modeling rather than on analyzing

and optimizing business processes. Subsequent analysis is limited because more in-depth information would have to be obtained for this.

Summarized, the key deficits in the status quo for case studies in business process management are:

- **Unidimensional data basis:** The case description focuses on textual information.
- **Case information is already accessible:** Learning the actual use of different data collection techniques is excluded from class teaching. Thus, time effort and informative value of different data collection techniques remain abstract for students.
- **Artificial scenarios:** Complexity of process analysis lags the reality of performing process analysis in a real-world environment.

## 2 Concept and Objectives

In practice, the analysis of business processes involves the combined application of different data collection techniques, such as study of process documents, observation, interviewing process employees and the quantitative evaluation of process data. Therefore, students need to immerse themselves into a real-world environment. They need to study process documentations and match this information with information provided by employees in interviews. In addition, they should walk along the single activities and tasks of a process and evaluate its performance based on quantitative data, such as lead times.

To consider these requirements, text-based case studies need to be expanded to include process documents, interviews with employees, video-sequences of the process flow and process time stamps. This can be enabled by converting the case study into a digital format to include all the additional information. The title “augmented process analysis and optimization” is derived from the fact that a text-based case study is extended by various real data and information to allow for an augmented view on the process. To enable students to learn from their own practice and experience, the approach follows the concept of action research as defined by Altrichter, Kemmis et al. [1].

The newly designed case study is aimed at students of business administration, business informatics and industrial engineering who are dealing with the topic of business process management. These students participate in an advanced level course (5th semester for full-time students, 7th semester for part-time students). The case is based on the Swiss production company Sigvaris, a manufacturer of compression products, which applies two different production strategies: make-to-stock and make-to-order. To limit complexity only the national, Swiss-internal business, is covered in the case. The following section addresses the didactic design of the case.

## 3 Learning Objectives

Derived from the teaching and learning situation as well as the above-mentioned concept, the following learning objectives can be formulated, grouped to the knowledge dimensions used by Conklin [3]:

- Conceptual knowledge  
The students know the common data collection and analysis techniques and their advantages and disadvantages.
- Procedural knowledge  
Students can structure the procedure for collecting process information as well as analyzing business processes and can apply the associated methods.
- Metacognitive knowledge  
Students can select and apply the most appropriate data collection and analysis techniques according to the individual situation.

## 4 Structure of Knowledge

In the case study there is increased emphasis on a procedural knowledge structure to be conveyed to students, because the focus is on the procedure for process analysis and optimization. This structure can be illustrated with the following four steps:

- Step-1: Understand the company business:  
Read and observe closely, based on a video on the stages of a customer order, digest the factual messages on business activities and the order-to-pay process.
- Step-2: Qualitatively analyze, understand, and model the order-to-pay process:  
Differentiate different types of orders: customer-specific products versus standard products, model associated processing steps, identify problem areas based on video interviews.
- Step-3: Quantitatively analyze, understand, and model the order-to-pay process.  
Identify and quantify differences between actual and target process e.g., lead time variances.
- Step-4: Identify opportunities for optimization  
Question and analyze deviations between actual and target process e.g., loops, setbacks, and delays and identify possible causes. Recommend "quick wins" and improvements that can be achieved in the medium term. Identify necessary information that must be provided by management as a prerequisite for further improvements.  
Objective and motivation for students in step-4 is to qualify for a consulting assignment.

## 5 Case Implementation

The implementation of the case study is guided by a problem based learning approach [6], which is, according to Engel, shaped by the following characteristics [5]:

- Cumulative – repeatedly reintroducing material at increasing depth
- Integrated – de-emphasizing separate subjects
- Progressive – developing as students adapt
- Consistent – supporting curricular aims through all its facets

With this as frame, the digital case study has been implemented on the learning platform Moodle, supported by the H5P-plugin, which permits interactive quizzes. This decision was taken, because Moodle is a standard platform in the Swiss university environment and can be used without additional license costs. From a technical point of view, any other platform that allows interactive quizzes would also be applicable. Processing of the case is divided into four sequences with the aim to guide students by gradually increasing the level of difficulty:

- Sequence-1: Getting to know the company and the stages of order processing.  
The students get an overview of business activities and environment of the company Sigvaris. In addition, a video is used to explain the run-through of a customer order. This simulates an on-site visit.
- Sequence-2: Focus on the order-to-pay process and its qualitative analysis.  
After the introduction, the students focus on an in-depth examination of the order-to-pay process. For this purpose, they have access to process artifacts e.g., process documents, measurement sheet for customized support stockings, and interviews with process employees documented as video sequences. To ensure that students grasp the key information, they are guided via an interactive quiz.
- Sequence-3: Quantitative analysis of the order-to-pay process  
Here, students concretize and supplement the results from the qualitative analysis with a process mining analysis, thereby obtaining real information, e.g., on lead times. Here, the students are also guided through an interactive quiz.
- Sequence-4: Assignment for group work  
In sequences 1–3 students have familiarized themselves with the initial situation at Sigvaris and gained an overview of the order-to-pay process. They now have a broad data and information base at their disposal:
  - Qualitative data/ information gained through
    - Process chain inspection
    - Process documentation
    - Interviews with process employees
  - Quantitative data/ information gained through
    - Process mining

Students are to use the knowledge previously acquired as base for the following and last part of the case study, which concentrates on the order-to-pay process with customers based in Switzerland. The final part of the case study is being worked on in groups of 3–4 students and results in a grade. The goal of each team is to qualify for a consulting assignment at Sigvaris. For this purpose, defined tasks have to be worked on and the proposed solution must be elaborated by each team. The corresponding document is then sent to Sigvaris as a project proposal. The document should have a size of four to six pages plus attachments. On this basis, Sigvaris management decides which team is awarded the consulting assignment.

The four sequences are summarized in Fig. 1, which includes the action research design principles applied to achieve competence to act with students.

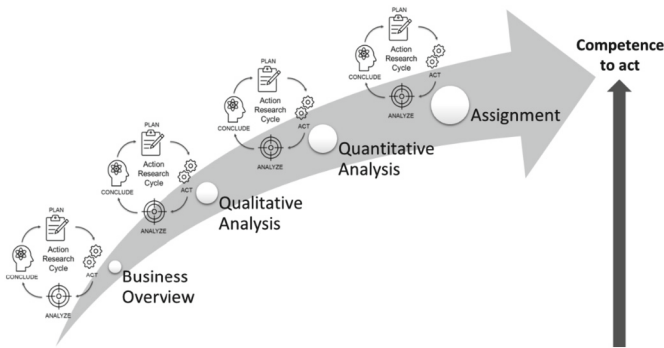


Fig. 1. Systematic capability building guided by action research

## 6 Implementation in the Classroom

The case has been piloted in two courses in fall 2022. The experience gained is reflected in the following section.

### 6.1 Structuring the Content

Since the analysis of the order-to-pay process is a complex task, processing of the digital case study should be done step by step. Accordingly, four steps are deployed:

Steps 1–3 serve to prepare students for the subsequent task in step-4 as well as to ensure that they are focusing on the appropriate section and instances of the process. This is secured by an interactive quiz, which was implemented with the Moodle plugin H5P.

Step-4 represents the actual test. Here, the students have to identify optimization levers in the process, based on the prior knowledge they have acquired.

The case study is implemented in Moodle in such a way that the next step in the case study is only activated for the students when a certain number of points (90% of the maximum possible points) has been achieved in the preceding quiz.

### 6.2 Time Structuring

A time span of three weeks is planned for the entire processing of the case. Students can use classes (2–4 lectures per week) for working on the case. There is no teaching during this time, and the students are guided by interactive quizzes through the case. At the end of the three weeks, students must submit a report on identified optimization potential via Moodle.

### **6.3 Working in Groups**

The case should be worked on in groups of 3–4 students. This considers the typical practical situation that a project team is usually used for such a task. In addition, this setting supports the discussion of the findings within the group and enables collective learning.

### **6.4 Guidance and Evaluation**

In steps 1–3, students work independently in their groups, guided by the Moodle quiz, which ensures that they extract and interpret the essential information. During this time, the instructor is available each week for a one-hour time slot to clarify questions. This is to balance knowledge and experience differences across the different groups.

The report submitted in step-4 is evaluated based on a criteria set used to evaluate whether the students have been able to identify relevant cause-effect relationships and whether they have dealt with the case in such depth that they are also able to specifically name and demand missing information from the management.

In addition to this formal evaluation, a debriefing is carried out together with a company management representative in two lessons. The representative selects the soundest solution based on his practical perspective and awards it. This is supplemented by a discussion in which the student groups receive feedback on their solutions. These solutions are compared with actual decisions made within the company.

### **6.5 Avoiding a Transfer Trap**

The goal of the case study is to make students recognize the strengths and weaknesses of different data collection methods using a concrete practical example. This is achieved implicitly through processing the case, since the students must use different data collection methods to answer the questions posed and compare their results.

The data collection methods chosen include studies of documents, process observation, interviews, and evaluation of process time stamps with the means of process mining. These methods are universally applicable, neither industry or business activity nor company size matter in this context. Therefore, the risk of a transfer trap is considered low in this setting.

Nevertheless, the debriefing should also include a sequence to discuss what differences might have to be considered when a service instead of a physical product is considered. With a service, the “production process” takes place in the interaction with the customers and cannot be recorded with time stamps of predefined activities, as it is the case in a customer advisory meeting, for example. In this case, increased attention must be given to interviews as data collection method.

## **7 Experiences from Piloting in Class**

During the first implementation, an evaluation of the created teaching and learning material was conducted via a student survey. With respect a response rate of 24% it must be considered that the case study had been worked on in groups of 3–4 students.

Typically, the feedback was provided by the voice of one group so that effectively the overall response rate was greater than 75%.

### 7.1 Concept of the Digital Case Study

More than 55% of the responses rated the concept of a digital case study based on real company data as “very good”, the remaining part of 45% as “rather good”. Decreases in the rating result from the fact that there was no possibility to consult a company representative during the processing of the case study.

Lessons learned:

For clarification of questions, in future the lecturer will be available to the students for questions once a week for one hour. This is to balance differences in knowledge and experience across the different groups.

### 7.2 Achievement of Learning Objectives

The learning objectives defined were a higher transfer orientation than before and the creation of an environment in which students are “immersed” in the task (“immersive analytics”). More than 60% of the answers consider the achievement of this learning objective fulfilled within the range of “rather well” to “very well”. Students partly complained difficulties in using the process mining tool Disco<sup>1</sup>, which was previously introduced and used in class.

Lessons learned:

For clarification of questions regarding the operation of the process mining tool, the lecturer will be available to the students for questions once a week for one hour.

### 7.3 Design of the Quizzes/Learning Success Checks

The design of the quizzes/learning success controls regarding the aspects.

- Clear and understandable questions
- Verification of the solution
- User-friendliness

was rated “completely agree” or “rather agree” for more than 80% of the answers. Therefore, no adaptation is planned here.

### 7.4 Design of the Learning Path

The design of the learning path with the aim of a multi-level structure and a successive increase in complexity:

- Introduction to the problem on the basis of delimited assignments (drag & drop process modeling, multiple choice questions).
- Proposal for optimization (as proof of performance) in the form of open questions

More than 60% of the answers attested “completely agree” and more than 35% of the answers “rather agree”. This approach will be maintained as originally designed.

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<sup>1</sup> Disco is a process mining tool provided by the company Fluxicon BV.

### 7.5 Suggestions for Further Development of the Concept

The suggestions for the further development of the concept concentrate on the organizational aspect that it should be possible to ask questions to the lecturer during the processing of the case study. This will be realized in the form of a question-and-answer session once a week.

## 8 Conclusion and Outlook

For future implementations, the chosen approach with the current learning materials can be maintained. From an organizational point of view, a question-and-answer session for the students once a week will be offered to clarify content-related as well as methodological questions e.g., operation of the process mining tool Disco. In addition, it will be examined how the Moodle plug-in “Levelup” can be used to further implement the aspect of gamification for the assignment. What makes the case study stand out is its connection to current research in agile business process management [2]. There, people are looking at new technological approaches, such as process mining, with the aim of shortening the time required for process optimization.

Based on the experience gained with this new format of case study, the elaborated approach and structure can directly be transferred to other companies regardless their business activity or industry. However, making this transfer successful requires a close cooperation with the respective company as well as an open mind set on industry side. Access to the material created and used for the case study can be granted by the authors upon request.

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