Serious gaming for raising awareness of digitalization opportunities in supply chains – a study at Nutricia

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Serious gaming for raising awareness of digitalization opportunities in supply chains – a study at Nutricia

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Preface

Dear Reader,
I am glad to present my Management of Technology Master of Science graduation project report to You, concluding my 2-year studies at the Delft University of Technology. In the past eight months, I learned a lot about how a large multinational company works during my internship. Besides, I was happy to put our knowledge obtained across my studies into practice and contribute to business process development as an intern with the game I developed.

The master thesis project was inspired by my work experience at Nutricia as a supply chain intern in the Deployment department. As the intern, I was assigned a large variety of tasks and had to help out colleagues on demand. Therefore, I quickly acquired a thorough overview of the business process. Soon I've realized that many data input and reporting tasks could be made efficient using programs. To accelerate my repetitive tasks, I've developed simple scripts to obtain data from the ERP system and generate spreadsheets for reporting. Initially, the created programs fulfilled their tasks; the developments were beneficial due to the hours saved compared to manual reporting. However, since the business process was designed for a manual way of working, further digitalization was not possible in my current intern role. Since further digitalization needed the involvement of the whole department, and especially managerial decisions, I have decided to build this project around the idea of digitalization.

The project was discussed with my team lead during our personal meeting, where I was provided with additional information about the digitalization process of the company, as well as a confirmation about their support for my project. The team lead mentioned that digital transformation was a topic considered as an interesting direction of the development.

I want to thank the Deployment team for providing valuable input to my project and taking the time to participate in the game sessions. Special thanks to my external supervisor, Liesbeth Spaanderman, for her support during the whole project.

I am grateful to the thesis committee members. I sincerely thank Fernando Kleiman for his enthusiastic support from the first day of my thesis project, both academically and psychologically. I want to express my gratitude to my second supervisor, Marcel Ludema. His feedback was always challenging in nature. Thus, his guidance on the design process resulted in a higher quality of my thesis. I am grateful for the support of my first supervisor, Marijn Janssen, who supported me throughout the whole process and provided me precious insights on digitalization.

I want to thank my dear mother for her endless love and care in all her life. The past three years have been the hardest time of my life without her, but I know that she always supports me from Above. I am incredibly thankful for the endless love and support of my boyfriend, Beni. Without him, I would not be able to present this thesis today. I also want to express my greatest gratitude to Beni's family and my great friends who made these years memorable in Delft.

Summary

The fourth industrial revolution is changing the way of working and manufacturing in multiple ways. The increasing digitalization of business processes makes employees more productive, lowers costs for firms, reduces the environmental footprint of the companies, and improves the quality of services. While born-digital companies built their business process around digital opportunities by default, many large traditional companies are lagging behind in digitalization. This work aims to raise awareness of the opportunities of the digital world for the employees of large pre-digital era companies. This study was conducted at Nutricia, the subsidiary of Danone, focusing explicitly on the Deployment team, which was treated as a service provider.

This work tackles the digitalization problem by developing a serious game to be played by the company's employees. Compared to traditional teaching methods like workshops or presentations, gaming leads to a more engaging experience and enhances cooperation among the participants.

To develop this game, the first activity was a systematic literature review conducted to investigate the earlier applications of serious games for digitalization in supply chains. This leads to the identification of a significant research gap, as it was concluded that no serious game was developed with the purpose of initiating business process digitalization in companies. This leads to the main research question:

> "How to initiate business process digitalization in the Deployment team of Nutricia with a serious game?"

This project builds on the design science approach in the context of digitalization. An artifact was developed based on requirements collected as the first step to reach the design objective. The list of requirements was obtained based on further literature studies about digitalization and background on gaming.

First, a digitalization-oriented study of lean and services value stream management reveals the opportunities from the perspective of business process development: a successfully implemented transformation can improve the quality of services while reducing costs and the risk of error. The Lean-based service value stream management approach identifies the main wastes of the service industry, including data entry errors, lost files, redundant data storage, unnecessary reports, lengthy approval procedures, poor ergonomy, and user experience.

Research on the digitalization trends and technologies provides insights into the applicable solutions, emphasizing the challenges faced by large companies and solutions related to the supply chain topics suitable to the Deployment team's processes. High-potential technologies include robotic process automation helping to make repetitive tasks easier, cloud-based

ERP systems for better user experience, accessibility, and more dynamic development. Artificial intelligence-based solutions can help to solve optimization problems, while APIs enable automated communication between ERP systems to another, simplifying collaboration and data sharing with business partners.

The next step in the literature review was an in-depth study about serious games, revealing that such artifacts proved to be a powerful tool for raising awareness. Additionally, a game with a practical outcome can directly contribute to the initiation of the transformation process. As part of the game session, players were asked to develop a conceptional implementation plan.

The background on serious games is further studied to support the decision making to find a suitable design. Cooperative and competitive goal-structured games were examined regarding learning performance, motivation, and goal commitment. This project uses a cooperative approach since players are colleagues working together on the common goal of digitalizing their business. Cooperative games proved to increase interaction between participants and resulted in higher motivation than competitive games. Among the high-tech model and simulation and the low-tech board-style game construction, the latter option was chosen because it provides more qualitative data compared to the high-tech approach that is more beneficial for quantitative evaluation. Finally, the flow and game-based learning discussion provided insights into how to enable the flow experience for the players during the gameplay.

After the literature review, a case study was conducted on the Deployment department of Nutricia that defines additional requirements for the game design. The Deployment team consists of team leads, deployment planners, documentation coordinators, and interns. However, the study considers the improvement of the planners' process; therefore, the documentation coordinators were excluded from the research. Information was obtained from work instructions, presentations, interviews with a team lead and three planners, and the author's personal work experiences.

Initially, additional knowledge was collected about the company's organization and supply chain, followed by a focused analysis of the Deployment department's business processes. Second, a survey was conducted to assess the awareness of employees amongst six planners and the team lead. The outcome confirms the need for a serious game at Nutricia as employees find digitalization beneficial; however, they lack ideas on how to continue with the digital transformation of their process. Thus, it specifies the game's design objective: the aim is to raise awareness for employees on the digitalization opportunities at the company, including how to do it and how to benefit from it. Furthermore, the results can also support the process selection and function as data input for the game design process. The most suitable business process was selected for the game in terms of showing players the digitalization opportunities.

To fulfill the requirements defined in the literature study and practical problem analysis, a 2-player, cooperative, online serious game has been developed. The design process was iterative, and in total four prototypes were developed. The prototypes were tested with mentors and graduate students to avoid the bias of playing the game with Nutricia employees beforehand. The last prototype was play-tested online with two pairs of graduate students.

The final game design, called DigiGame, consists of two phases. The game board is presented in figure 1. Players puzzle the business process from given building blocks in the first

phase and digitalize it in phase two using the available technologies. Besides completing daily tasks, participants need to select a step of the business process they want to digitalize. Then, the player is shown a hint regarding the applicable technology, which is guessed by the other player based on the description given by the initiator. The digital maturity of the process is represented by a heat map and an overall digitalization level indicator shown in figure 2. The game is won when all technologies have been applied. To fit the time constraints, only the second phase was played with Nutricia employees.

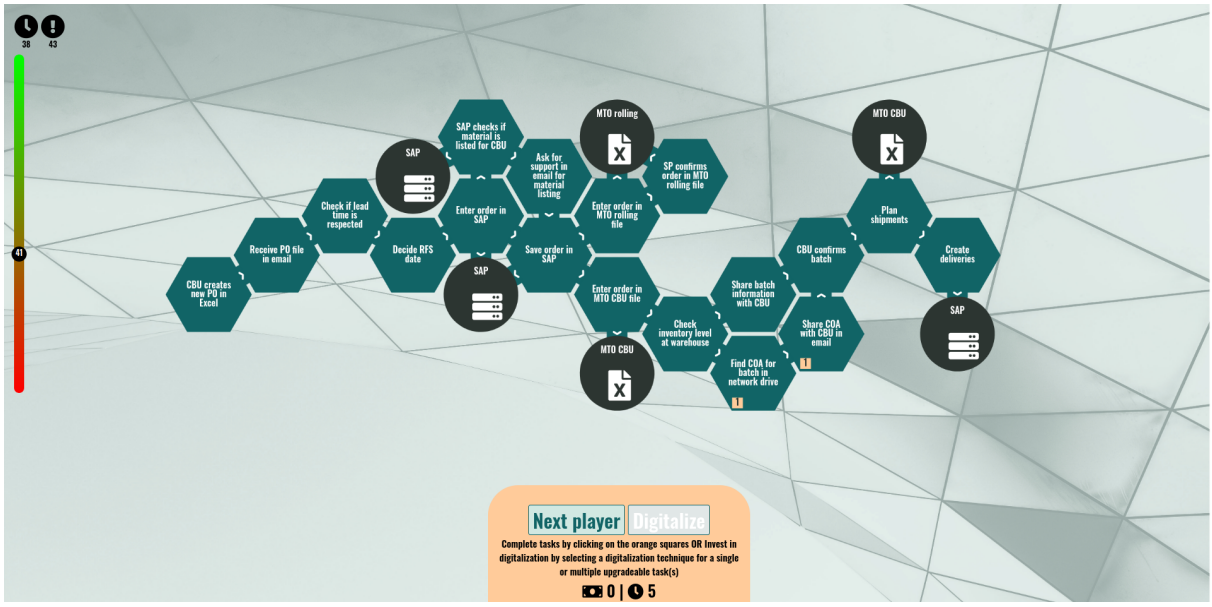
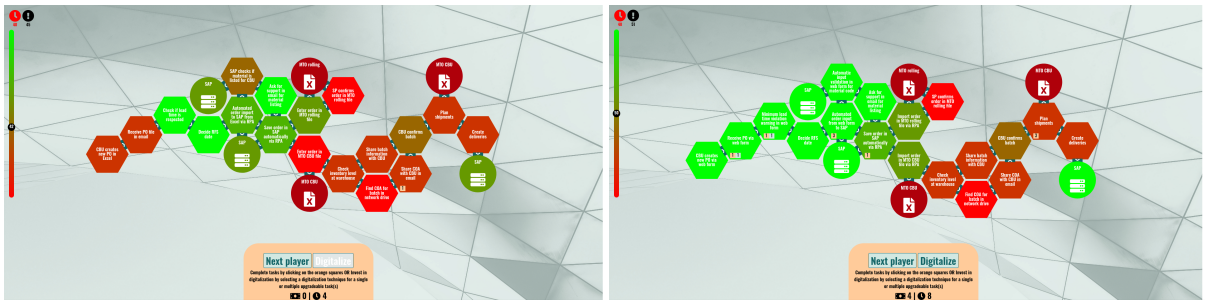


Figure 1: Game board of DigiGame



(a) Heat map before (b) Heat map after

Figure 2: The changing of the heat map based on the effects of digitalization

Five game sessions took place, with the participation of two players on each session: seven planners, two team leads, and one intern. A game session consisted of a short introduction, the gameplay, and a debriefing session. After the completion of all sessions, a collaborative debriefing session took place to discuss further insights with the whole team. Additionally, players filled out a questionnaire before and after the game sessions.

The game sessions were evaluated qualitatively based on transcripts. First, the prepared documents were coded with the Atlas.ti software, resulting in 138 codes in the first round, grouped into nine categories. The codes and categories were visualized on four networks to help answer the research question.

The main assumption was confirmed in the debriefing session: employees at Nutricia can recognize that digitalization is beneficial, but they lack the knowledge of the digitalization possibilities in their business processes. DigiGame successfully raised awareness on the digitalization opportunities at Nutricia for most players. The game was most effective for players who had experience with the analyzed process. Some players acquired a digital mindset during the game session and considered other business processes for digitalization options. While inexperienced players obtained little knowledge about digitalization opportunities, they stated that they had learned a lot about the process itself.

An essential characteristic of a genuine serious game is its apprehensible connection to reality. Players could grasp the message of DigiGame, and they were able to connect the experiences in the game to reality.

Players defined a prioritized digitalization list during the first debriefing session. In the second, collaborative debriefing session, two scenarios were presented to all participants based on their priorities indicated before. Discussing the two approaches' benefits and drawbacks was the first step towards the conceptual implementation plan, created later in the session. Participants agreed on starting with the first scenario, a short term solution, which is feasible and can already be implemented. They suggested proceeding with the second scenario, a more sustainable, integrated approach later. Hence, the game was a suitable decision-supporting tool for digitalization. Moreover, players agreed that all business processes should be considered with a digital mindset to find all digitalization opportunities in the department.

DigiGame, the developed artifact, provided a solution for an open business need at Nutricia, resulting in the primary practical contribution of this work. Employees became more aware of the advantages of a digital business process and already started thinking about implementation details after discussing a conceptional implementation plan. Moreover, the game session contributed to the organizational learning at Nutricia.

Considering the theoretical contributions, the research confirmed the results of earlier work regarding the high potential of using serious games for raising awareness. Additionally, it was proven that a game could provide a digital mindset and introduce the opportunities of digital transformation in a business context to non-IT-focused employees, providing answers to open questions introduced by multiple previous works.

During the qualitative analysis, multiple impacts of the game have been discovered:

- learning about the digitalization opportunities,
- acquiring a digital mindset,
- considering other digitalization options,
- perception change,
- skeptical about implementation,
- getting more familiar with the business process and
- becoming aware of the complexity of the process.

The diverse impacts can be connected to the experience with the presented business process in the game, knowledge about digitalization, and personal traits. Notably, no previous work revealed similar observations. Thus, it can be concluded that the game sessions contributed to the development of the participants in a diverse way.

The main limitation of the game is that in the current form, it is applicable to Nutricia's process only; however, it was designed keeping in mind simple adaptability to alternative business processes.

Future research is proposed in the direction of a more general game that can be easily adopted to multiple companies. Additionally, evaluating the game on a larger sample is also the subject of interest.

The thesis work is summarized in a visual abstract shown in figure 3.

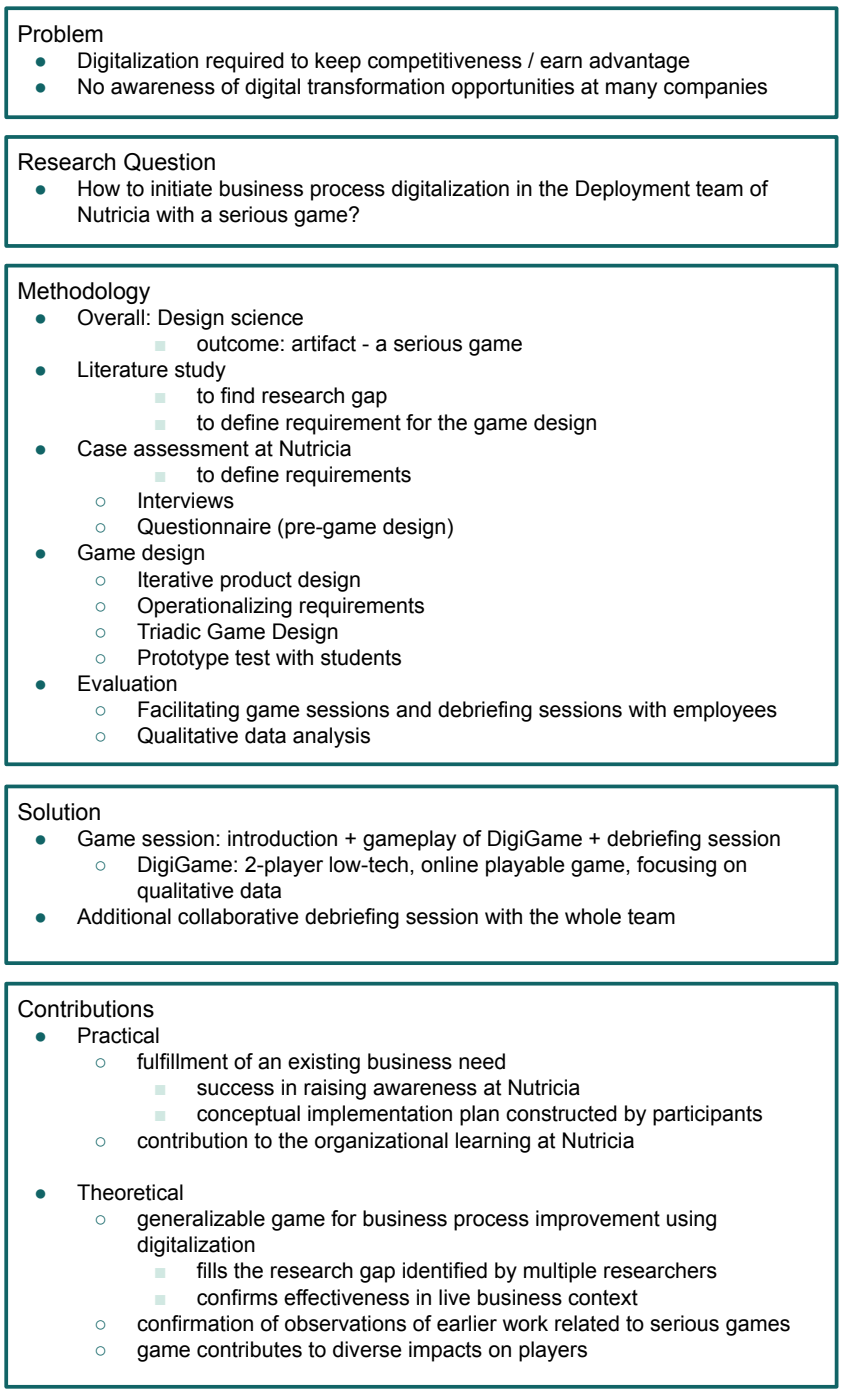


Figure 3: Visual abstract

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Chapter 1

Introduction

Digital transformation is the process of integrating digital technologies into all areas of business or even redesigning business models and culture around digital opportunities. A serious game can make employees aware of the possible use cases of digital technologies in their business processes, contributing to the establishment of a digital culture as well as the initiating of the business transformation.

This chapter discusses the challenges of the ongoing digital transformation for large companies, followed by a brief introduction of the description of the company. After, the proposed solution to the discussed problem is introduced. Finally, the structure of the report is presented.

1.1 Digital transformation

The fourth industrial revolution is already transforming the way of working and manufacturing (Skilton and Hovsepian, 2018). Amid increasing automation and robotization in the production process, vast amounts of data are generated. Interconnected management systems and algorithms are increasingly taking over tasks from operators. The novel technologies lead to unprecedented cost reduction and improve the quality of service or make the company's ecological footprint smaller by smartly utilizing available data and resources. With the increasing practical solutions powered by artificial intelligence (AI), cloud computing, and the internet of things (IoT), a new dimension of digital culture opens up. (Salkin et al., 2018)

Digital transformation is the process of integrating digital technologies into existing business models and processes or redesigning them, considering the opportunities given by digital technologies. The goals of digitalization are to make the business process more efficient: save money, improve responsiveness and reliability.

The transformation is led by digital giants and startups born in the digital era. Multinational tech companies not only give examples but also provide essential technologies like cloud and AI platforms. Also, in the last decade, there are more and more examples of born-digital companies moving outside the cyberspace, questioning the position of market leaders who sometimes cannot keep up with the development. In the food industry, the noticeable effect of digitalization from an everyday perspective is the increasing possibilities of online ordering and innovative digital marketing campaigns. Additionally, there are significant changes taking place in the background with the adoption of industry 4.0 technologies in the manufacturing, supply chain, and management processes.

Many examples show that the competitive advantage of companies collected through multiple decades of experience in research and development can vanish in years. Especially if traditional companies fail to leave legacy technology behind and refuse innovation. Therefore, keeping up with the opportunities provided by the digital world is essential. In many cases, to keep products and services competitive, there is an increasing need to redevelop existing business processes around the new digital opportunities. Sebastian et al. (2017) Making employees understand the opportunities provided by digitalization is essential in this context since their thinking and know-how can be largely centralized around the traditional business processes, without an outlook on the benefits that the novel technologies could provide.

While digital transformation remains a hot topic for more than a decade, it received extra attention with the outbreak of the coronavirus pandemic. The restriction introduced worldwide by the governments proved to be an existential threat for many companies. However, firms with a well-digitalized business process showed faster adaptation to the new circumstances, like the necessity to work from home. As a direct consequence, many companies realized the competitive advantages digitalization might give and started accelerating their transformation projects. (Canuto et al., 2020; Petersen and Bluth, 2020)

According to Sebastian et al. (2017), at large pre-digital era companies, the majority of the revenue still comes from traditional products and are in an early stage of the digital transformation. Nevertheless, significant investments are made in digital technologies. The authors found three key elements contributing to the success of the digital transformation. The first is the establishment of the digital strategy that promoting SMACIT (social, mobile, analytics, cloud, IoT) values. Secondly, the efficient support of operational tasks by digitalization techniques proved to be essential, called on "operational backbone". The final point is the establishment of a platform that makes rapid innovation as the response for new business opportunities possible. The two identified digital strategies are customer engagement through digital technologies and providing digital solutions. Both directions require a well-established "operational backbone", providing a solid background and a base to establish operational excellence. According to the authors, the implementation of the operational backbone "should start immediately". Then a "digital services platform" should be designed for rapid adaption and innovation.

Overall, it is inevitable that a company follows technological trends and looks into digital transformation opportunities to remain competitive in the market against both traditional competitors and fast-growing startups. This way, they can ensure keeping their market position or even strengthening it if the competition is lagging behind in the digitalization process. However, it also requires a digital mindset and possibly the re-thinking of business process, even if those proved to be sufficient for decades.

1.2 Description of the company

Nutricia[1], a therapeutic food and clinical nutrition manufacturing company, was founded in 1896, a century before the digital era. The company was acquired by Danone in 2007 and continues operating as its subsidiary.

As its main profile, the company manufactures medical nutrition and exports it worldwide. Since it is a large multinational company, it is split into several departments across multiple countries, and business processes run on several separate complex enterprise software systems after

[1] https://www.nutricia.com/

multiple mergers and acquisitions. The focus of this work is solely on the deployment department on Nutricia. From an intra-organizational perspective, the department provides a service by managing orders, documentation, and reporting regarding the international distribution of the products. The employees of the deployment department mostly work on the computer in the company's ERP system, supplemented by spreadsheets used on a daily basis. A minority of the tasks, mostly related to invoicing and documentation, are still paper-based, partly due to international legal requirements.

The way of working in the department was also affected by the Covied 19 epidemic. Supplying the world with medical food, the company was naturally considered essential. However, to minimize the risk of spreading the virus, most office jobs started to be carried out in home office. Only a few people remained in the office to take care of the paperwork. Meetings and the training of new employees started to be organized via video conferences.

1.3 A serious game to initiate digital transformation at Nutricia

As concluded by Sebastian et al. (2017), many large pre-digital companies are only at the beginning of their adaption to the digital economy. The authors state that in the way to a digital business, reaching operational excellence supported by a solid digital base system is necessary. Analyzing the situation at Nutricia's deployment department, it can be concluded that many similarities exist compared to the firms analyzed. The department uses multiple on-premise ERP systems and spreadsheets, and those are mostly connected manually. Similarly, communication with business partners is dominated by manual processes like e-mail and phone communication and manual data input to the online interfaces or shared resources (spreadsheet). The mentioned can all be the subject of the digital transformation on the way to operational excellence.

Similarly to other large companies, where the business processes were designed during the pre-digital era, digital transformation is challenging. The business process naturally needs to keep running by the employees during the transformation; thus, the involvement and commitment of the affected departments is essential, as well as close cooperation with the IT department.

Commitment needs an understanding of the advantages, and possible drawbacks digitalization may give to each individual working at the company and the whole team. There are several ways to raise awareness of digitalization opportunities. First, presentations and workshops can be held. Presentations are a classical, mostly passive way of learning. A serious game requires active participation of the players. Additionally, cooperative games increase interaction between players, leading to collaborative brainstorming and discussion. Romero et al. (2012) Since the digital transformation requires a department-wide perspective, using a game can be beneficial to get familiar with the needs and opinion of the whole team.

Therefore, this work focuses on the design of a serious game to initiate digital business transformation at Nutricia.

1.4 Structure of this report

Figure 1.1 presents a roadmap to this work. The dark colored part shows the methodologies, and the light colored the outcomes of the chapters.

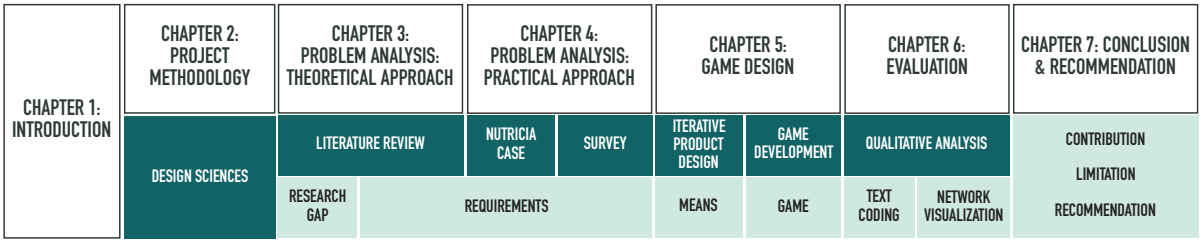


Figure 1.1: Overview of the project

After the introduction in **chapter 1**, **chapter 2** introduces the research questions and presents the design and research methodologies used in this design project.

Chapter 3 presents an in-depth analysis of the problem. It concerns a systematic literature review about concurrent works resulting in defining the research gap. It is followed by a digitalization discussion than the background on games is presented. The findings from the literature review serve as a foundation to define requirements for the game.

Chapter 4 presents Nutricia's current business process is analyzed considering the possible digital improvement points. The study is based on Nutricia case assessment and survey analysis with the employees of the company. The practical analysis provides additional requirements for the game design.

Chapter 5 present the design of the serious game based on the requirements stated in the preceding chapters. The iterative design process is presented to define the means to fulfill the requirements in the game. Finally, the game is presented in this chapter.

The quantitative evaluation of the game sessions is presented in **chapter 6** with the outcome of the coding of the transcript and network visualization of the findings.

The work is concluded in **chapter 7** by summarizing the key takeaways, reflecting on the evaluation of game sessions, and answering all research questions. The chapter results in defining the contributions, limitations of the study. Recommendations are defined for further research.

Chapter 2

Project methodology

This project aims to create a serious game that can help companies through the current or future decision process of digital transformation. It can be reached by raising awareness on the opportunities to help them define their needs.

2.1 Research questions

This section introduces the research questions of this work. First, an elaboration on the research objective is presented, followed by the discussion of all (sub-) research questions.

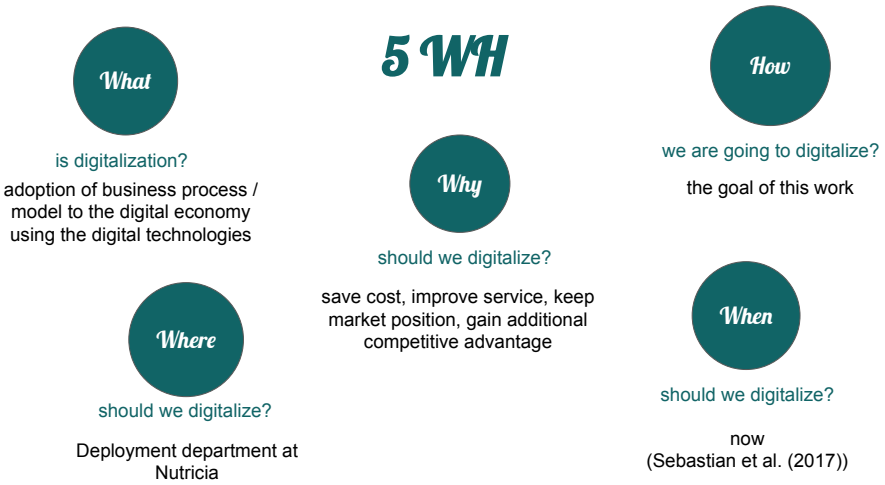


Figure 2.1: 5WH approach adapted from Isaksen et al. (2010)

In section 1.3, it was identified that there are a lot of digital transformation opportunities in the company. Figure 2.1 helps in locating the origin of the problem. Digitalization is the improvement of business processes or the transformation of business models using digital technologies. A highly digitalized business process has multiple benefits: first, the cost can be saved in several ways, including reducing or reassignment of the human workforce, improvements in service in terms of speed or reliability. Besides, it can give a competitive advantage or help keep up with direct competitors based on the market situation. In this project, the focus is on the digital transformation of the Deployment department's business process, to reach operational excellence.

According to Sebastian et al. (2017), digital transformation should start urgently. This work helps to answer the question *How?* by raising awareness of digital opportunities in the company and initiating the transformation process. To tackle the lack of awareness of digitalization opportunities of employees, a serious game is designed.

Based on the introduced problem, the research questions are summarized in table 2.1.

Main RQ: **How to initiate business process digitalization in the Deployment team of Nutricia with a serious game?**		
Design Stage	RQ#.	Research Question
Foundation	1	What are the requirements for a serious game for the Deployment team at Nutricia?
Game Design	2	How to operationalize the requirements into a game?
Evaluation	3	What are the impacts of playing the game on the employees involved in the digitalization process?
	4	What is the conceptual implementation plan constructed by the participants of the game session?

Table 2.1: Research Questions

The main research question concerns the overall design project and is supported by four sub-research questions RQ#1 - RQ#4. The sub-research questions are assigned in three groups, based on the three design stages: foundation, game design, and evaluation.

Research question RQ#1 aims to determine the design requirements. It is used to discover relevant parts of the literature and the business process. Research question RQ#2 present how to construct a game that meets the requirements. Research question RQ#3 and RQ#4 consider the evaluation of the serious game.

2.2 Research framework: design science

The core of the research project is designing a serious game. Therefore, a design approach is taken in the context of digitalization. Contrary to natural sciences, where the aim is to understand the real (either natural or artificial) phenomena, design science seeks to create real artifacts for human purposes. (March and Smith, 1995) Design science strives to solve a certain problem through creating innovation that can be either an idea, practice, or product. Existing theories serve as the foundation for the design extended with the researcher's experience, creativity, intuition, and problem-solving capabilities.

2.2.1 Design Science Framework

The overall methodology of this project builds on Hevner et al. (2004)'s Design Science Framework, which provides a conceptual framework and guidelines for understanding, executing, and evaluating a design science research.

The application of the framework for this project is presented in figure 2.2. The environment provides the problem space. The perception of the people in the organization regarding the business needs and the existing technology infrastructure can define the problem for the researcher. The relevance of the study is given by looking at the business needs of the company. Therefore, in the current project, a case assessment and a survey are conducted to get to know Nutricia's business need. Furthermore, during the analysis, requirements are defined for the game design giving an answer for RQ#1.

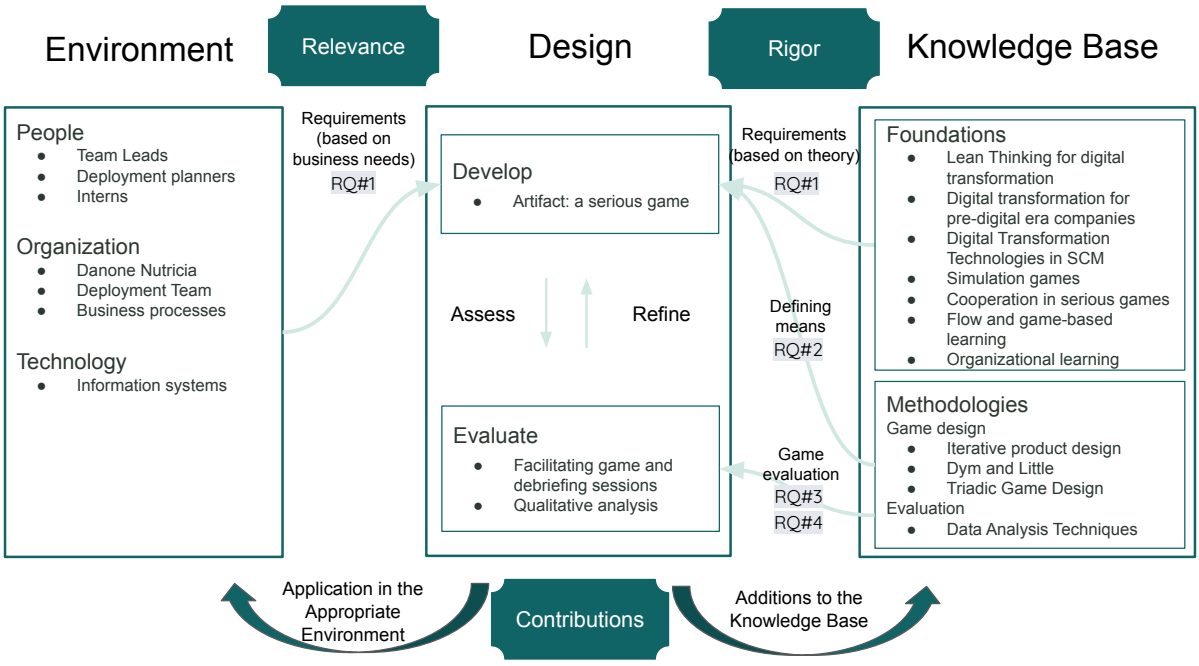


Figure 2.2: Design Science Framework adapted to this research from Hevner et al. (2004)

After the business need is defined, it has to be addressed by designing an artifact that yields utility for the specified issue. The knowledge base provides the truth for the design decisions by determining the applicable foundations and methodologies. The theories, frameworks, constructs, and models presented in figure 2.2 are used as a foundation for game development. The theoretical background supports defining the requirements for the game. (RQ#1)

Additionally, methodologies guide the design and evaluation of the artifact. Applying the game design methodologies, the means can be defined to fulfill the requirements of the game. Therefore, these methodologies described later in this chapter can guide the operationalization of the requirements into the game answering RQ#2. Furthermore, with proper methodologies used to evaluate the game, it can help answer the evaluation-related research questions: RQ#3 and RQ#4. Properly applying the foundations and methodologies can facilitate the rigor of the design project.

An essential attribute of design research is its clear identification of the contribution to the knowledge base and application of the artifact to the appropriate business environment.

2.2.2 Guidelines to build an artifact

Hevner et al. (2004) provides seven guidelines for the building and application of an artifact. Guideline 1 describes that the design science research outcome shall be a purposeful artifact that resolves an important organizational issue. This thesis focuses on designing a serious game for supporting the digitalization process at the Deployment department at Nutricia.

According to Guideline 2, the designed artifact aims to solve an important and unsolved business problem at Nutricia. The need for a serious game for initiating digital transformation at the Deployment department was confirmed by the department's team lead. As in the introduction is discussed, the lack of digitalization in other companies is relevant as well. Therefore, the artifact can be useful for another context as well, the *Problem Relevance* is met.

Guideline 3 encourages the researcher to evaluate the artifact by its utility and functionality via appropriate methodologies from the knowledge base. Evaluation is an essential part of the research; it shall include integrating the artifact in the business environment. Therefore, the serious game will be tested with employees from the local department. To evaluate if the artifact meets, the research objective will be done via qualitative data analysis. As a supportive tool, quantitative data analysis will be applied as well.

Guideline 4 specifies that an effective design science research shall present the contributions clearly. The three types of research contributions can be based on novelty, generality, or significance. Either the design of a new artifact itself, applied in the appropriate environment, can be a contribution, or the research can serve as an addition to the knowledge base either as foundations or methodologies. The contribution of this research is the design of a new artifact. The artifact will be applied in Nutricia's business environment, aiming to solve the defined business need. Moreover, the design research also aims to add to the foundational knowledge base by presenting the artifact for researchers.

Guideline 5 explains that the research shall be conducted with rigor. That applies to both the construction and evaluation of the artifact. Rigor can be achieved by using proper theoretical foundations and research methodologies. The game development is supported by the knowledge base; relevant theories are used as the foundation of the design procedure. The various research methods to be applied to satisfy the rigorous design process will be presented in section 2.3.

Guideline 6 draws attention to the iterative nature of the design process. Designing an artifact is essentially a search process to find an effective solution for the business need. Since design problems are often quite complex, simplification or decomposition is needed as a starting point. Then, while progressing iteratively, the problem can be expanded. Thus, designing the focal game is executed in an iterative way. To find a suitable design for the problem, several prototypes are created and tested with students before presented to the target audience.

Guideline 7 addresses the communication of the research. It asserts that both technology- and management-oriented audiences shall be informed about the study. The thesis project will be made available to other researchers. First, it will be found online at TU Delft's repository. The report will be shared with the team leads at Nutricia and with the participants of the game session.

2.3 Research methods

The following section introduces the research methods applied in the thesis. First, a literature study is conducted to define the research gap and requirements for the game. Than a case assessment at Nutricia provides additional requirements for the game design. Next, the game design and evaluation methods are discussed.

2.3.1 Literature study

During the systematic literature review a research gap was founded, which will be introduced in section 3.1. The review confirmed the relevance of the research as there are no serious games available for supporting digital transformation at companies. Therefore, Hevner et al. (2004)' Guideline 2 is met, the artifact aims to tackle an unsolved problem.

A further literature study has been conducted to define the requirements of the serious game

design. After determining the research gap, the relevant articles found in the systematic review were the first source for the requirements.

Next, the digitalization aspect was reviewed in the literature. It includes a discussion on the Lean Thinking Philosophy for digital transformation and a study on digital transformation in large pre-digital era companies. Finally, examining the digital transformation technologies for supply chain-related business processes.

It is followed by a literature study on the game design aspect. It includes a discussion on the background on serious games and the state of art game design. First, the product design framework can give inspiration to the design process. After, the cooperation and competition in serious games, the high-tech or low-tech gaming for innovation and flow and game-based learning are studied. All of these literature reviews provide valuable requirements for the game design.

The discussed literature reviews serve as the foundation knowledge base for designing the game by articulating the design requirements.

2.3.2 Case assessment

The company was analyzed by getting a more detailed picture of the Deployment department. First, work instructions were studied to find the relevant information for the project. The supply chain of Nutricia is studied, then the organization. After, the department's key responsibilities were explored to get an overview of which tasks should be digitalized. Moreover, the information systems were explored, which is essential in a digitalization related project. Besides the firsthand information collected from the work instructions, own experience was taken into account, as well as information gained via conversations with colleagues. The outcome was discussed with the team lead and improved based on the feedback. The case assessment was the primary source for developing the questionnaire to assess the awareness of employees on digitalization and to provide knowledge about the environment at Nutricia.

2.3.2.1 Interviews

Unstructured interviews were conducted with the people from the company to check if the understanding of the reality is correct. Since the information is required to understand the way of working at the company, a non-probability sampling design, judgment sampling was applied. It focuses on individuals who have the expertise of the given topic (Marshall, 1996) (Zhang and Wildemuth, 2009).

In total, four employees from the company were interviewed. The first selection criteria for the stakeholders was that all respondents need to be experienced with the MTO business process. Furthermore, all kinds of experience levels of the participants need to be represented in the sample. Therefore, a team lead and three deployment planners with different experience level were interviewed. First, for the grounding of the problem, several discussions were held with the team lead. Moreover, to have a deeper understanding of how deployment planners execute the planning, the contract, and delivery creation, a discussion took place with each selected deployment planner experienced with the process.

2.3.2.2 Questionnaire to assess the awareness of employees

As in section 4.3 will be discussed in details, a survey was developed to access the employees' awareness level at the Deployment department at Nutricia. The input data for the questionnaire

was grounded with the case assessment and the literature study.

The selection of the participants was made by convenience sampling. The selection criteria for filling out the questionnaire was to include all planners and the deployment team lead from the Deployment department. The documentation coordinators were excluded from the study because their role is different from the planners, and the scope of this research is to improve the planner's process.

The questionnaire was filled out by all six planners and the team lead in the Deployment department. Convenience sampling is a non-probability sampling design. The conclusions are derived from the participants in the experiment.

2.3.3 Game design method

The game design method applied in this study consists of multiple frameworks. First, Hevner et al. (2004)'s Design Science Framework is used as the main framework by supporting the requirement identification from the environment of Nutricia and the knowledge base from the literature. Furthermore, Guideline 6 is applicable to the game design process emphasizing the iterative nature of designing an artifact.

Thus, an iterative approach is required for designing a purposeful game. With the support of the contemporary framework for product design by Burgos (2006) and the Basic Design Cycle by Roozenburg and Eekels (1995) an iterative approach is taken to develop suitable means to fulfill the requirements and thereby to achieve the design objective.

Finally, Dym and Little (2008)'s framework is applied to create the "design space" for the project by summarizing the design alternatives. Multiple means are defined for the requirements identified in the prototyping phase.

Additionally, the Triadic Game Design methodology also served as an inspiration for the design process.

A serious game is a game that has a purpose more than having fun while playing it; it has a non-entertainment purpose as well. For creating such a meaningful game, the Triadic Game Design method can help game designers by offering them an approach to balance the different worlds of Reality, Meaning, and Play. The world Reality is the model representation of the focal problem the game is aimed to tackle. In chapter 4 the reality is discussed: the real business at Nutricia to be digitalized. In the same chapter, the model of reality is reached gradually by considering the digitalization opportunities in the business processes.

The world Meaning deals with the value creation for the players and how the game's purpose will be achieved. The game itself is a tool to reach the goal; in the world of Play, the game concept is being created. In the next subsections, the way of designing the game is discussed.

2.3.3.1 Iterative product design

The contemporary framework for design methods by Burgos (2006) explains the change in complexity across the design process. First, the designer has to focus on understanding the problem that is solved by the designed product. After building an initial understanding of the concept, the next step is researching the topic to obtain further information, followed by brainstorming focusing on innovative ideas. The complexity of the problem is gradually increasing until the real-life system is fully understood. Therefore, to understand the real-life system, the theoretical and practical background of Nutricia was studied.

Although the real-life situation is too complex to be solved, the problem has to be refined

while decreasing its complexity. The designer can resolve the problem using value analysis, ranking, weighting, value analysis, systematic and boundary search, and prototyping. In this study, for selecting the suitable process for the game, survey-supported value analysis was applied based on the Service Value Stream Management. Furthermore, to come up with a suitable design for the game, iterative prototyping was conducted. The effectiveness of the artifact can be evaluated on the developed prototype, followed by iterative improvement and re-evaluation.

A design process is a trial-error method with an iterative structure represented by The Basic Design Cycle concept. (Roozenburg and Eekels, 1995) The designer proposes an empirical solution in each design cycle. Then, the designer creatively develops a possible solution based on its experience and intuition. Afterward, it can be tested with simulations and experiments, with trial game sessions in the current study. If the product's quality proves to be sufficient, the process moves on to further steps with the design. However, if it does not meet the requirements, the designer has to move backward either to the synthesis or the problem formulation step and take alternative decisions. This iterative process continues until a product with the optimal parameters is obtained. With the trial-error method, the means for designing the serious game were defined.

2.3.3.2 Operationalizing requirements

Dym and Little (2008) provides a tool to build up a conceptual design, therefore supporting to create the final design. The collected list of requirements serves as an input for the design process followed by Dym and Little (2008)'s guidance. After the input data for the design is given, the next step is to build up the "design space". The "design space" contains the design alternatives towards the design solution. Dym and Little (2008) introduces the idea of a "morphological chart" that lists the principal functions in one axis and the means on the other axis. In the current design project, the principal functions are the requirements, and multiple means are assigned to each requirement. With an iterative product design, these means can be defined by meeting the design requirements. As proposed by Dym and Little (2008), at least one mean shall be selected for each requirement to fulfill the design objective. By presenting the requirement-mean matrix, the way of operationalizing the requirements can be summarized answering research question RQ#2.

2.3.3.3 Balanced Scorecard

The application of the Balanced Scorecard for this project can help to emphasize the importance of the game.

The overall aim is to increase digitization in companies with designing a serious game for this purpose. The focus is on two strategic priorities: customer orientation and striving for operational excellence. Kaplan and Norton (1996)'s approach was used to link these strategies to create a Balanced Scorecard. Figure 2.3 shows the visualization of the integrated Balanced Scorecard for the current project.

The objective of the game design is to initiate a business transformation in the company, therefore, to reach the business objectives shown in figure 2.3. The game aims to show how the internal process can be optimized. The discussed elements are minimizing the mistakes, saving time, and through this, increasing the overall efficiency of the process. These objectives can be measured with the time savings on tasks and the time and money saved due to fewer mistakes.

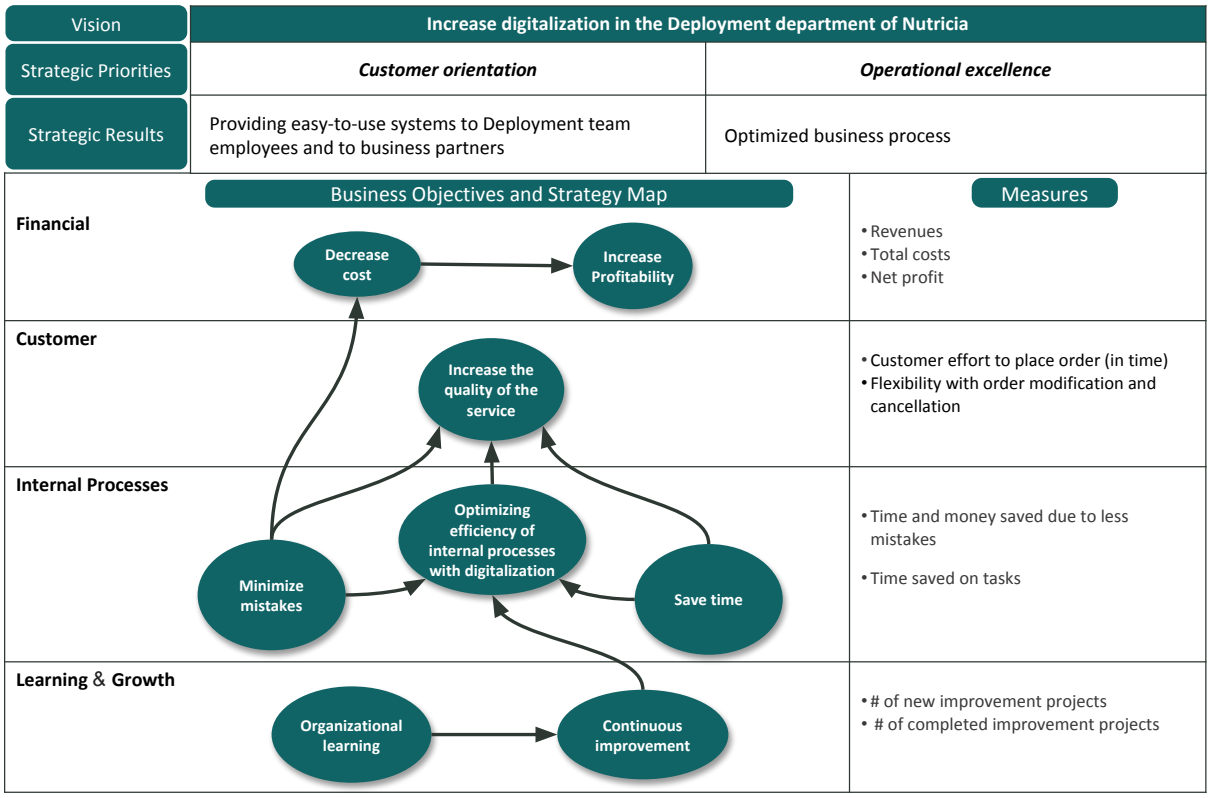


Figure 2.3: Balanced Scorecard for the game design project based on Kaplan and Norton (1996)

An important aspect is the learning and growth in the company. The game can contribute to the learning process of the organization. Organizational learning is defined as the change in the knowledge of an organization (facts, procedural knowledge, routines, and skills are all considered) implied by obtained experiences. (Argote, 2012) If the digital mindset can be reached in the company during the game experience, it can be a driver to use innovative solutions for the presented business case. Furthermore, it might be possible to initiate continuous improvement in the organization by considering other business processes to be improved.

The discussed improvements of the internal processes in the company can benefit the customers with increased service quality. It can be measured with the customer effort to place an order measured in time or with the flexibility of order modification and cancellation. Furthermore, enhanced process efficiency and customer service can positively affect the financial aspects via decreased costs, therefore increasing profitability.

2.3.3.4 Prototype test with students

The developed prototypes were tested with mentors and graduate students to avoid the bias of playing the game with Nutricia employees beforehand. The earlier prototypes were tested with mentors to get insights into the playability of the game. The last prototype was play-tested online in two game sessions with two pairs of graduate students who provided valuable feedback for the further improvement of the game further. It has to be checked if the game is expected to contribute to the organizational learning and to the understanding of the internal processes as discussed in the previous section. The outcomes of the sessions and their impact on the game development is further discussed in section 5.1.4.

2.3.4 Evaluation methods

2.3.4.1 Facilitating game sessions and debriefing sessions with employees

Five game sessions, including the first debriefing session, were played by ten people with different experience levels. In the collaborative debriefing session, eight people took part and provided valuable feedback.

The game session was carried out among seven planners and two team leads, and one intern of the Deployment department. The selection of the players was made by convenience sampling. The selection is supported by the fact that the included people are involved in the investigated business process in some way in the Nutricia Deployment department. Since some of the participants are more experienced with the selected business process, the difference amongst the people with more or less expertise can be investigated.

After each game session, an approximately 20-30 minute debriefing session was conducted with the pair of players. A 30-minute collaborative debriefing session took place with 8 participants from the prior game sessions after all game sessions took place.

2.3.4.2 Debriefing session development

Peters and Vissers (2004) emphasizes the importance of debriefing sessions taking place after the play of the serious games. Kriz (2010) defines the term debriefing as

> "the method to combine the participants' reflections on their experiences with the assessment of mental, social, and systems processes to deduce applications for real situations beyond the gaming simulation experience."

During these sessions, participants can reflect on what happened in the game and discuss their experiences while strengthening the learning perspective. Originally, the learning takes place within individuals. However, collective learning can foster mutual understanding, creating a shared vision, team building, and collaborative decision making. (Peters and Vissers, 2004) This research has an exploratory dimension, meaning that it aims that the participants put together a list of digitalization preferences. Therefore, besides the post-game debriefing sessions in pairs, a collective discussion meeting was planned to take advantage of the collective learning and joint decision making perspective.

One of the most important objectives of the debriefing process is comprehending the connection between the game and the real-life situation. Peters and Vissers (2004) suggests the following three questions to help players in making such connections:

1. *"What are major events and processes observed while participating, and do they resemble real-life events and processes?"*
2. *"Does this observed resemblance offer cues for action in real life, considered the course of processes in the simulation game?"*
3. *"Are these cues doable, desirable, and practical, in view of differences between the simulation game and real life and in view of reactions in real life to be expected?"*

The first question's content is included in the post-game debriefing session; the second question is discussed in both the post-game debriefing session and the collaborative debriefing session. The third question is to be answered in the collaborative session.

2.3.4.3 Post-game Debriefing Session

The first debriefing session takes place immediately after the game session with the team. Since several 2-player sessions game are planned, structured questions were prepared for the discussions afterward. Nevertheless, each discussion is different; participants may have other questions and respond to the questions differently that initiate new topics to be discussed.

Based on Kriz (2010) and van den Hoogen et al. (2014) work the following questions were defined for the debriefing session:

1. How did you feel?
   (a) How did you experience the game?
   (b) Do you have any questions? Any doubt? Any suggestions?
2. What has happened?
   (a) What decisions did you make?
   (b) Based on what events was this decision triggered?
3. How are the game and reality connected?
   (a) Please discuss the relationships between gaming simulation elements and system elements (in real life).
   (b) Reflect on similarities and differences between the experience and reality.
4. Did you learn something?
5. How do we proceed from here?
   (a) Would you like to implement any digitalization technique introduced in the game?
   (b) If yes, please provide a prioritized list of the digitalization techniques for the tasks.

The first question helps in cooling down after the play session. The general questions of 'How did you feel?' and 'How did you experience the game?' allows the participants to talk about the first ideas that come to their minds regarding the game session. Moreover, describing their emotions in the first phase enables them to release the tension and conduct a calm and focused conversation later. Asking for questions, doubts, and advice from the participants can reveal their opinion. When they criticize the artifact, they talk about their experience honestly.

The second question set is for data collection. Participants can talk about their observations regarding the game. The guiding questions 'What decisions did you make?' and 'Based on what events was this decision triggered?' can help players analyze their decisions and the happenings during the play. The facilitator can interact with the players when needed and give feedback to foster a further understanding of the concepts.

As Peters and Vissers (2004)'s first question was touched upon in the second question by summarizing the major events in the game, the resemblance of the game to the real-life situation is discussed in the third question. This discussion can be valuable for transferring the experience and knowledge from the play session to real life. Examining the relationship between gameplay and real-life elements, and analyzing the similarities and differences between them can help avoid deriving generalizations that are not grounded.

In the fourth question, participants can define what they learned from the experience.

Finally, the future aspect is discussed. Players are asked to reflect on the digitalization techniques they got familiar with within the game. A practical outcome is expected from the game; players must provide a prioritized list of digitalization techniques for the tasks. This question connects to Peters and Vissers (2004)'s second question by asking the players to take a real-life action based on the experiences from the game.

2.3.4.4 Collaborative Debriefing Session

After all game sessions, a collaborative debriefing session is planned to discuss the game with all participants together. The three aspects discussed in this session aim to collect data to answer the evaluation-related research questions: RQ#3 - RQ#4 .

1. Do you think your perception on digitalization opportunities changed after this play experience?
2. In the discussion after the game session, in the final question, you were discussing a prioritized list of the digitalization techniques - I summarized the suggestions you made. As an outcome of the experience, we had two different scenarios:
   What do you think of it?
   (a) I would like to know if you have any comments on that – are these priorities interesting for you?
   (b) Do you think this is feasible?
3. What can be done from now?
   (a) What do you think should be done?
   (b) Do you think you will apply any of the digitalizations discussed?

The first question is related to RQ#3 , the second and third to RQ#4 . The first question directly asks for the impacts of the game on the players, asking about the difference in perception before and after playing the game. For constructing the second and third questions, Peters and Vissers (2004)'s second and third questions discussed in section 2.3.4.2 were the inspiration. The second question considers whether participants can apply the knowledge acquired during the play to construct a conceptional digitalization plan. With Peters and Vissers (2004)'s words if it provides *"cues for action in real life"*. The third question approaches the digitalization plan from a practical perspective. It concerns if the actions are doable, desirable, and feasible.

2.3.4.5 Qualitative data analysis

The interviews were transcribed; the transcripts can be found in the appendix. For data management and visualization, ATLAS.ti software was used.

To process the large amount of data, coding is used for data reduction. Saldaña (2015) defines the code as the following:

> "A code in qualitative inquiry is most often a word or short phrase that symbolically assigns a summative, salient, essence-capturing, and/or evocative attribute for a portion of language-based or visual data."

In the first, exploration phase, Open coding is applied, focusing on the observations, attempting to find the main concepts in the texts. The open coding can result in a long list of codes, Friese (2019) suggest that between 120 and 300 is the ideal number of codes, more than that cannot be adequately handled.

Saldaña (2015) describes several coding methods and encourages selecting the appropriate methods for the particular study that fits the research question(s). Multiple coding methods can be selected; in this study, the following methods were used:

- Descriptive coding: summarizes in a word or a phase, introduces the topic, not the content itself,
- In Vivo coding: the participant's own term is used as a code,
- Process coding: indicates actions in the data,

- Emotion coding: labels the emotions experienced by the participants,
- Values coding: reflects the participant's values or beliefs.

The codes can be classified into initial categories.

The second, analysis phase is called Axial coding; it consists of defining the dominant codes and categories in the research and the relations between them. Repetitive patterns are searched for; the researcher can reflect on the similarities and differences found in the data. The reorganization of the dataset is important; redundant codes are removed, similar codes are merged.

The last phase of coding, the reduction phase, is called Selective coding or Theoretical coding. The aim is to find the core category that can explain in a few words what is the topic of the research. All other categories and codes are integrated around this core concept (Corbin and Strauss, 2014). Glaser (2005) advocates that not all grounded theory needs to develop Theoretical code.

Coding is an iterative procedure; there are no strict boundaries between the three phases. After the first code list and the categories have been identified, the transcripts are reviewed, taking into account the new categories.

In qualitative data analysis, the researcher is closely involved in the analysis. Coding collaboratively has advantages because multiple minds can interpret the data in different ways. Discussions between the coders can result in a better understanding of the data. Moreover, consistency (at least 80% agreement) between the coders processing the same data can provide reliability for the analysis. However, in this research, solo coding is applied. The insight of Saldaña (2015) on how the lone researcher can validate the findings provided support for this research. First, discussions with colleagues or mentors about the coding and analysis can be beneficial throughout the process. It can help find better connections, clarify ideas, and make new insights into the data. Furthermore, checking the interpretations with the participants is a good way to validate the findings.

2.3.4.6 Quantitative data analysis

Pre- and post-game questionnaires were applied with the participant to facilitate qualitative evaluation. Although the qualitative analysis has limited relevance due to the small sample size, the presented questionnaire can be utilized as a foundation for further research if the game is tested with a larger audience.

In both the pre-and post-game questionnaires, the participants were asked how much they agree with four statements related to digitalization (table A.6). Then, seven tasks of the MTO process were listed, and they had to decide how much digitalization can improve the task, the quality of service. They had to answer whether they have an idea on how to digitalize the given tasks, similarly to the pre-game design questionnaire (table A.7). Finally, three block of post-game questions were asked about what they learned, what they think about the artifact, and what they think about the future aspect. These questions were only asked after the game session (table A.8).

As mentioned before, the small number of participants does not allow the collection of the needed amount of data to perform quantitative data analysis with significant results. There is no room for statistical generalization in this project. Therefore, it has to be emphasized that the purpose of the qualitative evaluation is just to check if the findings of the qualitative data show the same result as the qualitative analysis as a supporting tool. Therefore, only the patterns can be explored.

2.3.4.7 Bias avoidance in questionnaires

Questionnaires should be carefully planned to avoid bias which can negatively affect the validity of the research. In this work, measures were taken to prevent multiple types of bias.

Non-response bias (Berg, 2005), thus the effect of opinion difference between participants and non-participants was avoided by the positive atmosphere in the company. The team lead gave full support for the project and the positive attitude to the project let all employees from the team fill out the questionnaire and participate in the game sessions. Since the first debriefing was part of the game session, everyone participated. The collaborative debriefing session was also well-attended with 80% of the participants.

Multiple types of response bias FUR (1986) may appear in the questionnaire. First, acquiescence bias so that participants usually tend to be positive in the case of the scale type questions, the answers can be affected by the phrasing. Additionally, the participants were colleagues of the author which is an additional point of concern for positive or negative answers. As a solution, parts of the questionnaire were filled both before and after the games and assuming the same bias, the relative values and trends were evaluated.

A second types of response bias, social desirability bias may occur when participants do not answer the question honestly but try to gain more social acceptance by the answers. Considering the topic of the questionnaire, such bias is less likely to influence the answers. Additionally, according to the literature, anonymity can decrease the risk of this bias.

Question order bias appears when earlier questions influence participants during the answering process. The potential systematic bias caused by the pre-defined order of the questions can be controlled by presenting the questions in a random order. (Brinkman, 2009) The questions in the pre-game questionnaire were formulated in a matrix with the statements line by line and the tasks that should be rated according to the questions in the vertical axis. In this case, the questions are independent and the order of tasks are irrelevant of the filling order. Therefore, the chance of a bias is negligible.

In the pre- and post game questionnaire a similar question block was presented in matrix format. Additionally, the rest of the statements were listed in random order inside the corresponding blocks.

Finally, a test-retest reliability test was implemented on the pre- and post-game questionnaires. The pre-and post-tests were tested with graduate students twice with a day difference without applying the experiment to ascertain that the questionnaire is not biased. (Brinkman, 2009)

2.4 Extended thesis outline

Figure 2.4 presents the extended outline of this work with showing in which chapter the research question is answered and what research or design method is applied.

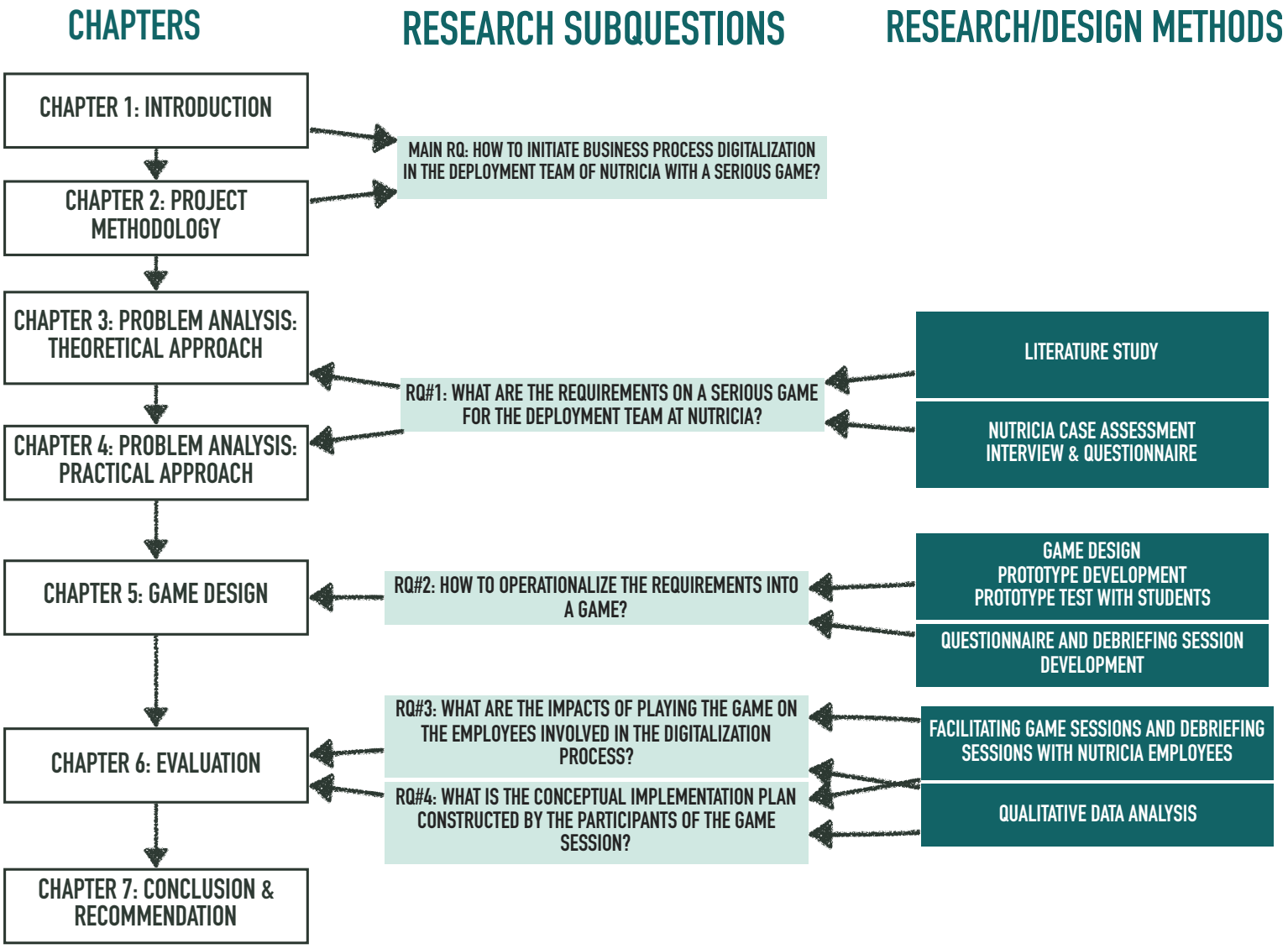


Figure 2.4: Extended thesis outline

Chapter 3

Problem analysis: theoretical approach

This chapter will discuss the problem analysis that provides the foundation for the design project. The aim is to answer research question RQ#1 by providing a list of digitalization requirements for the game design based on a literature review.

After defining the research gap - which also gives some requirements for the game design - a digitalization discussion is introduced in section 3.2. It includes a discussion on the Lean Thinking Philosophy for the digital transformation and a study on digital transformation in large pre-digital era companies. Finally, the digital transformation technologies for supply chain-related business processes are examined.

It is followed by a game design discussion in section 3.3. In this section a background on serious games was examined. The section discusses the cooperation and competition in serious games, high-tech or low-tech gaming for innovation and flow, and game-based learning. All of these literature reviews provide valuable requirements for the game design.

3.1 Research gap

The goal of this section is to reveal a research gap in the introduced problem. Besides discovering the solutions that already exist in the literature for similar problems, the focus is also on finding supportive material, with possibly further use for this research.

With the introduced purpose, a systematic literature review was conducted on the subject of serious games on business digitalization using online scientific search-engines. Literature review is the most suitable method for finding literature gaps.

The relevance of the problem identified in chapter 1 was also proved by earlier research. Stadler and Rückel (2019) have investigated whether there is a need for serious games considering the topic of business process digitalization. Based on qualitative interviews with decision-makers in companies, universities, and vocational schools, the study shows potential for a serious game with the purpose of helping digital transformation. Thus, there is scientific confirmation on the need for such a game.

3.1.1 Systematic review

The details of the systematic review will follow to study previous research on serious games for digitalization. The following scientific search engines have been used:

- Scopus `https://www.scopus.com`
- Web of Science `https://webofknowledge.com`

The search terms are the following:

`("serious game" or "serious gaming" or "game-based learning") and ("digitalization" or "digitalisation" or "digital transformation")` 2020. 05. 22. *Scopus: 27, WoS: 12 results*

Since several irrelevant results were present, unrelated to business processes or supply chains, the search terms were defined as follows:

`("serious game" or "serious gaming" or "game-based learning") and ("digitization" or "digitalization" or "digitalisation" or "digital transformation") and ("supply chain" or "logistics" or "business process")` 2020. 05. 22. *Scopus: 8, WoS: 4 results*

Two of the results were conference summaries. There, the matches for the keywords came from abstracts of multiple papers, thus they proved to be irrelevant and have been removed from the list. Additionally, two publications were found by both search engines, so overall eight unique papers have been identified, presented in table 3.1.

Based on abstracts, five papers were classified as irrelevant for the context of this project.

The work by Sivak et al. (2007) describes digitalizing a board game. Thus, it is not about the digital transformation of business processes.

Author (year)	Title	Engine	Relevant?	Refusal reason
Löffler et al. (2019)	Teaching Methods for Simulation Games: The Example of Learning Business Process Change	WoS, Scopus	Yes	-
Kaczmarek et al. (2017a)	How to promote self-regulated learning processes by using serious games	WoS	No	No access to paper.
Duin et al. (2017)	Learning In Ports With Serious Gaming	WoS, Scopus	No	Training of low-skilled employees
Kaczmarek et al. (2017b)	How serious games unfold their potential in further training in logistics. Results of a multiperspective empirical requirements analysis	WoS	No	No access to paper.
Loffler et al. (2018)	Simulation games for the digital transformation of business processes: Development and application of two prototypes from the automotive and online retail sector	Scopus	Yes	-
Kretschmer et al. (2018)	Playfully to training success: Evaluation study of a pc-based serious game for packaging logistics at DB schenker	Scopus	No	Training of low-skilled employees
Rosenthal and Strecker (2018)	Business process modelling as serious game: Findings from a field study	Scopus	Yes	
Sivak et al. (2007)	Managing the tradeoffs in the digital transformation of an educational board game to a computer-based simulation	Scopus	No	Digitalization of a board game

Table 3.1: Results of the systematic literature review without the conference summaries

Kretschmer et al. (2018) introduces a serious game to train new employees to fulfill tasks in specific packaging positions. The introduced game provides a 3D simulation of a packaging workspace, where similarly to popular video games, players have to complete levels. Hereby the aims are different compared to this study because Kretschmer et al. (2018) focuses on teaching the usage of developed digital technology to staff members. In contrast, this work focuses on raising awareness for the opportunities provided by the digital transformation.

Similarly, Duin et al. (2017) trains low-skilled workers for physical tasks in ports, using serious games.

The papers of Kaczmarek et al. (2017a) and Kaczmarek et al. (2017b) could not be accessed in full length, but based on the abstracts, the scope of the papers were different from the current project.

The next sections briefly present relevant parts of papers identified as containing important experiences that can improve the outcome of this project.

3.1.2 Simulation games for the digital transformation of business processes

Loffler et al. (2018) designed two simulation games as a tool for teaching the digital transformation of business processes. The games were tested with secondary school students with pre- and post-game questionnaires.

The first simulation game introduces the processes of a car manufacturing company to the players. The business process is split into multiple steps, and players can adjust the business process step-wise. The outcome of the game is the number of cars sold, and the team with the highest profit wins. The learning objectives include getting familiar with the terms used, the production process, and the possible automation of these car manufacturing processes. Moreover, to analyze the impacts of the decisions made regarding the production processes, players have to find the optimal balance between short term (human resource) and long term (machines, robots) investments for each step of the process. The simulation game is based on a relatively simple mathematical model with a few formulas defining, for example, the production quantity and customer satisfaction based on the variables set by the players.

The second simulation game considers managing an online retail store. It has to be played in pairs, and teams compete against each other. The primary goal is the analysis and improvement of the business process by making decisions on applying the available digitalizing techniques regarding three departments:

- logistics (automated distribution center),
- warehousing (RFID chips, robotized packing stations, assembly lines),
- online presence (chatbots, automatic invoice generation).

The learning objectives are similar to the other game but more emphasized the impact of digital transformation. The control variables provide information about the consequences of decisions for teams, and the impact of a digitization action can be estimated by the players beforehand. There is a time constraint in the game. Wrong decisions can also be harmful; thus, strategic thinking is required to increase business performance. The impact of specific action on a state variable is defined by a matrix. Hence the consequences can be calculated. The game was evaluated through a discussion session with the players. For further evaluation of the success of the game in teaching digitalization, a short quiz was used. Interestingly, 60% of the students supported the reduction of employees for a higher profit. However, this was only the case by 20% when their own jobs were at risk. While more than half of the participants showed a

Game 1: Car manufacturing company	Game 2: Online retail store
• the business process is split into multiple steps • players can adjust the process step-wise • goal: maximize profit • analyze the impacts of the decisions made • find optimal balance between short term (human resource) and long term (machines, robots) investments for each step of the process	• played in pairs and teams compete against each other • analysis and improvement of the business process • by making decisions on applying the available digitalizing techniques regarding 3 departments: logistics, warehousing, and online presence • time constraint • wrong decisions can also be harmful

Table 3.2: Summary of the games of Loffler et al. (2018)

positive attitude to digitization, 20% remained critical. In the end, students became more aware of digital transformation and said to have a better understanding of its impact on the process.

The authors concluded that the games' learning objectives were fulfilled, and simulation games proved to be sufficient teaching methods. While the first game is Java-based, thus requires installation, the retail game is web-based, which is advantageous because it requires no installation and only one server has to be maintained. The authors suggest that their work can be used as a basis to develop more advanced serious games for digitalization related topics.

The work of Loffler et al. (2018) shows that creating awareness of digital transformation with a serious game is feasible and reveals promising opportunities. The goal of the current work is to scale up Loffler et al. (2018)'s game design for a more complex context and use a game in a different scope, specifically at a Nutricia Deployment team rather than at a school. In table 3.2 the main features of the two presented simulation games are summarized. This can be the starting point for designing the game for Nutricia.

3.1.2.1 Teaching business process change with a game

Löffler et al. (2019) researched simulation games for teaching business process change (BPC), which is nowadays usually driven by digitalization, for upper vocational school students. The paper aims to analyze how different teaching methods affect the learning process so the most beneficial combination can be applied. Twelve papers have been reviewed as part of the survey process: all of them were using experiential learning (Kolb, 1984), whereas 4 of them used pre-game presentations and 5 of them case-based learning as teaching methods. Playing simulation games gets players multiple times through the experiential learning cycle (active experimentation $\rightarrow$ concrete experience $\rightarrow$ abstract conceptualization $\rightarrow$ reflective observation) and contributes significantly to the learning process. Previous work also stated that simulation games with an underlying model proved to be helpful in getting students more familiar with business process change because students can experience a dynamic situation through game models based on reality.

The paper confirms that presentations and introductory material contribute to the learning process and are enjoyable for players, as well as discussion sections afterward.

While introductory presentations proved to improve learning efficiency, this work focuses on analyzing the effect of the game. To avoid the bias introduced by the additional materials and to verify that effects were solely caused by the game, no requirement for the presentation was defined.

3.1.3 BPMN game for training at company

Rosenthal and Strecker (2018) developed a serious game for corporate training. The training objective was to make employees familiar with the complexity of the company's tendering and order management processes.

The developed game board is based on the skeleton BPMN model of a large company's tendering and order management system. Given a schematic of the process, players in groups of three to four have to match elements with their placeholders on the board. Their research aims to analyze how the game stimulates the active learning process measured in how they achieve the training goals. The first goal is to improve the participants' understanding of the business process (BP) and BP models. Additionally, it is expected that improvement suggestions can also be collected by obtaining the players' ideas. During the matching, players are provided with additional information about the elements in short video clips to help locate their place in the process. Teams are set up to involve employees from multiple divisions, so a cross-functional team is constructed from people with diverse expertise, insights into different parts of the process, and experience level. The game sessions are split into phases, and between them, players are asked to discuss their experiences and submit improvement ideas. The authors observe that teamwork and group tasks highly contribute to achieving the training objectives; players are well-engaged in group cooperation. The diversity of groups also provides advantages, as well as the video-based elements.

The game introduced by Rosenthal and Strecker (2018) focuses on making players understand a business process and the modeling framework. Finding points of improvement plays a secondary role. In table 3.3 the main features of the presented game are summarized. The experiences can be incorporated in further research, including this work.

BPMN game for corporate training
• process model template: simplified model of the tendering and order management process • short videos are attached to the model elements • prearranged, cross-functional teams of 3-4 people • assign events, tasks, roles, documents, information systems to the corresponding placeholders in the modelling tool • discussion between all groups and the trainer regarding the play, improvement ideas of the process are shared • multiple-choice questions after the play

Table 3.3: Summary of the game of Rosenthal and Strecker (2018)

3.1.4 Conclusion of the research gap

After narrowing down the search results using the carefully selected search terms, eight unique papers have been identified, found by the two leading scientific search engines. Based on abstracts, three papers proved to be relevant and were selected for an in-depth review, so their prominent ideas can be utilized in this research.

The work of Loffler et al. (2018) concerns digital transformation. However, it is a high-level simulation game and is only used in an educational context. Rosenthal and Strecker (2018) introduces a game in a business context but focuses on learning the process itself and the modeling language with no emphasis on the digital transformation itself.

Concluding the systematic review of the literature, no prior work mentioned serious games

that help to initiate digital transformation at a company. Thus, it is possible to conduct novel research within the identified gap, while earlier studies make it promising and provide a foundation.

3.2 Digitalization discussion

The digitalization approach is discussed based on a dominant process improvement method. Amongst the prevailing trends, theory of constraints, six sigma, and lean (Nave, 2002), the latter approach prove to be applicable for the project. Six sigma focuses on uniform process output. However, in case of the services provided by the Deployment department, high customization is required with significant added value by human workforce. Theory of constraints results results in fast throughput, but separates workers and management with no requirement of total participation. In the case of Nutricia, the involvement of all employees is essential. The lean approach focuses on creating more value for customers and eliminating waste. This directly results in reduced flow time using step-by-step, quickly visible improvements. Therefore, in this project, the digital transformation opportunities are investigated from a lean perspective.

3.2.1 Lean based management framework for digital transformation

Digitalizing business processes usually improve the quality if done right, while it can considerably reduce costs for the human workforce, logistics, and business relations. (Laudon and Laudon, 2013)

Romero et al. (2019) proposes a framework for digital transformation by integrating five management pillars with the Lean Thinking Philosophy.

Many companies decided to go ahead with digital transformation because of its popularity and expected high return on the investment without first thinking about the `process-culture-technology' alignment. It can be dangerous to follow a `technology-push' initiative. Thus it can lead to unsatisfactory results by not being able to justify the investment cost. It can happen if the digitalization does not have real added value in the business process or if the innovation cannot be used in its full potential because there was no intention for motivating and training the employees of the strategic use of the technology. Therefore, applying a lean mindset can help eliminate the waste of the business processes and re-engineer them, taking into account the value-added aspect. The lean philosophy focuses on the processes and culture, not on implementing the new technology itself in the first place. (Womack and Jones, 1997)

The five mentioned management pillars related to digital transformation are discussed in detail below.

(Digital) Strategic Management A digital strategy is more than just implementing new technology. To reach a digital competitive advantage, the strategy should include rethinking the current business processes, and creating novel ways of working; thus, the organizational culture will change.

Processes (Re-)Engineering Management The re-engineering of the process is the first step before applying the technology for the renewed process. The digitalization of an outdated process can limit the development of competitive advantage. Thus, a process-enteric perspective can facilitate the inclusion of value-added features and/or to realize efficiency gains in cost, time, quality, service level, etc. Re-engineering the process is a complex socio-technical activity; the

human and organizational context should be considered besides the technological opportunities. Thus, to obtain a suitable organizational culture that fits the values of the management and the employees, the process should be redesigned in a way that all stakeholders' ideas are gathered and all players can agree on the new process state. (Davenport, 1993)

(Digital) Technology Management Digital Technology Management is essential when a digitalization process takes place. The company should follow a technology-pull strategy, with a clear objective in mind and a reason for applying the focal technology. Besides the wildly adapted and trivially integrable technologies, it is also important to gain further insight into the future technologies that could provide the company competitive advantage. Organizations can create technology roadmaps to plan and support the transformation process carefully.

Change (People) Management As mentioned before, the organizational culture will change during a successful digital transformation. A positive digital culture is needed; namely, employees need to believe that digital technologies can support their work. Thus they are willing to change the way of working for the benefits of the new situation. (Sood, 2018) The following factors are essential for building a digital culture: an innovative way of thinking, adaptability to changes, customer-central thinking, openness and transparency, data-driven decision-making, digital mindset, and employee engagement. (Buvat et al., 2017)

(Digital) Risk Management Digital risks can include technology risks, cyber risks, strategic risks, and operational risks. As part of the digital culture, employees should be aware of the possible digital risks and be trained on how they can manage them in the daily digital business operations. Employees could apply lean tools for risk identification, such as Value Stream Mapping, Five Whys, and fishbone diagram for identifying the root-causes. (Romero et al., 2019)

It is visible from the presented management pillars that in a digitalization process, the organizational culture is expected to be changed; otherwise, the technology itself is almost useless. The new culture should keep Nutricia's main values and involve new digital opportunities. To be able to conduct a digital transformation successfully, employees should be motivated in innovation. It can start with a common awareness of the opportunities, benefits, and risks of digitalization. The game-centered workshop's main aim is to provide a platform for participants to create their digitalization plan together. Thus, they will be committed to the outcomes, which fosters establishing the company's digital culture.

3.2.2 Service Value Stream Management

Since the added value of planners at the Deployment department is the planning and administration of the deliveries, the Service Value Stream Management is discussed. Bonaccorsi et al. (2011) presented the lean approach in the context of the services by extending the Value Stream Management for services. Lean thinking is based on the following five principles:

1. determine what creates **value** for customers,
2. analyze the **value stream** to find the actions increasing the value of the output and identify wasted steps,
3. maximize **flow** by minimizing waiting times and interruptions in the process,
4. use **pull** approach to fulfill customer demand,

5. and aim for **perfection**.

Applying these concepts for services can improve cost-effectiveness and output quality by focusing on the customers' requirements and eliminating unnecessary, possibly expensive steps from the process.

During the implementation of lean processes, many fall into the trap of automating the same process, which only leads to a small advantage compared to the reinvention of the process based on lean principles.

Value Stream Management provides a method to reach a lean enterprise, mostly applied to manufacturing processes. However, the case of service providers proves to be different: value streams and waste are more challenging to define. Thus, the authors propose changes to the framework resulting in Service Value Stream Management (SVSM). The SVSM procedure consists of 6 steps.

First, all involved employees shall be committed to lean. The management can provide financial and other resources, while the workers involved in implementing the process come up with the improvement ideas. Notably, the objective is to speed up operations and focus people on creative tasks instead of repetitive work.

The second step is teaching lean concepts to the involved employees through training sessions or other alternative methods. Increasing their motivation and lean-related skill development also plays a vital role in the process.

Next, the value stream needs to be selected for analysis, based on a higher frequency or generated revenue of the service. The defects should also be observed during the investigation because of their direct effect on customer experience. The top ten wastes of the service industry are shown in table 3.4. Based on the own experiences and discussions with planners (discussed later in chapter 4), it can be concluded that many of the wastes introduced by Bonaccorsi et al. (2011) appear at Nutricia's deployment team. It concerns data entry errors, duplication, and delays caused by long approval procedures.

Defects	Data entry errors; Lost files; Lost or damages goods;
Duplication	Data re-entering; Multiple signatures; Unnecessary reporting; Multiple queries;
Incorrect Inventory	Stock out; Wasting time finding what was needed; Unnecessary copies;
Lack of customer's focus	Unfriendliness; Rudeness; Poor attention to the customer;
Overproduction	Reports no ones will ever read; Processing paperwork before time;
Unclear communication	Incorrect information; Lack of standard data format; Unclear work flow;
Motion/Transportation	Poor layout; Ineffective filing; Poor ergonomic;
Underutilized Employees	Inadequate tools; Excessive bureaucracy; Limited authority;
Variation	Lack of procedures; Lack of standard formats; Standard time not defined;
Waiting/Delay	Waiting for approvals; Downtime; Waiting for supplies;

Table 3.4: The ten wastes of the service industry from Bonaccorsi et al. (2011)

After the value stream is chosen, the next step is to map the current state. While constructing the current value stream map, team members can get familiar with the process and question the way it is performed. The service is considered from the customer's perspective, questioning what value each step has and identifying the waste in and between the steps. Therefore, mapping the current state in the game can be beneficial; employees can examine the process

critically while building it up.

This is followed by an analysis, identifying the impact of waste and set the target for improvement. Each tasks are classified as *value-added*, *non value-added but necessary* and *waste*. Good to keep in mind that some steps can be considered as waste from a process-oriented perspective but value-added for the customers at the same time. In this case, the customer-oriented perspective should be considered first but acknowledge the process-oriented aspect too. Finally, the future state can be mapped.

The leanings from the SVSM is applied in the Nutricia case assessment in chapter 4.

3.2.3 Digital transformation for large pre-digital era companies

Sebastian et al. (2017) surveys case studies about 25 large multinational companies that have been established far before the digital era. Their goal is to determine the firms' progress in digital transformation and to identify development strategies that could help similar companies staying competitive in the digital economy.

The authors observed two different digital strategies. First, the digital customer engagement strategy (used by 8 companies) aims to exploit customer data analysis opportunities, digital communication, and improved interaction to engage customers to buy their products. In this case, companies still offer their traditional products; only promotion and customer contact is changed.

The second strategy is about offering digital solutions to users or combining existing products with innovative digital products. Researchers found that it is important that a company commits itself to one of the mentioned strategies in order to help staff focus and have the required resources available.

Overall, it was observed that the implementation of digital transformation is challenging; most companies were still in their initial phase. However, two important technical elements were identified as the key to success.

First, the companies need to establish an *operational backbone* providing a solid, scalable base for running the daily business without problems and helps to reach operational excellence. For example, a well-designed operational backbone is the single source of information for important data (to avoid redundant storage and the errors coming from it), has high availability, and provides interfaces for the digital services platform.

The second element is the *digital services platform* which is in contrast to the operational backbone quickly adapts to new business requirements and is the primary ground for innovation.

At the investigated companies, the IT department and its role significantly changed from the start of the transformation process, and they were the first department to transform. These changes involved hiring extra staff or even establishing a new department around digital business, introducing the IT services management model, or changing responsibilities.

The authors draw up five essential pieces of advice for managers in such companies.

1. Take a clear decision on which mentioned digital strategy to follow.
2. Start investments in the establishment of the operational backbone immediately.
3. Define the requirements and start developing a digital services platform.
4. Involve business partners in the specification of the digital services platform.
5. Introduce a services culture.

The importance of points one to three were discussed above. Point four emphasizes that a provided digital service should be in match with the partner requirements. For example, if cus-

tomers are end-user, it is likely that they prioritize a well-usable webshop, contrary to a company that primarily serves wholesalers who may prefer having an API connection to send orders. The final point emphasizes the importance of the way of thinking that should rule across the IT department and the higher management, with service-oriented thinking.

The paper provides insights into the progress of digital transformation in companies similar to Nutricia (Danone). At Nutricia, the income is still generated from the sales of products, with some online presence in terms of website and advertisements. As a food company, it is likely that customer engagement has promising opportunities in the digital world for the overall firm. Focusing on the Deployment department, from a service-oriented aspect, offering digital solutions to partners can be an indicator of digital culture.

Based on the authors' second advice, the company should start investing in the setup of the operational backbone promptly and focus on reaching operational excellence. This leads to the next requirement for the designed game stating that the game should include technologies that target the establishment of operational excellence. Furthermore, Sebastian et al. (2017) suggests the involvement of the business partners in the specification of the digital services platform. Therefore, when selecting the business process for the game, the process should include partners such as suppliers and customers.

3.2.4 Digital transformation technologies for supply chain-related business processes

Next, a brief introduction of practically applicable technologies will follow. In industry 4.0, a more in-depth integration of software and hardware solutions occurs by introducing intelligent cyber-physical systems. Data collection using the internet of things (IoT) or the application of barcodes and NFC tags can make the supply chain more efficient. Nevertheless, it can only be considered in a higher-level company-wide digital transformation project. However, this research is limited to the techniques applicable for the tasks of Nutrica's Deployment department, like planning and documentation services.

Hartley and Sawaya (2019) conducted research about the progress of digital transformation and the attitude to specific technologies across multiple firms.

Robotic process automation (RPA) is a cost-effective and easily implementable solution to improve the business process by automating repetitive, time-demanding, tedious tasks. In general, a software mimics the user by simulating mouse and keyboard inputs, or it can launch simple scripts to generate reports, invoices or perform simple calculations and data input automatically. The actions to perform can usually be recorded or programmed either in code or via a graphical user interface.

The main advantage of RPA is the easy implementation: the business process itself does not need to be changed. Additionally, using high-level tools, usually integrated into ERP systems, there is no need for expertise; end-users can implement simpler automation solutions. Compared to the time it could save for frequently performed tasks, the costs are negligible. Therefore, RPA is the first step of the digital transformation for many companies. On the other hand, RPA is prone to changing input and user interfaces. For example, changes in structures of spreadsheets may lead to extracting the content of the wrong cell. The upgrade of the software can also cause issues if the label or the position of a button changes.

Artificial intelligence (AI) and its sub-fields like machine learning and optimization techniques also provide a wide variety of solutions to make supply chain processes more efficient. Machine

learning applications, the most popular choice among the companies investigated by Hartley and Sawaya (2019), analyze patterns and large data sets, and use the collected experience to make more optimal decisions in the future. Among others, scheduling, demand planning, and risk analysis problems can be efficiently solved with the mentioned methods. However, the implementation is challenging: the field requires special expertise, and much sensitive information needs to be shared. More widespread adoptions are promised by the integration of such technologies in the most popular ERP systems like SAP, Oracle NetSuite, or Microsoft Dynamics. Besides machine learning, the tools of **operations research (OR)** like **mathematical modeling and optimization**, can significantly contribute to making businesses more efficient. For example, optimally filling containers, planning the order of parcel delivery, scheduling the products to manufacture, and predicting demand are complex, but daily challenges of supply chain managers. These problems are typical application fields of OR methods.

Hartley and Sawaya (2019) also observed that digital transformation processes might lag due to the obsolete ERP systems because maintaining and keeping ERP systems up-to-date is expensive and demands more effort from the IT team. Many investigated companies used ERP system versions released more than a decade ago. With the emergence of cloud-computing **Cloud-based ERP systems** are constantly expanding their market share. Such systems reduce costs by making own server parks obsolete, as well as shrinking and expanding the system can be solved easily. It is usually maintained by the manufacturers; thus, (security) updates can be installed earlier to provide up-to-date functionality. Access is guaranteed from a web browser; thus, there is no need for costly software installation and maintenance. Moreover, it is easier to provide web-based forms, user interfaces, and APIs for business partners, opening up further automatizing opportunities and higher levels of customer experience. Due to the support of the manufacturers, up-to-date systems are less vulnerable to hacker attacks, and a malfunctioning server can be replaced easily without considerable downtime. A considerable drawback is custom functionality, which can be more costly to implement compared to traditional ERP systems.

The usage of **blockchain-based solutions** can be considered in large inter-organizational supply chains, where the mutual trust between the participants can be improved by the usage of cryptography technologies. Earlier applications include the supply chain of aircraft manufacturers where the risk of using broken parts can be prevented this way.

Single sign-on (SSO) solutions allow corporate users to access multiple IT resources (business management systems, computers, printers) with the same authorization (mostly username and password combination). With the technology, a central authentication system validates logins across the company's infrastructure. Thus, users only need to remember a single password and can change it at a single control panel periodically, before expiration. Additionally, all employees have their own login; thus, it is easy to track who, when accessed, a given resource. A notable drawback of a unified login system is that a stolen identity can be used to enter multiple systems and allows accessing several databases. The security can be enhanced by two-factor authorization, so besides entering a password, the user also needs to enter a one-time code received in SMS or generated by a token generator (custom hardware or mobile app). Limiting login to a (virtual) private network or a geographical location also provides an additional security layer. (Shivakumar, 2020)

A web **application programming interface (API)** connects information systems across a network (an internal network of the company or the internet). Using an API, a software can send

requests to another system to obtain, modify data, or initiate complex operations. For example, an API can automatically provide information about transportation costs or estimated transportation time. The software making the request can make use of the obtained information for further computations. Additionally, APIs can collect information from multiple sources and support the users in non-digitalizable parts of the process. Complex software systems with interconnected APIs are fundamental pillars of a successful digital transformation. (Basole, 2016)

Many firms handle crucial parts of the business processes using **spreadsheets**. While there are considerable advantages of spreadsheet software (Microsoft Excel, LibreOffice Calc) like ease of use, fast adaption to the business process, even without special IT expertise, the many drawbacks can outweigh these pros. There is usually a lack of input verification, and parallel access to the same table can be problematic, as well as the tracking of user access or changes and managing permissions. Moreover, automation opportunities are limited since this software is primarily intended for end-users. For example, due to the lack of input and layout validations, removing or changing content can break even the most carefully designed automation scripts, making integration to a digitalized business process difficult. (Adams, 2018) In some cases, the parts of the workflow implemented with spreadsheets may not be integrated into the ERP system. In this case, **(relational) database management systems** provide an in-between solution which is both cost-effective and overcomes the mentioned drawbacks of spreadsheets.

Shared databases provide a safe way of data sharing between multiple software tools, departments, or companies, without the earlier mentioned drawbacks of the e-mail and spreadsheet-based workflows. Thus, further inter-department collaboration and automation becomes possible.

With the evolution of large companies, including establishing and merging subsidiaries and departments, the number of information systems may grow to the tens or even hundreds for large companies. Due to the lack of integration, manual data transfer may be required between different ERPs or other databases. Besides the already mentioned shared database solution, integrating the systems can significantly reduce the work hours spent on manual data input. Integration can either happen by migrating the functionality of one system to another or using a connection through an internal API.

3.2.5 Conclusion of the digitalization discussion

This section introduced a management framework for digital business transformation incorporating the Lean Thinking Philosophy. Next, an overview of the application of lean to services providers is discussed in the context of Service Value Stream Management. After, a review study helps the understanding of digital transformation in Nutricia based on experience from similar pre-digital era firms. Finally, the latest digital transformation technologies were identified that can help companies reaching operational excellence. The introduced technologies will be connected with Nutricia's business process in section 4.5.

3.3 Background on serious games

In this section, a brief introduction of serious games will follow. First, prominent use cases are discussed. Then, the focus is on design choices and best practices.

3.3.1 Games for raising awareness and learning

First, the definition of games is presented. Adams (2014) defines the game as the following:

> "A game is a type of play activity, conducted in the context of a pretended reality, in which the participant(s) try to achieve at least one arbitrary, nontrivial goal by acting in accordance with rules."

Using games for educational purposes is an emerging field. The question of whether games, in general, are efficient in the teaching process, also raised question scientifically. Therefore, a lot of research has been conducted in the field recently. With more and more work appearing in the field, there was a need to summarize the achievements in a survey. Connolly et al. (2012) provides a systematic literature review on the positive impacts of gaming regarding learning, skill development, and engagement based on empirical evidence of the impact of playing the games from 2004-2009.

The paper from Boyle et al. (2016) reviews the literature of the next five year period (2009-2014) motivated by the emerging interest in digital and serious games. The survey shows that almost five times as many works reported empirical evidence of the positive results of playing games than in the preceding 5-year period. Also, serious games and game-based learning became more popular. The entertainment games have been found to provide unintended learning possibles for players. The insights from these games can assist in creating a serious game. Since the papers discussed outcomes of both entertainment and serious games, the outcome set proved to be quite different in the two categories. The results were summarized based on the outcomes investigated in the given papers: knowledge and skill acquisition was more relevant in the case of game-based learning, while affective, behavior change, psychological outcomes were studied with entertainment games mostly. Perceptual and cognitive, soft, and social skills outcomes were studied by both game types similarly.

Regarding awareness creation, knowledge acquisition, social and soft skills, and perceptual and cognitive outcomes are interesting. Knowledge acquisition outcomes were discussed in the case of several different subject disciplines. In most cases, the study showed that the game session resulted in a better performance than the control group tested by randomized control trial method.

The review study showed that games can be a powerful tool for raising awareness. Thus, a serious game can be used to raise awareness on the opportunities at the company. It includes what would be the next step, making employees of Nutricia understand what and how to do. Players can also realize the benefits and risks of the digital transformation process.

3.3.2 Game with practical outcome

Bharosa et al. has developed a role-playing game based research method to determine the principles of Integrated Service Delivery (ISD). A bottom-up approach facilitates that the new plan is built up together with the employees; examples and best practices are discussed. Thus they can identify what perspectives are needed. In this way, employees tend to be more motivated to learn new skills and will be committed to the plan/set of principles created.

A gaming session is a safe environment for playing with different scenarios of changing the system and observe the effects of the decisions. It can raise awareness of the discussed problems while facilitating a fun way of interaction for the players. Games can provide a field for mobilizing tacit knowledge and helps to commit participants to the outcomes.

The workshop for synthesizing principles included two collective debriefing and brainstorming sessions after each play session. In the first playing round, the principles were determined, and in the second round, the principles were implemented. The impact of the implemented solution found during the game could be discussed afterward.

It was found through the research that the participate approach resulted in a commitment to the outcomes. Finding the solutions the participants themselves can result in more enthusiasm towards the outcome than if it was provided by experts. The game provides more interaction among participants and more entertaining than other interventions, such as presentations and trainings. More creative and acceptable results can be reached, as employees become a 'kind of ambassadors' of the outcomes.

Similarly to Bharosa et al., for the digitalization process in Nutricia, business process adaptation is required, and employees need to develop a new skill set to be able to use the new possibilities provided by the technology. Based on the experience of Bharosa et al., a similar bottom-up approach can be taken at Nutricia, where operational employees (planners) significantly contribute to determining the desired outcome. Therefore, planners should actively participate in the game session as players. As Bharosa et al. observed, the extra tacit knowledge experienced in the game significantly improves commitment to the transformation process.

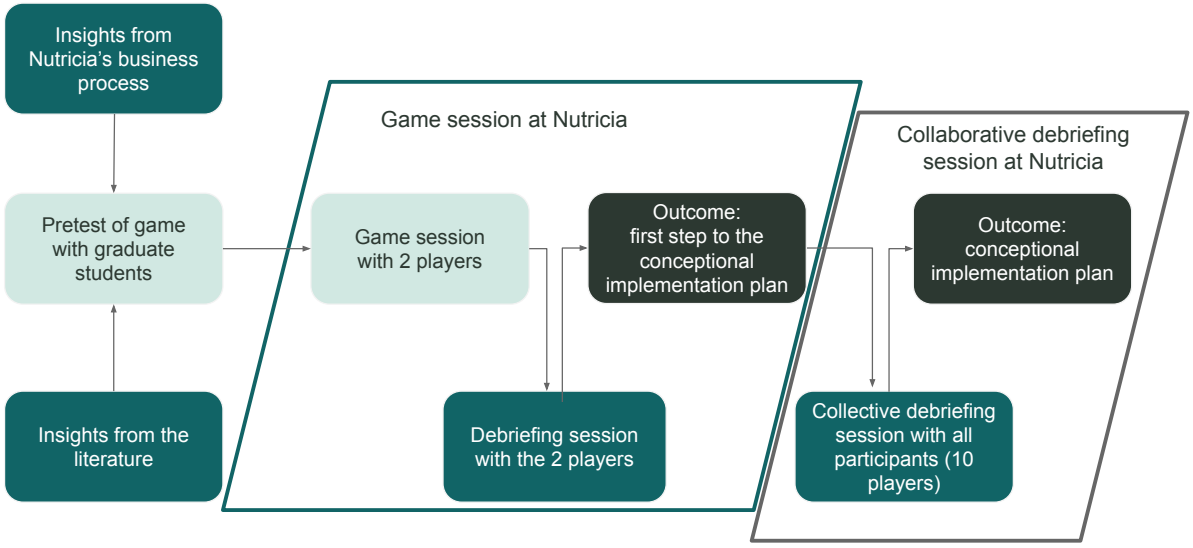


Figure 3.1: Overview of the design approach adapted from Bharosa et al.

The work of Bharosa et al. inspired the practical outcome of the game that players can develop a conceptional implementation plan during the game session. Figure 3.1 shows an overview of the design approach adapted to this study. In accordance with Hevner et al. (2004) 's Design Science Framework, first, the insights from the business environment and literature are taken to design the game. Before the game is played in the company setting, it is pretested with graduate students. After playing the game, two debriefing sessions are held. The first session is scheduled just after the game play in the two-player teams. The second debriefing session takes place with all of the participants in a separate session after all game sessions have occurred. In the debriefing sessions, employees involved in the digitalization process can construct a conceptional implementation plan. By creating the plan themselves, planners should become the ambassadors of the digitalization plan.

3.3.3 Cooperation or competition in serious games

As discussed in section 3.2.1, in a digital transformation process, the motivation and commitment of the employees to the change are essential. Finding a suitable goal structure for the game can help to achieve these goals. IIn a systematic review, the literature discussing both competition and collaboration in serious games was studied. The following three articles were chosen based on the abstracts from the 30 articles found with the search terms.

Wang et al. (2019)'s research aims to understand the difference in the learning outcomes of a serious game with three different setups: competition, collaboration, and solo play in serious games. The findings showed that the multiplayer interaction models - both the collaborative and competitive - performed better than the solo play regarding the learning performance, and the players enjoyed it more. In the collaborative version, the players shared related knowledge and information through frequent communication and multiple confirmations. However, in the competitive gameplay, participants were intrinsically motivated to perform better. The desire to win encouraged the players to be more engaged in taking challenges and thinking over the strategy. Thus, in both the collaborative and competitive models, participants were able to achieve better learning performance.

Romero et al. (2012)'s study explores the effect of multiplayer game-based learning dynamics regarding collaborative learning in serious games. Collaborative game-based learning helps to acquire collaboration skills like negotiation, collective decision making, and problem-solving. These skills are crucial in the context of initiating a digital transformation in the company. Moreover, as players are part of groups, it increases their motivation while providing a safe playground.

Peng and Hsieh (2012) examines the influence of the goal structure (competition or cooperation) and the player relationship (friends or strangers) on performance, motivation, and goal commitment in a motor performance-centered computer game. The cooperative model resulted in higher player motivation than the competitive game structure. Moreover, playing with friends leads to increased goal commitment than playing with strangers in the cooperative form. On the other hand, in a competitive condition, the relationship type does not result in any difference in commitment. However, the research considered a motor activity-centered game; the results may apply to other contexts that involve motivating participants. Further research is recommended by Peng and Hsieh (2012) to explore if the results can be generalized to other game types with more complex mechanics. Furthermore, such games that include conversations between players should be investigated as well in this context.

Following the outcomes from the literature, and the fact that the game targets employees from the same company, a cooperative game shall be designed.

3.3.4 High-tech or low-tech gaming for innovation

Meijer (2015) reviews high- and low-tech games for innovation and analyze them to identify distinct patterns arising from the comparison. The low-tech phrase refers to the games represented with analog methods such as the game board and cards. However, digital supports are possible in low-tech cases as well. The high-tech case applies advanced computational simulation models and human-computer interfaces. A given problem can be represented both in a high- and low-tech form, with the same rules, but representing the reference system using different tools and techniques. Some research observed that teaching more specific skills requires games with

a higher fidelity model (i.e., closer to reality, accurate). However, other studies showed that simplistic "zero-fidelity" games could be just as effective, while they are easier to create because there is no need to develop an advanced model. Dormans (2011) also concludes that games with simplified models and symbolic simulations can also lead to complex player behavior. The strength lies in the usage of appropriate game mechanisms rather than the accuracy of the model.

Meijer (2015) identify the advantages of high- and low-tech games. High-tech games involving accurate models provide more qualitative data. Contrary, low-tech games help to acquire more qualitative information from the players. In this project, the latter could reveal how employees think about digitalization, and it can help to come up with a conceptional implementation plan together.

3.3.5 Flow and game-based learning

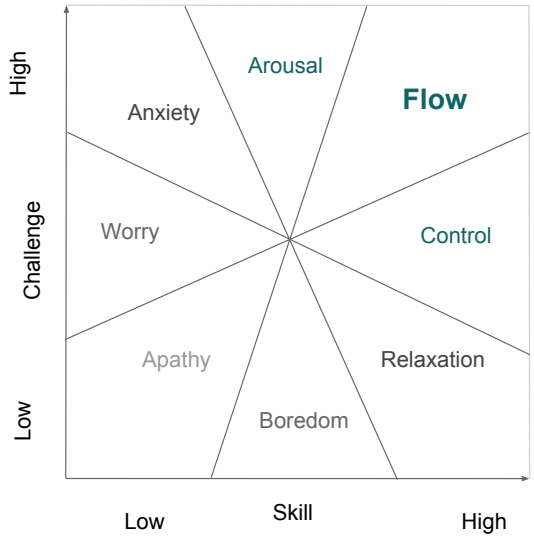


Figure 3.2: Skill – challenge chart created based on Csíkszentmihályi (1975)

In the state of flow, a person perfectly concentrates on a task with its full brain capacity. In this high-engagement state, the person forgets about the world around and refuses to consider external or internal disturbances, including time, hunger, and thirst. The flow experience is made possible by tasks challenging enough for a person to keep the engagement, while its knowledge and skillset make it possible to accomplish it. Figure 3.2 presents the states a person can be in, based on the levels of challenge and the match in required skills. From the good but suboptimal arousal state, it is easy to get into the flow state by gaining additional knowledge or skills. In this state, people can also experience the point when they reach beyond their comfort zone. From the control state where the person is not excited enough, a move to the flow state is possible by adding more challenge to the task. (Csíkszentmihályi, 1975) (Csíkszentmihályi, 2004)

A key factor in the success of game-based learning is whether the player can be pushed into the flow state, which positively affects learning. The game designer has to avoid players falling into anxiety, or on the other hand, relaxation or boredom. Keeping people engaged is only possible if players' skills and experiences are considered during the design process. Since matching multiple players' needs can be challenging, multiple options, paths, or extra challenges can

be added to the game. Starting with fewer options and easier challenges helps to avoid initial anxiety. In a properly constructed game, starting in the arousal state, the flow state can easily be reached by moving well-performing players to more difficult levels quickly enough to keep them engaged. Later, when players would move to the control state, extra challenges can be added to help to remain in the flow state.

Thus, enabling the flow experience for the players can be beneficial. Having fun helps to focus on the game while keeping other disturbances out. Flow experience contributes to engagement and makes learning more efficient. Such a state can be reached by matching the skills of players so that the session is neither boring nor too difficult. However, positioning the game's difficulty is challenging due to the high variability of experience and knowledge about the digitalization of the employees at the Deployment department. Overall, starting from a simpler round and slowly moving over to more and more difficult phases can keep the players challenged while reducing anxiety that increased difficulty causes.

3.4 Conclusion of the theoretical analysis

Identified in the systematic review on serious games for digitalization in supply chains, no suitable game exists that initiates business process digitalization in companies. Earlier games were designed for simpler cases and were used in an educational institution, while this work concerns a more complex situation with a specific business application: the development of a game for raising awareness of the opportunities provided by digital transformation solutions at a large multinational company.

The identified research gap and the summary of earlier work, provides a basis for this work, with the opportunity to incorporate aspects and experiences in the upcoming chapters. Afterward, the essentials of digitalization and game design were discussed to serve as a foundation of this project by requirements established answering research question RQ#1.

Next, a summary of the requirements for the game derived from the literature review follows. 15 design requirements were identified in the theoretical part of the problem analysis. The requirements are summarized in table 4.2. in the order of their appearance in the analysis with their number to identify, description, type and information about its source.

Identifier	Description	Type	Source
R#1	The game should present the impact of digitalization	Need-to-have	Section 3.1.2 (Simulation games for the digital transformation of business processes)
R#2	The game should introduce the opportunity of reinventing a business process with a digital mindset	Nice-to-have	Section 3.2.1 (Lean based management framework for digital transformation)
R#3	It is appropriate to present KPIs in the game so players can follow the progress of digitalization immediately	Need-to-have	Section 3.2.2 (Service Value Stream Management)
R#4	It is interesting to have a phase when players can build up the relevant process	Nice-to-have	Section 3.2.2 (Service Value Stream Management)
R#5	The game should include technologies that target the establishment of an operational excellence	Need-to-have	Section 3.2.3 (Digital transformation for large pre-digital era companies)

Identifier	Description	Type	Source
R#6	The selected business process should include partners	Need-to-have	Section 3.2.3 (Digital transformation for large pre-digital era companies)
R#7	The game should raise awareness of players on the digitalization opportunities at the company	Need-to-have	Section 3.3.1 (Games for raising awareness and learning)
R#8	Planners should participate in the game session	Need-to-have	Section 3.3.2 (Game with practical outcome)
R#9	The game session should result in a practical outcome (conceptional implementation plan)	Need-to-have	Section 3.3.2 (Game with practical outcome)
R#10	A cooperative game needs to be designed	Need-to-have	Section 3.3.3 (Cooperation or competition in serious games)
R#11	A low-tech game shall be designed	Need-to-have	Section 3.3.4 (High-tech or low-tech gaming for innovation)
R#12	The number of options available should continuously increase during the game session	Nice-to-have	Section 3.3.5 (Flow and game-based learning)
R#13	The game should be fun to play	Need-to-have	Section 3.3.5 (Flow and game-based learning)
R#14	The game shall be easy to use and understand	Nice-to-have	Section 3.3.5 (Flow and game-based learning)
R#15	The game must be targeted to the players and consider their educational background	Need-to-have	Section 3.3.5 (Flow and game-based learning)

Table 3.5: Design requirements from the theoretical analysis

3.4.1 Elaboration on the requirements

The chapter is concluded with a separate discussion of the requirements.

R#1 : The game should present the impact of digitalization

To make participants understand the pros and cons of digital transformation, they have to get familiar with its possible impact on the business process and the customer experience. According to Loffler et al. (2018), a game presenting the impacts of the decisions made by the participants regarding digitalization was sufficient for reaching the learning objectives.

R#2 : The game should introduce the opportunity of reinventing a business process with a digital mindset

Implementing a digital transformation can be challenging. It includes more than an implementation of a new technology; the culture and the process have to be aligned with the technology. The suitable technology has to be defined for the company, taking into account their need with the change while keeping the company's main values. However, the digital mindset of the employees is indispensable. Therefore, the game should introduce the possible ways of reinventing the business processes by using their freshly acquired digital mindset.

R#3 : It is appropriate to present KPIs in the game so players can follow the progress of digitalization immediately

Presenting the KPI's in the game is important for showing the effect of digitalization. KPIs correspond to certain measures required by the analysis. The SVSM can provide insights on which KPIs to include in the game.

R#4 : It is interesting to have a phase when players can build up the relevant process

In the SVSM, after the value stream is selected for the analysis, the current state of the process is mapped. Inspired by the SVSM, it is beneficial to consider that participants build up the process themselves. In this way, it can be tailored based on their work at the company. Moreover, when they map the current state of the process, they can question why it is executed in a certain way. However, if the participant is not familiar with the process, constructing it up can help in getting further insights from the process.

R#5 : The game should include technologies that target the establishment of an operational excellence

According to Sebastian et al. (2017), the prerequisite of a digital business is creating an operational backbone supporting operational excellence. Therefore, it is essential that participants get familiar with the technologies helping to reach this first major goal.

R#6 : The selected business process should include partners

Sebastian et al. (2017) states that in a digital solution strategy (which is assumed to be the way for the service-oriented Deployment department), considering the needs of business partners is a key element. Therefore, it is important to take partners explicitly into account from the first step of the transformation process (the game session). Based on this, the selected process will include the parts when CBUs and Supply Points are in connection with the Deployment team.

R#7 : The game should raise awareness of players on the digitalization opportunities at the company

Employees at Nutricia are not aware of the digitalization opportunities in their business processes. Designing a serious game can be facilitated to raise awareness on what could be the next step to take in improving the processes. The game can work as a decision support tool to identify how to digitalize in the company and what would be the benefits and risks of the implementation.

R#8 : Planners should participate in the game session

Bharosa et al. suggests that by a bottom-up approach taken. Considering the experience of the employees to build up a solution can contribute to motivation and commitment for the employees to the outcome created. Therefore, planners are valuable assets to the game session.

R#9 : The game session should result in a practical outcome (conceptional implementation plan)

Inspired by Bharosa et al.'s game session that aims to synthesize principles during the workshop, the focal game design would also result in a practical outcome. Employees playing the game can take part in determining a conceptional implementation plan for digitalization. It means the first steps towards an implementation plan, including a prioritized list of the digitalization

techniques and a corresponding initial plan of actions to implement them.

R#10 : A cooperative game needs to be designed

Motivation and commitment of the employees are essential in a digitalization process. The competitive game structure is recommended to achieve the highest motivation of the players. Being part of the team plays a positive impact on motivation. Playing with friends rather than strangers can further enhance the players' goal commitment in a cooperative setting. Additionally, collaboration skills can be enhanced during the session: collective problem solving, joint decision-making, and negotiation skills can be developed.

Furthermore, in a digital transformation process in the same department, the collaboration between the participants is essential to achieve the collective aim.

R#11 : A low-tech game shall be designed

According to Meijer (2015), low-tech games provide more qualitative data compared to high-tech games where quantitative data dominates. In this design project, the focus is on receiving qualitative data from the game session; thus, a low-tech approach must be taken.

R#12 : The number of options available should continuously increase during the game session

For facilitating the flow experience for the players, their engagement should be managed throughout the whole gameplay. At the beginning of the game, fewer options can be shared to ensure that players understand the objective and how to play the game. Later, when they acquired the necessary skills for the game, more options can be added to keep their attention on the game and avoid getting to a bored state.

R#13 : The game should be fun to play

First, fun is a necessity of the games in general, also if it is a serious game. Additionally, having fun while playing the game is beneficial for several reasons. If the players enjoy the game, they can connect digitalization to a positive experience. Thus, they will be motivated for the digital transformation. Furthermore, the fun can keep the players engaged during the session. If they can experience the flow, it can contribute to better learning outcomes.

R#14 : The game shall be easy to use and understand

To be able to provide participants a flow experience, the game has to be easily understandable and usable.

R#15 : The game must be targeted to the players and consider their educational background

When selecting the technologies to be included in the game, players' educational background should be taken into account to ensure that the technologies are understandable for the participants. Its importance can be derived from the flow discussion presented in Section 3.3.5. To facilitate the players' flow experience, the skills required to play the game must match the skill set of the participants.

Chapter 4

Problem analysis: practical approach

In the next sections, the practical aspects of the problem analysis are presented. It can provide the Environment of the business context for Hevner et al. (2004)' Design Science Framework applied in this thesis.

First, the stakeholder analysis is presented in section 4.1 that can help define the requirements for selecting the game players.

In section 4.2, the company and the deployment department is introduced in details. Next, in 4.3, the questionnaire to assess employees' awareness of digitalization provides valuable insights for game development.

After the Deployment team's reality is presented, in section 4.4, selecting the relevant business process for the model of the reality is discussed. It is followed by presenting the digitalization opportunities for the presented business process in section 4.5.

The chapter is concluded by deriving a list of requirements from the practical analysis in section 4.6.

4.1 Stakeholder analysis

Before considering the stakeholders, the extent of the digital transformation project must be considered. While implementing simple scripts hardly changing the business process, the employees of the focal department, the IT team, and the management team are involved in the process. Other parties of the supply chain, suppliers, and customers need to be included for bigger projects. The company's shareholders are also interested in digitalization because, with the innovation of the business processes, they can expect the growth of the company's shares in the long term. However, employees might prefer to be stuck with the processes they are used to and show resistance to the change. Another reason for staying with the old method can be that they lack the knowledge of the opportunities and how to digitalize their processes. Eller et al. (2020) have found that employee skills positively affect digitalization. Not just the skills are necessary for the digital transformation, but the shared enthusiasm is essential to rewrite the values, norms, and organizational behavior needed for the innovation process.

Although digital transformation can lead to a competitive advantage for the company through an improved, more effective business model that has a positive effect on the financial performance as well, the implementation of the transformation is quite challenging. First, the conflicting values of employees might damage the shared enthusiasm for the transformation.

Figure 4.1: Stakeholders of the digitalization process in a power – interest grid for Nutricia, based on Bryson (2004). At Nutricia, planners are considered as employees and team leads as managers.

Second, managers face difficulty to decide on the sufficient level and scope of business model digitalization. Moreover, the transformation demands considering the required investment and necessary management skills. (Eller et al., 2020)

The digitalization process stakeholders are shown in a power – interest grid in figure 4.1. As it can be seen in the diagram, the stakeholders can be dived to four categories: *players* with both high interest and power, *subjects* with low power but high interest, *context setters* have power, but low direct interest and the *crowd* with both little interest and power. (Bryson, 2004)

Managers and employees are defined as *players* since they have both power and interest in the outcome of the digitalization process. If they are motivated and aware of the opportunities and their needs in digitalization, they can be the enablers of the process. On the other hand, if they are resistant to digitalization or have no idea how to start with the process, there will not be a positive output regarding the automation process and can act as hindrances. The IT team can act like *context setters* since they are involved in the implementation of the digitalization process. Shareholders are *subjects* in the process by having a high interest in the company's financial performance and growth that can be positively affected by digitalization.

The stakeholder analysis has shown that the managers and employees can be the two enablers of the digitalization process. Therefore, planners and team leads need to be involved in the game sessions.

4.2 Case assessment at Nutricia

This section aims to understand the environment of Nutricia. First, the supply chain of Nutricia is analyzed, then the organization is presented. The research focus is on the Deployment department; thus, the responsibilities and way of working are discussed. Furthermore, to understand the digitalization options tailored for the case, the current information systems are introduced.

4.2.1 The supply chain

Nutricia manufactures highly specialized medical nutrition for children, patients, and elderly. The supply chain of Nutricia is shown in figure 4.2. The company has multiple factories (called Supply Point) specialized for different product portfolios and medical devices. Besides the large Supply Points, several third parties are producing Nutricia branded finished products. The product palette is distributed worldwide, with a large portion of the deliveries going through the Medical Distribution Center, the central warehouse located in Venlo. The warehouse is operated by DSV, the transport and logistics partner of Nutricia. Customers like hospitals, distributors, pharmacies, and patients in neighboring countries (The Netherlands, Belgium, Germany, France) are directly served from Venlo. In the rest of the world, the products are delivered through Nutricia's country business units (CBUs). In some cases, direct flows are bypassing Venlo; for example, Supply Point Wuxi directly serves the Chinese CBU. The Deployment team's purpose is to deploy the finished goods to CBU's warehouses at the right time, with the right quantity, respecting the agreed parameters such as remaining shelf life and transportation needs. Moreover, they shall provide the documentation for the procedure and proper complaint handling.

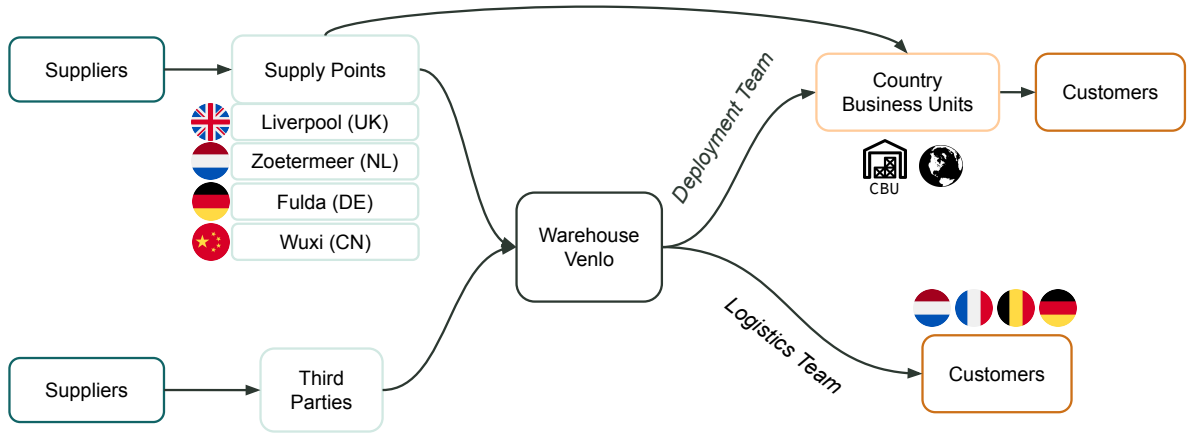


Figure 4.2: The Supply Chain of Nutricia

4.2.2 Organization

The Deployment team's place in the organization is shown in figure 4.3. The mission of the Nutricia Third Party Operations (3PO) is "Delivering sustainable end to end BEST CARE around the world." The Global Distribution and Logistic team is responsible for the deliveries to the customers in neighboring countries (The Netherlands, Belgium, Germany, France) and to the CBUs around the world (figure 4.2). Looking more into the structure of the Deployment department, there are three team leads: responsible for the documentation team (2 documentation coordinators and an intern for support), planning team mostly for Europe (3 deployment planners) and a planning team for mostly outside of Europe (4 deployment planners and an intern (the author's role [1])).

[1] this thesis is part of an internship project and the author is part of the deployment team as intern

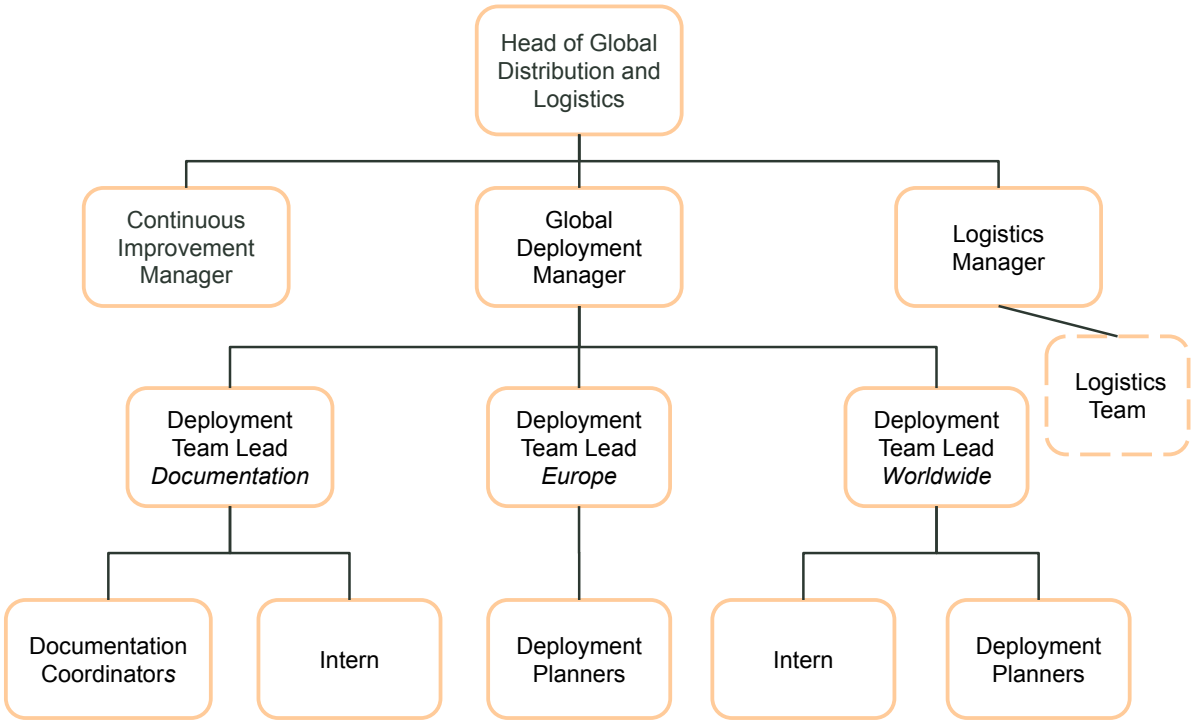


Figure 4.3: Organizational Chart of the Global Distribution and Logistics team

4.2.3 Deployment department

The Deployment team is involved in planning the deliveries of goods to countries served through the CBUs. The key responsibilities of the department are

- the distribution of the stock in Venlo to all CBUs in the most efficient way,
- informing CBUs about supply risks,
- creating export documentation,
- fair share allocation in case of shortage,
- handle logistic complaints,
- mediate between supply points and CBUs,
- executing phase-ins and phase-outs.

There are two supply models used by CBUs. First,

- **make to forecast (MTF)** CBUs estimate their own demand and put the forecast in the *SAP* system. Based on advanced optimization tools, the planning system provides advice to the planners on the product level, based on the current stock and required deliveries.
- **make to order (MTO)** CBUs send their orders to the responsible planners with the required delivery date. The orders should respect the lead time of the Supply Point, producing the selected product.

Each planner is assigned to multiple CBUs with similar operational models or the same region. In general, planners have the same duties, but the implementation slightly differs for each CBU. Besides CBUs, all planners are responsible for being in contact with a supply point, discussing the product risks on a weekly basis.

This project focuses on the Deployment team; thus the service provided by the division is in

focus, instead of the goods sold to end customers.

4.2.4 Information systems

The company uses multiple information systems,

- *SAP ERP* is used as the general unified ERP system with several functional and technical modules. Deployment mainly uses the *Sales & Distribution* module. Information from SAP ERP is interfaced with multiple other systems mentioned below.
  - *Sales & Distribution* module facilitates the creation of purchase orders, contract orders, sales orders, stock transfer orders, deliveries, and invoicing. It sends out advance shipping notice to sales units and keeps track of the transactions between the warehouse and sales units and supply points. Electronic data interchange (EDI) from deliveries are sent to the central warehouse operators (DSV).
- *SAP APO* (*Advanced Planner and Optimizer*) is a supply chain planning tool, linked to the *SAP ERP* system. The deployment team uses the Supply Network Planning module, while in the rest of the company, the other modules such as *Demand Planning*, *Production Planning and Details Scheduling* and *Global Available to Promise* are used.
  - *APO Supply Network Planning* applies constraints based on advanced optimization techniques to plan the product flow in the supply chain. The input data for the model comes from the demand plan. The availability of the products is considered when making a recommendation.
- Excipio is used for complaint handling
- Stratech is a software that helps in simplifying the process of requesting export documentation from the Dutch authorities
- ORsoft is a workflow tool used for requesting temporary listings and create or change customer data in SAP
- Excel tables: used as a shared resource, to follow order status and comment, shared with CBUs.

In some parts of the process, *SAP* is only used as a data source instead of an integrated data management and analysis solution. This situation makes the involved processes error-prone and requiring tedious manual data input and messaging.

4.3 Pre-game design questionnaire

A survey was the first interaction to involve planners in the transformation process. The questionnaire was developed to assess the interest in digitalization and measure the attitude of the employees. Additionally, the survey intended to understand which tasks can be digitalized according to users. The questionnaire was created based on work instruction documents and a discussion with the manager of the deployment team. It was created as a semi-structured, open questionnaire allowing them to fill out the questions for additional tasks and share their suggestions about digitalization of the tasks. It was completed by six planners and the head of the planner team.

The questionnaire and the raw results can be found in the appendix chapter A.2.

4.3.1 Development of the questionnaire

The survey was designed based on two aspects: the tasks to be digitalized and the measures to assess their current state and relates ideas. As a result, a matrix-like questionnaire can be created.

4.3.1.1 Tasks

The first step in the design of the questionnaire was the selection of the processes and tasks that could be digitalized. The responsibilities of the deployment team were discussed in section 4.2.3. The breakdown of actionable tasks can be seen below.

1. Distribution of the stock in Venlo to all CBUs in the most efficient way
   (a) Creating sales orders/contracts
   (b) Checking inventory level at warehouse
   (c) Planning shipments
   (d) Creating deliveries
2. Handle logistic complaints
   (a) Complaint handling
   (b) Creating credit notes
3. Informing CBUs about supply risks
   (a) Creating Supply Point risk file
4. Creating export documentation
5. Fair share allocation in case of shortage
6. Executing phase-ins and phase-outs
7. Mediating between Supply Points and CBUs

The last three responsibilities were excluded from the questionnaire because of the following reasons.

The fair share allocation can be done by the system when there is a shortage but not out of stock situation. In this case, a fair share rule is applied: all CBUs are replenished to an equal percentage of the minimum stock level. When out of stock situation takes place, a manual fair share is needed. Regarding the seriousness of the situation, deployment planners, team leads, and by the highest level, the top management handles the allocation. The necessity for manual fair share allocation is occasional, and the more serious the situation, the rarer to occur. Thus, there is no need to digitalize the process.

Executing phase-ins and phase-outs remains a manual operation because replacement products must be chosen carefully, and the process requires specialized knowledge of the product portfolio.

Mediating between Supply Points and CBUs is supported by weekly calls with both parties. From the process-oriented perspective, it might be considered as 'waste'. Still, from a customer-oriented perspective, it is a value-added activity; it can increase the trust between the parties. (section 3.2.2) Thus, it is worth keeping it, and naturally, this process cannot be digitalized.

4.3.1.2 Measures

The other dimension was identifying the measures that can help in the evaluation of the need for digitization in the case of the selected tasks.

To define the KPIs for the selection of tasks for digitalization, the Service Value Stream Management can be applied. (Bonaccorsi et al., 2011) In the SVSM, when choosing the Value

Stream, the more frequently performed tasks should be selected for investigation. Thus, the frequency and time spent on a task in a week are defined as the first KPI. SVSM emphasizes customer orientation and asks for identifying the number of defects of the service as its indicator. Therefore, the ease of making mistakes and the quality of service was defined as additional KPIs.

4.3.2 Results of the pre-game design questionnaire

Firstly, the planners were asked about the time they spend on a task on a weekly basis. Overall, a high deviation can be observed across the answers of different employees: 3 employees did not answer this question. Additionally, the answer of the manager was not counted in the results due to that is a different role. The rest of the responses shows a significant difference; therefore, only the magnitude of the average can be considered. This occurs because each planner has a slightly different focus and countries to plan.

		Time spent on the task	It's easy to make mistakes in the task	Digitalization can improve the task	Digitalization can improve the quality of service	I have an idea how to digitalize the task
Creating sales orders/contracts	μ	15	3.4	4.8	4.2	3.7
	σ	15	1.5	0.4	0.8	1.2
Creating deliveries	μ	270	3.2	3.6	3.2	2.3
	σ	159	1.0	1.1	0.8	0.8
Creating export documentation	μ	53	4.2	4.2	4.0	2.8
	σ	50	1.1	1.0	0.7	1.5
Checking inventory level at warehouse	μ	260	1.7	3.7	3.2	3.0
	σ	296	0.5	1.4	1.2	1.7
Planning shipments	μ	270	2.8	3.0	3.0	2.0
	σ	197	1.3	1.1	1.0	1.2
Complaint handling	μ	22	2.2	3.3	3.6	3.7
	σ	8	1.0	1.0	0.5	1.2
Creating credit notes	μ	22	2.8	3.7	3.3	3.0
	σ	8	0.4	1.0	1.0	1.0
Creating Supply Point risk file	μ	100	3.0	4.2	3.8	3.2
	σ	92	0.7	1.0	1.5	1.1

Table 4.1: Pre-game design survey results (μ: average, σ: standard deviation)

Secondly, the ease of making mistakes on each task was discussed. *Creating export documentation* was rated as high risk of making mistakes, and *checking inventory level at warehouse* and *Complaint handling* were agreed on as rather mistake-free tasks while regarding the rest of the tasks the planners stayed neutral.

Next, they were asked if digitalization could improve the task and the quality of service. Most of the tasks were rated positively regarding these questions. Only in case of task *Planning shipments* showed to be neutral.

Regarding the self-assessment of *I have an idea how to digitalize the task*, employees agreed with the statement in case of tasks *Creating sales orders/contracts* and *Complaint handling*. They disagreed by *Creating deliveries* and *Planning shipments*.

Finally, two open questions were asked about the ideas they have regarding digitalize the tasks and how digitalization could improve the quality of service.

Overall, it is visible from the questionnaire results in table 4.1, that planners find digitalization useful regarding most of the tasks but have little concrete ideas on how to implement such a digital transformation. This confirms the need for a serious game at Nutricia. Moreover, with the

questionnaire outcome, the requirements on the serious game for Nutricia have been defined. The aim is to raise awareness for employees on what are the digitalization opportunities at the company. Furthermore, the outcomes can also support the process selection (section 4.4) and data input for the game design process.

4.4 Determining the relevant business process

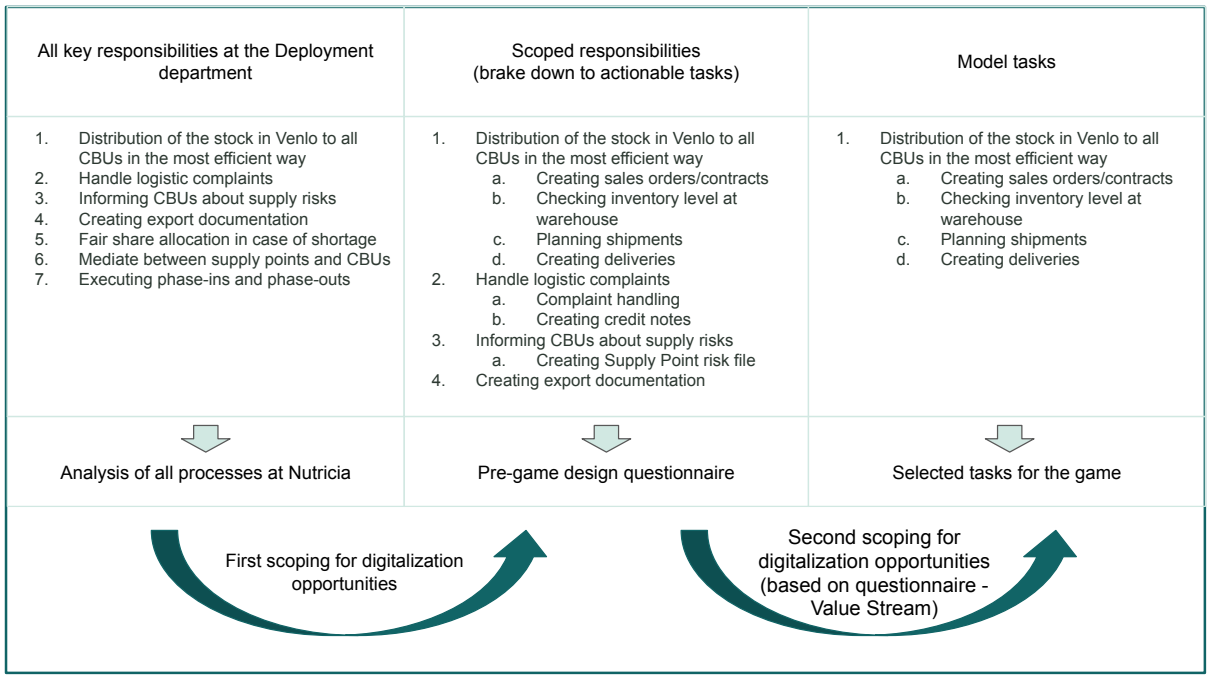


Figure 4.4: Guideline for the process selection for the game

The selection process, summarized in figure 4.4, consists of three phases. First, all key responsibilities of the Deployment department were collected in section 4.2.3. Then, in the first scoping for digitalization opportunities, the process elements that are irrelevant in terms of digitalization have been removed as presented in section 4.3. The filtered list formed the subject of the pre-game design questionnaire. The scoping's correctness was confirmed in the questionnaire since the participants did not propose additional tasks to include in the free input fields. Afterward, the second scoping for digitalization opportunities follows, with the goal of identifying the elements of the process with the highest improvement potential based on the questionnaire outcomes presented in section 4.3.2. To identify the highest improvement potentials, the SVSM method is applied.

The frequency is defined as the main selection criteria for the Value Stream: *Creating deliveries*, *Planning shipments*, *Checking inventory level at warehouse* are the tasks defined as frequent. Although *Creating sales orders/contracts* is found to be negligible in this analysis, it is one of the responsibilities of the intern [2]. The task is time demanding, so it will be added to the Value Stream.

The same applies to *Creating export documentation*; the task is supported by both the interns and the documentation team. Moreover, the task is judged to be an applicant for digitaliza-

[2] the author's position

tion of all three dimensions (easy to make mistakes, digitalization improves the task, improve the quality of service). However, the qualitative information confirms that the ongoing Stratech implementation would improve the task. Therefore, the *Creating export documentation* is excluded from the Value Stream. After the full implementation and testing of Stratech, it can be reconsidered if there is still room for improvement, but it cannot be evaluated properly in the current transitional state.

Complaint handling, *Creating credit notes* and *Creating Supply Point risk file* procedure have not reached a high frequency, the time demand for the task is not high from the intern role either; thus, they will be excluded from the further analysis.

Therefore, the main blocks are identified for the Value Stream:

- Creating sales orders/contracts
- Checking inventory level at warehouse
- Planning shipments
- Creating deliveries

Next, the detailed introduction of the MTO process will follow.

4.4.1 The MTO Business process

Based on the author's work experience, and interviews with a planner, the main tasks were separated into smaller sub-tasks in order to make them individually treatable in the game. The process was reviewed by the team lead and confirmed to be correct.

Next, the scope was narrowed down to the main blocks identified above. This means the whole MTO process from the CBU creates the Purchase Order until the planner creates the delivery gets into the model (figure 4.5). Arranging transport is out of the scope of this study because it was not mentioned as a time-consuming task by any of the participants in the questionnaire.

The first part of the process is related to the *Creating sales orders/contracts*. Initially, in the least automated form of the MTO process, the CBU creates the purchase order as an Excel file and sends the file to the planner via email. The planner or the intern has to check if the lead time is respected for the certain Supply Point before entering the order in SAP. Moreover, sometimes the orderable material is not listed in the system; thus, the item has to be added to the system by the responsible person. In such a case, the planner asks for support via email and wait until it has been processed. Only when the listing is added can the order be saved in the ERP system. For handling the data, two Excel files, the MTO rolling and MTO CBU files, are used. The data is added manually to the files, either when creating a new order (MTO CBU) or on a weekly basis (MTO Rolling). The Supply Point confirms the order in the MTO rolling file. There are separate MTO CBU files for each CBUs, and these Excel files are used for keeping track of the orders, making comments on the orders, and planning the shipments. In the planning phase, planners first *check the inventory level at warehouse* for each product and share the batch information with the CBU. Also, they have to find the Certificate of Analysis (COA) documents of the products on SAP Business Object or in the company shared drive and share them with the CBU. After the confirmation of the CBU, planners *plan shipments* via Excel, and *create deliveries* in SAP based on the planning outcome.

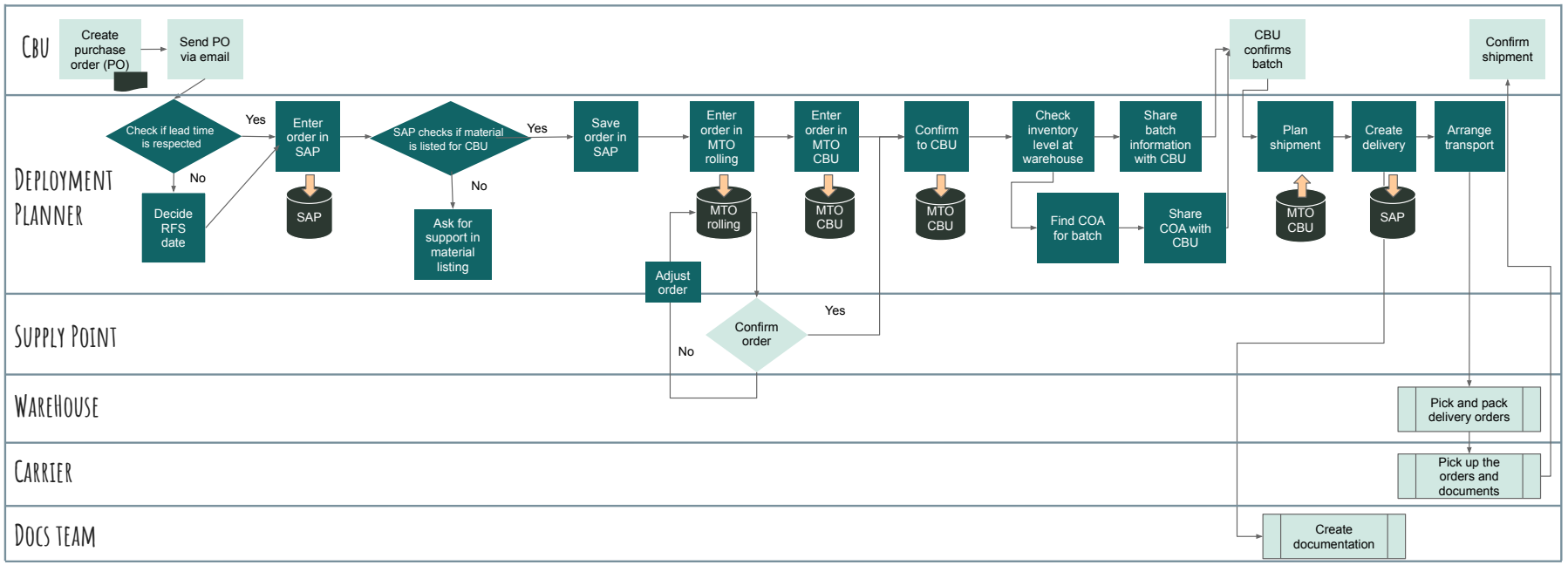


Figure 4.5: Swim lane process flow of the make-to-order business process at Nutricia

4.5 Digitalization opportunities in the business process

Finding the improvement areas in the process is supported by Bonaccorsi et al. (2011)'s study of the wastes in the service industry presented in table 3.4.

First, defects can occur due to data entry errors and lost segments of files in the case of entering orders manually in SAP and the spreadsheet files. Besides that, manual data entry tasks are time-consuming, managing the incidental errors is expensive and time demanding as well.

Second, duplication is a significant waste in the MTO process at Nutricia since several processes parts include data re-entering. Double input happens when entering the order to the ERP system and both the MTO rolling and MTO CBU spreadsheet files. Moreover, the planning outcome from the MTO CBU file has to be entered into the ERP system afterward. While double input is time-consuming, it is also a source of an increased risk of mistakes, resulting in inconsistencies across multiple data sources. To keep data synchronized in the unconnected databases, every change has to be manually entered in each system.

The third waste applicable to the business process is waiting and delay. If a product is not assigned to a specific CBU, no orders can be placed in SAP. In such a situation, multiple email messages need to be exchanged, resulting in delayed order placement and increasing the risk of late delivery. Additionally, the MTO rolling file is updated on a weekly basis, so the supply point can only confirm the order when it appears in the file. This may cause later notification about possible issues. In case of urgency, the file has to be manually updated outside the weekly period.

Exchanging emails is further delayed by the different time zones of employees across the globe. In extreme cases, resolving problems can take multiple days. Such problems might affect the planning process in exceptional cases: The CBU has to approve the batch, and if the approval arrives late, the stocks can already be taken by others.

Next, the digital transformation technologies introduced in 3.2.4 will be revisited to decide which methods are applicable to the MTO business process at Nutricia. The summary of the possible application of the digitalization techniques for the process is presented in figures A.2 - A.5 in the appendix.

Since the business process involves multiple data entry and copy tasks, robotic process automation is a promising candidate to get started with the digital transformation. Via RPA, the possibility of mistakes due to manual double data inputs can be decreased. By using the automation tools in SAP, RPA can be applied as automated order input in SAP from the Excel file containing the order lines shared by the CBU. Although redundant data storage can be reduced in further stages of digitalization, initially, RPA can be used to copy data into the Excel spreadsheets used to communicate with other departments: RPA can be used to import the orders to the MTO Rolling and MTO CBU Excel files.

An alternative solution for eliminating the manual data input is using web forms. Processing emails is difficult with an RPA-based solution; therefore, a web-based form with data validation can be employed to make automation easier. Web forms can also improve customer experience by immediately provide feedback to the user, which can save a considerable amount of time on both sides, compared to the email based solution.

The CBU can fill out a web form with the new order instead of sending the Excel file in email to the planner. This way, the orders arrive in a structured manner, making automated input from

the web form to SAP feasible. Beforehand, in order to prevent getting incorrect data into the system, additional measures should be taken. Data validation can be applied to warn CBU if the minimum lead time is violated. Furthermore, the material code is validated when filling out the web form. If the product is not listed for the given country, the listing can be requested via automated email in the web form. First, since the problem is already faced by CBU when placing the order, the assignment of the product can be initiated earlier. Second, the Deployment team does not have to be involved in the process anymore. Besides the automated data validation, planners can confirm orders and adjust the delivery details.

Nutricia currently employs multiple ERP systems (SAP, Excipio) supplemented by spreadsheets (Excel, OneDrive). Additionally, connections to business partners (administering shipments, requesting stock information) are manual procedures via e-mail, shared spreadsheets, or an online interface provided by the partner. Thus, there is much room in the integration of information systems and automating connections to business partners. Nutricia uses an on-premise SAP ERP system, which can be replaced with a cloud-based system to provide APIs and user interfaces to business partners, which can later replace some of the e-mail and shared document (spreadsheet)-based procedures.

For the MTO business process, the previously mentioned web form can be integrated as a cloud-based ERP system module. This more advanced solution makes it possible to input the data directly into a single database of orders. The Supply Point's information system can automatically confirm the orders via API. In exceptional cases, when human intervention is needed, a notification is sent to the responsible department.

A planning module can be created in the integrated system for the deployment planners. The planning interface would include data from multiple information sources obtained by connecting to APIs. The inventory level of the given materials derived from the warehouse's database can be displayed, among with the documents for the Supply Point's corresponding Certificate of Analysis (COA).

The cloud-ERP integrated web interface would provide batch information for the CBU, share the COA documents for the given batches and facilitate for the CBU to confirm the bath in the same interface. In this way, both planners and CBUs can have the information as soon as possible, decreasing the risk of delayed product deliveries.

With a single planning interface, planners can have all the required information on the same screen to execute the planning task. Since the planning is conducted in the cloud-based ERP system, delivery creation is automatic as part of the planning process.

Additionally, artificial intelligence and optimization software can be used in the planning process to replace the currently manual product to container allocation procedure.

Alternatively, as a temporary cost-effective solution, spreadsheets can be replaced with databases providing increased access management, parallel work opportunities. Report generation with RPA is also more reliable using databases having fixed columns, solving the current RPA issues caused by slightly different spreadsheets. A shared database can be used for confirmation of the orders by the Supply Point.

Finally, some technologies were not applicable to this business process.

Single sign-on was already implemented in the company, and it is used to log in to the computers, ERP systems, and document storage services.

During the manufacturing and deployment process, the planners work with other departments and subsidiaries of the company, so there is a mutual trust between the parties. Therefore,

blockchain-based technologies were not included in the game. Additionally, it is a technology difficult to understand during the time frame of the game session.

4.6 Conclusion of the practical analysis

The case assessment at Nutricia supports the understanding the supply chain, organization and the key responsibilities of the Deployment department at Nutricia.

Furthermore, a survey helped in understanding the critical parts of the business process and the attitude of the employees as well. It was concluded that the surveyed employees support the idea of more digitalization in their business process. However, the questionnaire concluded the lack of ideas on how to continue with the digital transformation of the process. To support the digitalization effort, the development of a serious game can contribute to raising awareness of the opportunities.

The following part summarizes the requirements for the game derived from the practical analysis. It aims to complete the answer to research question RQ#1. The 6 requirements are summarized in table 4.2.

Identifier	Description	Type	Source
R#1	Team leads and planners should participate in the game session	Need-to-have	Section 4.1 (Stakeholder analysis)
R#2	The game should add to the knowledge level of the players about digitalization	Need-to-have	Section 4.3 (Pre-game design questionnaire)
R#3	The selected process part in figure 4.5 should be represented in the game	Need-to-have	Section 4.3 (Pre-game design questionnaire)
R#4	The selected digital transformation technologies introduced in 4.5 should be represented in the game	Need-to-have	Section 4.5 (Digitalization opportunities in the business process)
R#5	The game should be played online	Need-to-have	Covid-19
R#6	It can be useful if the game is adaptable to different business contexts	Nice-to-have	Possibility to generalize the work

Table 4.2: Design requirements from the practical analysis

4.6.1 Elaboration on the requirements

Next, an elaboration on the defined requirements will follow.

R#1 : Team leads and planners should participate in the game session

The shareholder analysis has shown that team leads and planners have the highest interest and power regarding the digitalization process's outcome. The need for including the planners into the game has been discussed in requirement R#8 as well. Therefore, the two requirements can be united. Moreover, interns from the department can also be added as players to the game. First, they are familiar with most of the processes discussed in the game. They have the first-hand experience with manual data inputs and report generation. Furthermore, playing the game and asking for their opinion regarding the digitalization process can make them feel a valuable member of the company.

R#2 : The game should add to the knowledge level of the players about digitalization

The questionnaire to assess the actual awareness of employees on digitalization showed that planners find that digitalization can improve their business process (table 4.1). However, they do not know how digitalization techniques would be implemented. To make the employees familiar with the technologies, it is required that the game adds to the participants' knowledge level about digitization.

R#3 : The selected process part in figure 4.5 should be represented in the game

Section Section 4.4 (Determining the relevant business process) discusses the reasons for selecting the model of the process to be represented in the game.

R#4 : The selected digital transformation technologies introduced in Section 4.5 should be represented in the game

The argumentation for selecting the suitable digitalization technologies for the game is discussed in details in Section 4.5 (Digitalization opportunities in the business process).

R#5 : The game should be played online

The home-office situation due to the Covid-19 pandemic requires that the game is played online.

R#6 : It can be useful if the game is adaptable to different business contexts

The main research question aims to initiate the business transformation in the deployment department at Nutricia. However, it would be beneficial if the game could be adapted to be used in other business contexts as well, in other departments of Nutricia, or even in other firms.

Overall, six requirements have been identified based on the analysis of the company. After reviewing the introduced requirements, no direct contradictions were observed compared with the requirements derived from the literature. For example, a game playable online can still be low-tech when it is designed like a board game rather than a simulation with an advanced mathematical model. However, requirement R#8 and R#1 were merged and completed to 'Team leads, planners and interns should participate in the game session'. Finally, the requirements were approved by the company. In the next part of the report, the list of requirements will direct the designer on a clear path during the game design procedure.

Chapter 5

Game design

This chapter answers research question RQ#2, so the construction of the game considering the defined requirements in chapter 3 and 4. DigiGame was developed based on the methods described in 2.3.3.

The game design was inspired by the Triadic Game Design methodology that suggests using certain factors for analyzing the case that the game is going to be based on in order to build the model of the reality. In this project, the digitalization technologies are considered as the first group of factors. The possible digital transformation technologies for supply chain-related business processes were discussed in section 3.2.4.

In section 4.4 the selection of the most suitable business process for the model in terms of showing players the digitalization possibilities was introduced. These process parts are considered as the second group of factors. In section 4.5 the relationship of the factors is presented, identifying the digitalization opportunities for the selected MTO business process.

Based on Hevner et al. (2004)'s Design Science Framework, chapter 4 provides the requirements on the serious game regarding the business needs at Nutricia. The environment defines the problem space, in this case, the lack of digitalization in the Deployment department at Nutricia.

Given the business need, the knowledge base supports the design process by providing requirements. The design decisions are supported by the theories, concepts, and frameworks introduced in chapter 3.

In line with the Triadic Game Design's meaning discussion, the purpose of the game shall be emphasized. The purpose of the game is to show the opportunities of digitalization to the participants and help them definie their needs. Changing the business processes can be challenging; thus, a game can be a good way to take the first steps and experiment with it. An additional purpose is to make the players aware of their needs with digitalization and make them think about their processes from a new perspective.

In the following sections, the creation of the game concept is shown corresponding to the play world.

5.1 Iterative game design process

In the following section, the iterative prototyping phase is described. The aim is to define the suitable means to the identified requirements. The design process is supported by Burgos (2006)'s framework for product design and Roozenburg and Eekels (1995)'s Basic Design Cycle. The theoretical background was discussed in section 2.3.3.1.

As mentioned in section 3.1, the simulation games of Loffler et al. (2018) proved to be an efficient teaching method for students in digital transformation. Therefore, some concepts from the two games were considered during the implementation of DigiGame. The main concepts from Loffler et al. (2018)'s games are summarized in Table 3.2. Furthermore, Rosenthal and Strecker (2018)'s BPMN game for corporate training can also give insights into the game design. The summary of the game is presented in Table 3.3.

5.1.1 First prototype

Initially, DigiGame was planned as a two-session digital board game, with the first session built up around a model business process, while the second session considered the business process of the actual company. This way, the game can be generalized to multiple companies and departments. The game board was designed to represent the process built up by the players from elements and information systems, similarly to Loffler et al. (2018). Once the process is built up, players can start digitalizing it.

In the first session, the players would have to build up a business process from pre-defined elements to get familiar with the tool. The sample case was planned to be a well-known business process. Then, in the next session, participants could build up their own process from scratch by creating elements, information systems, and connecting them according to reality, based on pre-defined element templates. This solution is inspired by Rosenthal and Strecker (2018)'s process model template based game.

The model case of the first session attempted to serve as a clear metaphor for the business process and help get familiar with the game and the digitalization opportunities. However,

- any model process different from their own case would have needed more abstraction to apply it to their case,
- the time constraints of the gaming session would not have been met,
- sketching the business process would have been challenging for the players, as with free element creation, no straightforward help is possible, and there were many inexperienced players.

The goal was to develop a computer game that can be played remotely via discussion only through video conference. Therefore, pre-defined elements were required during the game session that considers the department of players in order to make it possible to validate the feasibility of the applied digitalizations.

The discussed issues led to rethinking the game a creating a second prototype.

5.1.2 Second prototype

In the second prototype, the idea of building up and digitalizing a process was kept, but only one session was planned. To make sure that the metaphor was clear, Nutricia's business process was chosen for the game board. Initially a simplified model of the business process was considered, constructed of five major building blocks:

- Creating contracts,
- Data input in Excel
- Checking inventory level at warehouse,
- Planning shipments,
- Creating deliveries,

and the corresponding information systems:

- SAP,
- MTO rolling file (Excel) and
- MTO CBU file (Excel).

The presented major building blocks involve many internal steps in practice. Since the digitalization techniques are applicable for the atomic building blocks, instead of considering the whole process, it was decided to work with the first major block in detail (figure 4.5 from creating contract until save order in SAP). When the concept was working, the business process was completed with the rest of the building blocks. The selection criteria of the process were discussed in section 4.4. Still, in the first phase of the game, the players get familiar with the business process by building up the process from the given blocks themselves. The involvement of players in establishing the game board helps them understand the whole process end-to-end comprehensively, which is crucial to be motivated in the digitalization part. This concept corresponds to mapping the current state in Service Value Stream Management described in section 3.2.2.

In the second phase of DigiGame, the participants have the opportunity to take a critical look at the business process using heat maps. In section 4.3, three KPIs were presented based on SVSM: time efficiency of tasks, the ease of making mistakes, and quality of service from a customer perspective. The elements of the current process were assigned initial values based on the pre-game design questionnaire's outcomes. To simplify the game and focus on the employees aspects, two heat maps were introduced in DigiGame to represent the time efficiency and how erroneous the process is.

In this version of the game, players randomly draw digitalization technique cards and resource cards, such as time and money. Players need to consider which digitalization techniques are suitable for the task elements. A technology can fit more tasks, as well. Moreover, there are dependencies between digitalization techniques; these are visible on the cards.

There is a collaborative aspect of the game. Each player receives a different set of digitalization techniques. To a given part of the process, more digitalization techniques are suitable, possessed by other players. Therefore, they can negotiate which technique to implement for the given task. They also have a shortage of resources; thus, more players need to approve the implementation and provide the time and money for the digitalization.

During the test round with the prototype, it was realized that players find it difficult to determine which parts of the process should be selected for a digitalization. Additionally, in this version of the game, many digitalizations could be selected to start with. It prevented implementing the simpler solutions afterward if the first implementation was a more advanced technique. The goal of the game, to introduce many technologies, could not be met in one session. Playing multiple sessions was not feasible due to time constraints. Therefore it was decided to separate the technologies into three rounds based on complexity. This way, all technology would be introduced during one game session round by round.

5.1.3 Third prototype

In the third prototype, the digital transformation technologies are split into three main groups. Instead of drawing the digitalization cards, all options are visible from the given round. Players can move to the next round after completing all digitalization in the current round. As players proceed to higher rounds, the complexity of digitalization techniques is increasing. In the first round, the current business process can be accelerated by automating user input to the current software infrastructure. Next, in the second round, more advanced digital transformation technologies bring the existing parts of the business process to a higher level and slightly improve the customer experience as well. Finally, in the third round, the whole business process is re-engineered with a digital mindset. With the rounds increasing, not just the complexity but the options available enhances to keep the players challenged throughout the whole game session. The decision was made based on Csíkszentmihályi (1975)'s flow theory related to the game-based learning discussed in section 3.3.5 .

To include the risks in the game, inspired by Loffler et al. (2018), wrong decisions can also be harmful. If a digitalization technique is not applicable to the selected task, the implementation cost and time are lost. The penalty for the wrong decision is only applied from the second round, again, to manage the player's engagement, thus helping get experienced with the game.

Some other adjustments have been made, and more playful elements were added to this prototype. In this version, the money and time cards were replaced with numeric values on the dashboard. Each player receives five time unit resources on each turn, representing a week of work time. The money resources are considered global, so both players can spend and collect money for the team, representing that in the case of the company, the budget is considered for the whole department in one. The daily tasks are symbolized by small squares appearing at the bottom of the elements on the game board. A task square appears with a pre-defined probability based on the pre-game design questionnaire outcome (table 4.1). This probability decreases after applying a digitalization to the element. For each completed task, the team receives money, either if it is done manually or automatically after digitalization.

After taking an initial look at the efficiency of the business process, players can either choose to complete a task or implement a digitalization. Players need to find an optimal balance between long term investments and completing the daily routine, similarly to Loffler et al. (2018)'s first game. Implementing a digitalization also costs money and time. When the task element has been digitalized, afterward in the next turns, new small squares can be appearing with a pre-defined probability that can be collected without using the time of the player. This represents that the task is done automatically. The goal of the game is to implement all digitalizations for the applicable tasks and maximize the collected money.

The trial game tests of this prototype showed that the game seemed too challenging to find suitable digitalization techniques to the task elements of the process. Moreover, fun elements and more collaboration were missing. To address this issue, a collaborative feature was added. This feature made the game more interactive, fun and supports the further understanding of the digitalization techniques.

5.1.4 Fourth prototype

To increase the collaboration and make sure that both players actively participate and understand all digitalization technologies, an additional feature was added. When a player selects an element to digitalize, a visual hint appears on the screen. Simultaneously, the other player receives a list of the available digitalization options from the actual round. The first player needs to provide a description based on a hint that helps the other player select the correct card. Creating illustration for introducing digitalization techniques was inspired by the success of presenting illustrative videos in Rosenthal and Strecker (2018)'s game. Participants rated the illustrations positively regarding the learning outcomes in the game.

The prototype was tested with two pairs of graduate students. In the test plays, even though the students were not familiar with the business process, they were able to match the digitalization techniques with the process parts. After the play session, players remarked that they learned about Nutricia's business process and found the game interesting. Moreover, they all claimed that they have learned about the digitalization possibilities. However, in both play sessions, the prescribed time limit was significantly exceeded.

Therefore, it can be concluded that the game met its purpose, and it is enjoyable to play it based on the two trial sessions. However, additional modifications are needed to fit the game session to the prescribed time limit. Therefore, simplifications were made in the game: single digitalization can only be applied once, and once it is applied, it affects all matching parts of the business process.

Moreover, an additional, shorter version of the game was introduced. In the shorter form, the first part of the game of building up the process was replaced by using the model process. Finally, the shorter version of the game was evaluated with the Nutricia employees.

This prototype became the final version of the game. The game is presented in details in section 5.3.

5.2 Operationalizing requirements

The following section is inspired by Dym and Little (2008)'s recommendations on design projects; the methodology was presented in 2.3.3.2. In the previous section, the iterative game design suggested means to meet the design requirements.

Table 5.1 presents the morphological chart for designing DigiGame. Due to space constraints, the means have been listed under each other for the requirements. The means selected for the final version are denoted with **bold** font, while the rest was dropped during the earlier prototypes in favor of other means.

The requirements were initially collected in the order they appeared in the problem analysis. In the following table, they have been regrouped semantically. Table 5.1 shows how the design requirements were operationalized to the game design answering RQ#2.

#	Description	Means
1.1 R#1	The game should present the impact of digitalization	• **Show characteristics of the process with heat map.** • **Show how these characteristics change after players perform an action. (Loffler et al., 2018)** • **Show that wrong decisions can cause damage (Loffler et al., 2018)** • **Show the trade-off between focusing on operating tasks and improvement.**
1.2 R#3	It is appropriate to present KPIs in the game so players can follow the progress of digitalization immediately	• **Use time efficiency level as base data for a heat map.** • **Use possibility of mistakes level as base data for a heat map.** • Use service level as base data for a heat map.
1.3 R#2	The game should add to the knowledge level of the players about digitalization	• **Digitalization cards and the corresponding hints present knowledge about the techniques.** • **Participants can analyze and improve of the business process (Loffler et al., 2018)** • **Dependencies make players aware of the order of implementation.**
1.4 R#7	The game should raise awareness of players on the digitalization opportunities at the company	• Create a two-session game with first presenting a model business process to be digitalized followed by a session focusing of the own business process of the participants • **Create a one-session game with Nutricia's business process with pre-defined elements to be build and digitalize** • The game presents alternative solutions for improving the parts of the process and players need to negotiate about the one to apply. • **The first player selects a part of the process to improve and the second player has to select the applicable technology. The first player can support the decision with the help of an illustrative hint provided by the game.**
2.1 R#9	The game session should result in a practical outcome (conceptional implementation plan)	• **Discussion with all players on the implementation of the improvement ideas (Rosenthal and Strecker, 2018)** • The game generates an implementation plan based on the digital transformation technologies applied during the game session. • **Players develop a conceptional implementation plan after the play session.**
3.1 R#10	A cooperative game needs to be designed	• **Create a game that can be played with minimum 2 players.** • Add game feature that encourages cooperation: negotiation between players. • **Add game feature that encourages cooperation: providing a hint for a player, while the other player has to guess the card to use based on that hint.**

#	Description	Means
3.2 R#11	A low-tech game shall be designed	• In the second session, players can freely apply technologies to the process built up on their own, without advice and feedback from the game. (first, two-session prototype) • **The game does not rely on an advanced simulation model.** • **The meaning of game elements like money, spent time, and quantity of completable jobs are symbolic.** • **The illustration of the hints is rather schematic than completely realistic.**
3.3 R#12	The number of options available should continuously increase during the game session	• **The digitalization techniques are split into three main groups based on complexity. Digitalization techniques can be implemented round by round with the complexity increasing after each round.** • **The number of options are increasing round by round.** • **Penalties are only introduced after the first round.**
3.4 R#13	The game should be fun to play	• Players can draw digitalization and resource cards to be used for digital transformation of the process. A digitalization card can be suitable for several tasks. • **Shortage of resources** • **A player needs to guess a card based on the other player's description of a technology based on the provided hint image or animation.** • **Scoring system: representation of the digitalization level, money collection**
3.5 R#14	The game shall be easy to use and understand	• **Create a tutorial helping players to understand the game without prior knowledge.** • Create a step-by-step tutorial round. • **Create illustration for introducing digitalization technologies to players as hints. (Rosenthal and Strecker, 2018)**
4.1 R#8 R#1	Team leads, planners and interns should participate in the game session	• **Invite planners to the game session.** • **Invite team leads to the game session.** • **Invite intern to the game session.** • **Create 2-player teams.**
4.2 R#15	The game must be targeted to the players and consider their educational background	• **Select technologies that are understandable for the players.** • **Create hints that are targeted for the players.**
5.1 R#3	The selected process part in figure 4.5 must be represented in the game	• Provide templates for building blocks to make the process representable. • **The game board and the elements are developed based on the selected process.**
5.2 R#4	It is interesting to have a phase when players can build up the relevant process	• **The business process can be split up to multiple steps / tasks. (Loffler et al., 2018)** • The business process is built up from fillable templates of elements. (Rosenthal and Strecker, 2018) • **Build up the process from pre-defined elements.**

#	Description	Means
5.3 R#2	The game should introduce the opportunity of reinventing a business process with a digital mindset	• **Make players able to improve the process step by step. (Loffler et al., 2018)** • Players need to consider which digitalization techniques are suitable for the task elements.
5.4 R#6	The selected business process should include partners	• **Add elements to represent the process end-to-end including the business partners.**
6.1 R#5	The game should include technologies that target the establishment of an operational excellence	• **The selection of the digitalization technologies considers all applicable solutions.**
6.2 R#4	The selected digital transformation technologies introduced in Section 4.5 should be represented in the game	• **Create digitalization cards for the selected technologies.**
7.1 R#6	It can be useful if the game is adaptable to different business contexts	• The game contains general building blocks with hints that can be customized for the actual process. • **The game master can pre-define building blocks and the applicable digital transformation techniques.**
8.1 R#5	The game should be played online	• Create a board game as a shared presentation / whiteboard. • **Create the game as a web application.** • **Create a game playable without installation.** (Loffler et al., 2018)

Table 5.1: Morphological chart for DigiGame

5.3 DigiGame - the final game design

This section presents the final game design, called DigiGame. First, the game description is provided. Afterward, the technology used to create the game is presented.

5.3.1 Game description

DigiGame is an online playable 2-player game. The longer version of the game starts by building up the business process step-by-step from the given building blocks. Players can ask for support by checking the neighbors of all blocks; therefore, people who may not familiar with the process can participate in the game. After the business process is built up, participants can check the reference solution and decide to proceed either with their solution or with the provided process.

The shorter version, which was played in the company, starts with the already built-up process presented in figure 5.1. Players can analyze the process regarding time efficiency and erroneousness by hovering the performance indicator icons shown in figure 5.2. The digitalization meter on the left side of the screen shows the current efficiency level of the whole business process.

There are two resources in the game: time and money. The money is a collective resource shared by the team. The time is individually provided for players; both players receive five time

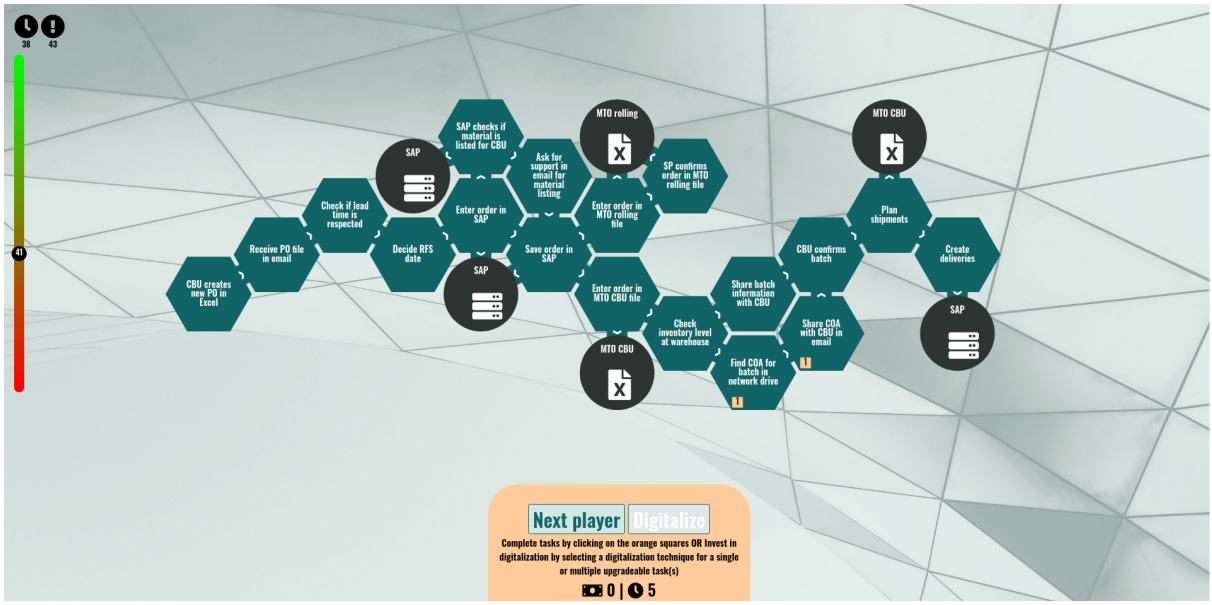


Figure 5.1: Game board of DigiGame

(a) Heat map before

(b) Heat map after

Figure 5.2: The changing of the heat map based on the effects of digitalization

units in each turn.

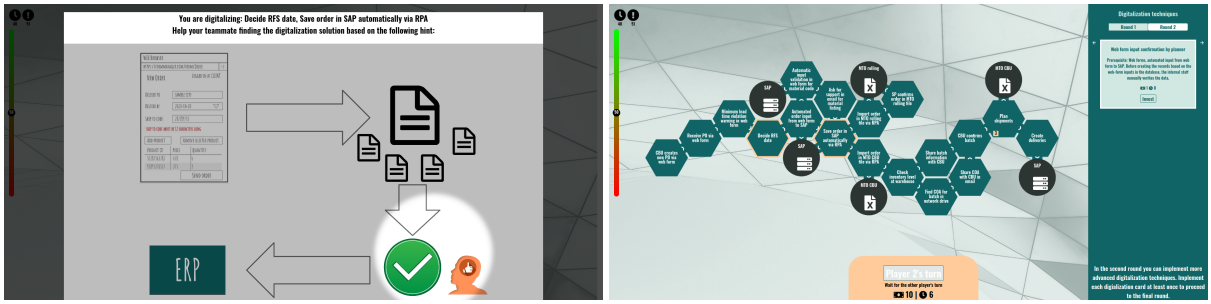
Daily jobs appear on the process parts in each turn based on probabilities. The jobs can be completed in exchange for the player's time.

There is the option of digitalization; if the resources allow it, at least one unit of time and money is needed to digitalize. After digitalizing a process part, the probability of appearing new jobs to be completed manually (signed by cubes) decreases, and the probability of new automatically completed jobs (signed by cubes) increases.

Money can be collected by completing the given jobs. Money is received for each job either it was completed manually or automatically as the result of digitalization.

The game builds on the trade-off of digitalizing or completing the jobs manually. If the players decide to digitalize, they first need to decide which process part to be improved. When player A selected a task to be digitalized, player A sees a hint describing the applicable digitalization technique. Simultaneously, player B sees a list of the available digitalizations. After a discussion with player A, B can select a digitalization technique to be implemented. The digitalization process is visualized in figure 5.3.

In the appendix, table A.1 summarizes the digital transformation solutions applicable to the



(a) Player A: explain the hint (b) Player B: select the digitalization technique

Figure 5.3: Digitalization technique selection for the selected process part

parts of the process, with their name, description, and descriptive image.

The technologies were classified into three rounds. Players can move on to the next round when all solutions were implemented from the active round. This way, participants can focus on a smaller group of technologies that are initially less complex. In the warm-up round, there are only two options, so it is easy to match a technology with the help; they get familiar with the game itself, so in later rounds, more focus can be put on content. There are also dependencies between some technologies represented in the game.

With the help of the heatmap, players can monitor the effect of digitalization regarding the time efficiency and erroneousness of the process (figure 5.2).

The team wins the game if all digital transformation technologies have been implemented, and the whole business process is digitalized.

In the appendix, table A.2 presents the most important screens of the game from the viewpoint of the players.

Figures A.2 - A.5 show which digitalization techniques can be applied to the building blocks of the process. As in the game, the technologies are organized into groups. In the first round, players can implement the RPA-based technologies presented in figure A.2. The second round, focusing on web-based forms and separate databases is introduced on figures A.3 and A.4. The final round, considering the ERP-integrated system is presented in figure A.5.

5.3.2 Technology

According to requirement R#4, the game should be played online. For a low-tech game, where there are no advanced performance and graphics-related requirements, a web application is appropriate. It can be directly played from the browser without any installation required. Modern web applications are developed in HTML5 and JavaScript with multiple frameworks (Vue.js, Konva canvas) on top of it to assist the development. The players are connected via a server that forwards the game state from one player to the other. The facilitator can also follow the gameplay; however, in this spectator view, it is not possible to perform any action.

The background image of the game and the cover image of the report was adapted from Olichon (2020).

Chapter 6

Evaluation

The chapter aims to answer the evaluation-related research questions: RQ#3 - RQ#4 . Recalling the relevant Research Questions:

RQ#3 What are the impacts of playing the game on the employees involved in the digitalization process?

RQ#4 What is the conceptual implementation plan constructed by the participants of the game session?

While the RQ#3 concerns the individual perspective, checking if the players' perception has been changed by playing the game, RQ#4 question tackles a more practical outcome regarding the value of the decision-making aspect of the game session.

The following parts of this chapter concern the data collection and qualitative analysis of the debriefing sessions, which is the focus of the evaluation.

Supplementary, the questionnaires were evaluated using quantitative methods. The summarized data is presented in section A.7, and is briefly concluded in 7.1.1.

6.1 Setting

The game was played by ten participants from the investigated department. Players have been assigned to a pair and played pairwise. The game session consisted of introducing the game tutorial, gameplay, and the debriefing session presented in figure 3.1.

For evaluating the sessions, data was collected through pre-and post-game questionnaires and debriefing sessions. The latter took place after each gameplay, supplemented by a collaborative final debriefing session after all groups played the game. All sessions took place online, using video conferencing solutions. The questions for the debriefing sessions can be found in the appendix A.2.2-A.2.3 and the questionnaire in A.6.7.

After each game session, an approximately 20-30 minute debriefing session was conducted with the pair of players, involving the same set of questions for each group.

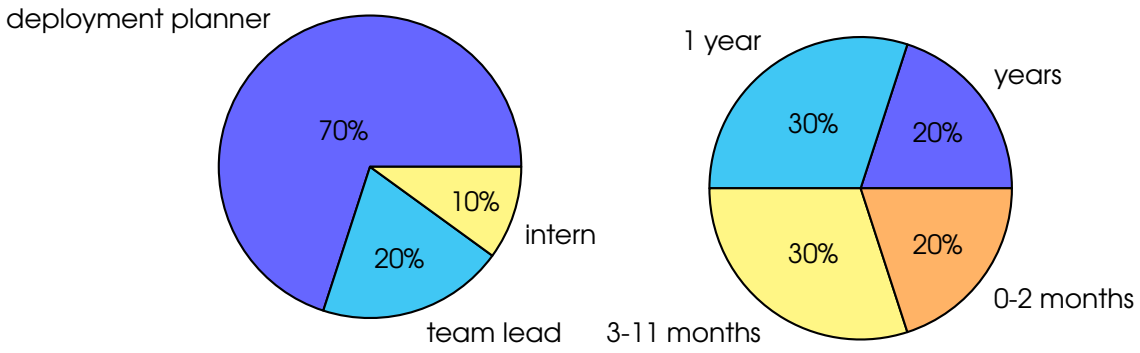
The 30-minute collaborative debriefing session took place with eight of the ten participants after all game sessions took place.

Figure 6.1a presents statistics about the roles of the players at the company: most of them

were deployment planners; however, team leads and interns also participated.

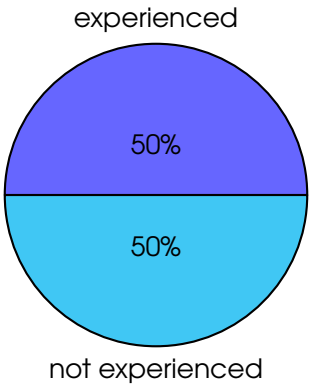
The experience in their actual role (figure 6.1b) varies from a few months to multiple years.

Based on figure 6.1c, it can be concluded that only half of the participants had in-depth knowledge about the MTO process beforehand.



(a) Roles of participants

(b) Experience in actual role



(c) Experience in MTO process

Figure 6.1: Statistics about the participants

6.2 Qualitative data analysis

The sessions were transcribed and coded in the `Atlas.ti` software with the methods described in 2.3.4.5. In the software, codes could be assigned to the segments of the text manually.

In this research, the grounded theory was used; the codes were defined based on the data. 138 codes were defined in the first phase, which meets the directive of Friese (2019) to create between 120 and 300 codes.

The codes were categorized into six code families in the first cycle. In the software, it was done by defining the categories and assigning the codes to the corresponding code family.

In the second phase of coding, nine code families were defined:

- Awareness ,
- Emotional game effects ,
- Game elements
- Game engagement ,
- Realism
- Digitalization techniques ,
- Decision-making input

- Way of implementation ,
- Properties of implementation .

The 9 identified categories were visualized in 4 networks. The results are presented in figures 6.2 - 6.5. The colors presented in the figures correspond to the code families, as highlighted above. The code families in white boxes are connected to the nodes with red dotted lines. While creating the network in `Atlas.ti`, the software facilitated to make the connections between the nodes with the following relation types: *assures*, *contradicts*, *is a*, *is associated with*, *is cause of*, *is part of* and *is property of*.

The created networks can help in the game evaluation and answer the research questions. In figure 6.2-6.5, CF denotes code family; these are connected with dotted lines to the various codes belonging to the code family. The numbers mentioned in the brackets indicate the frequency of the phrase that appeared in the text. Afterward, the player codes (A1 , A2 , B1 , ...) represent the respondent stating the phrase.

6.3 Answering the evaluation-related research questions

The following sections present the quantitative analysis to find answers to the research questions.

6.3.1 Impact of the game on the players

Figure 6.2 represents the network view for assessing the effect of the game on the players addressing RQ#3 . Moving clockwise, beginning at the top left node, the network is discussed below.

As mentioned before, the game builds on the fact that employees at Nutricia can see the benefits of digitalization, but do not know how to proceed with it. Some people confirmed this main assumption. Participant E2 said:

> "*I always knew that there were digitalization opportunities on the job, but one thing I got to learn from the game when I was playing, how it actually works.*"

It is visualized on the left side of figure 6.2, so the staring point in the network is code had no idea how to digitalize . The code is connected to curiosity, as participant C1 showed curiosity towards finding out the opportunities in the game.

Going to the right on the map from code had no idea how to digitalize, it is associated with learned about digitalization possibilities . During the debriefing session, most of the participants mentioned that they liked the proposed digitalization solutions and/or learned about the possibilities. Only two participants are missing from this set, and they had the least experience with the business process and digitalization. However, some people defined the game experience as

> "*eye-opener.*"

Others emphasized the identification of the dependencies in digitalization as part of the learning process. Player C2 reflects on the dependencies as irritating, since to digitalize certain tasks, first other parts of the process should be digitalized.

> "*you pointed out that I cannot just go and digitalize whatever I want, but first, there is a certain sequence in it. That you cannot go ahead and digitalize lets see how to find the COA before digitalizing other parts. That is irritating me, to be honest.*"

The participant explains the real-life connection to this irritation:

> *"But in the sense that sometimes for real we need a certain part to be process improved and really a lot of other things hanging on it that you have to pick up. Sometimes it's not okay that for one single simple thing, what I think you just have to improve a lot of other parts. But maybe it's just for the game now, but I don't think so because I see it in other cases as well, like for Stratech and Maco that there are small steps that need to be solved first and that can take a lot of time just to get to the point that we wanted to digitalize or improve."*

Some participants go further than examining the digitalization techniques for the given business process and thinking about taking the experiences from the game to other processes. This is coded as new digitalization opportunities visible in the top right side of the network. Being able to define new opportunities with the game assures a perception change for players according to C1.

Participant C1 explains:

> *"After playing the game, I saw a lot of opportunities, and I think it gives a bit more foot for thoughts and some support to also think about other digitalization opportunities, not only in the MTO process but in general."*

> *"So for sure, it has changed my perception for future opportunities on other processes as well."*

Caused by the curiosity towards the new digitalization opportunities and that participants liked the proposed digitalization solutions, the participants working with the MTO process seemed to be motivated in the digital transformation. B1 states:

> *"I got motivated for digitalization and want to know more about how these digitalization techniques would work in practice."*

While most of the players were positive about the digitalization possibilities, some of them were skeptical when it comes to the implementation. The right bottom corner of the map visualizes the following discussion. The first concern with implementation mentioned by all three participants was the setup cost. A1 asserts:

> *"For some solutions, they would obviously work, but they would be hella expensive to implement."*

On the other hand, C2 has other views on the cost:

> *"we could check the costs because it can be that the cost of creating a webform is sort of balancing out the manual work that you still have to do uploading the Excel into SAP."*

The second explicit concern was that digitalization should start at the corporate and not the department level. Participant E1 states:

> *"I think also probably it depends on the whole Nutricia and Danone outlook on digitalization. I think if it comes from one of the business goals to increase the digitalization level, then I think it is a lot easier to implement or roll out certain projects. I'm a little bit skeptical, starting the digitalization at the department level. But if that would help so set a motion for digitalization in Danone and Nutricia in general, then I think it is a good initiative."*

In contrast, Participant C2 reckons:

> *"So you do not have to look straight into gigantic big things, and this is also not a global Danone thing, it's our own process so we can just automate."*

The third concern is the risk of the data safety aspect and the vulnerability of the digitalization. Player C1 explains the scary part of digitalization:

> *"What is the biggest risk at the moment, for example, [Facilitator], you created some RPA, which is absolutely great, but if something crashes, of course, you have created work instruction, and it helped me, but if something worse happens, there is no support, so you're very vulnerable. It is also with the macros in Excel that [the continuous improvement manager] created, so people already left the company, it is very vulnerable if something crashes, you cannot repair it, but there is also no alternative way of working because nobody knows how to do it in a different way. That is, for me, the scary part of digitalization. Maybe that's my old mindset, being from a different generation."*

There was another learning aspect of the game presented on the bottom left side of the figure. Some people mentioned that their knowledge about the MTO process itself expanded. While participants who are inexperienced with the process learned about the MTO process, other people more experienced with it became aware of the complexity of the process. The complexity of the MTO process has triggered different emotions in the players: surprised and irritating .

E1 says:

> *"It really surprised me how many steps we are making from input actually to plan something. Because when you break it into steps – we can see that the steps involved are so inefficient."*

C2 claims:

> *"Basically, that's why this game was good because I did not even realize that this whole MTO process has so many different aspects. So that was very useful for me because mostly, the MTO process is just the irritating entering orders in the system and then taking batches and then deliver. But yeah, there are a lot of things, really."*

Overall, it can be concluded that the game successfully raised awareness on the digitalization opportunities at Nutricia. Almost all of the participants declared that they were impressed with the game. Most participants learned about the digitalization possibilities at the company. It can be noted that more experienced people with the process were more active in the debriefing sessions and had more insight regarding the further possibilities and new opportunities. Team leads started to elaborate on applying the digital technologies in other processes as well at the company. This shows that they acquired a digital mindset during the game session.

However, for the participants with little experience with the MTO process, the game had a smaller or no effect on acquiring knowledge about the digitalization technologies. For most of the inexperienced people with the process, presenting the possibilities with an unfamiliar process was too abstract; they could not make the connections to their own processes. On the other hand, people inexperienced with the MTO process emphasized that they learned about the process itself.

The individual learning aspect of the players was different for each player depending on their experience with the process, knowledge about digitalization technologies, and type of people, meaning their attitude to games.

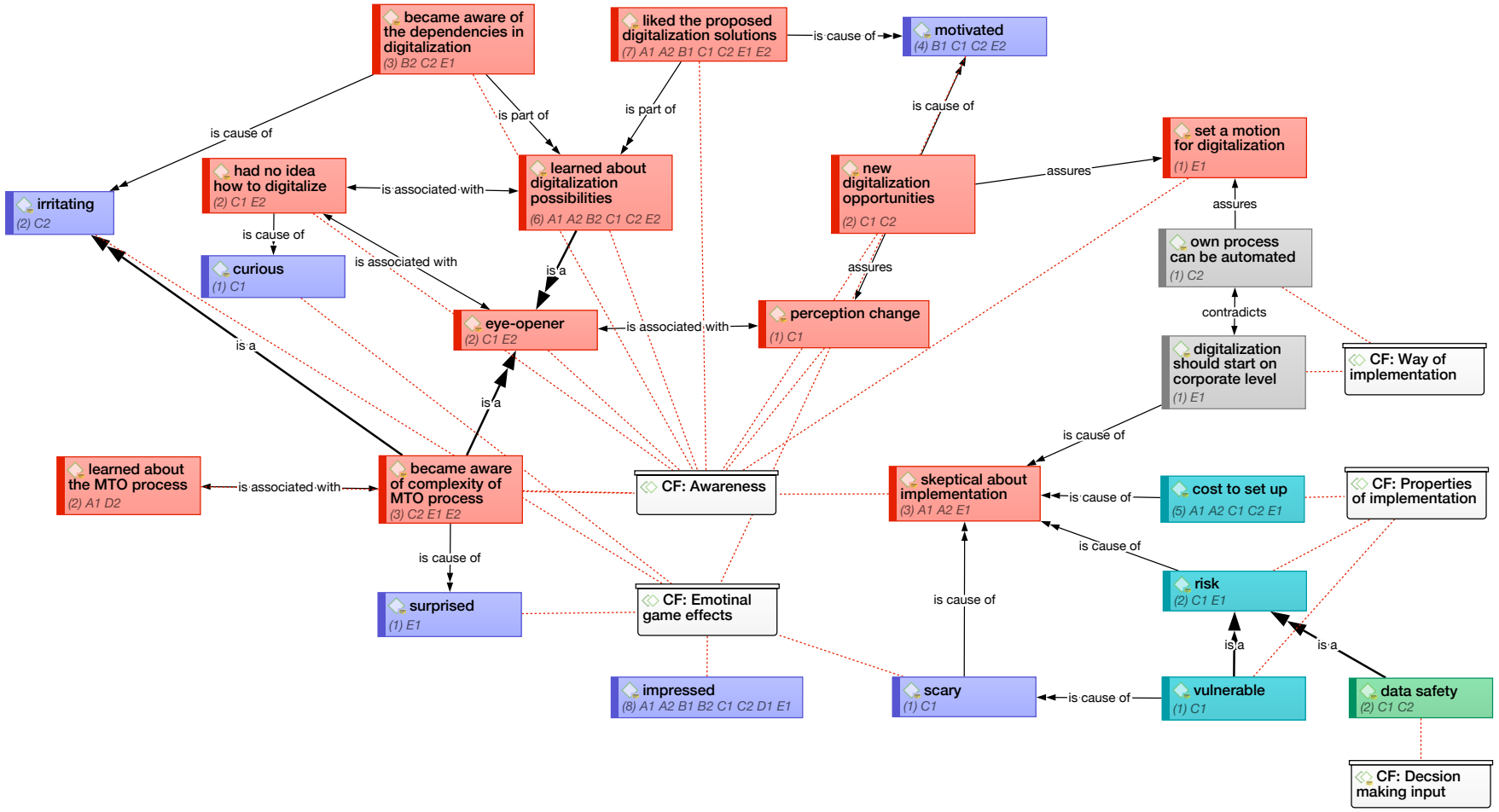


Figure 6.2: Impact of the game on the players. Nodes are colored based on the code family they are assigned to (also with red dotted lines).

6.3.2 Game-related evaluation

Figure 6.3 represents the network view of the game-related evaluation.

The purple blocks explain how the players assessed what happened in the game. As it is visible, players succeeded in grasping the essence of the game altogether. The main trade-off was to find the balance between digitalizing and completing tasks manually. Most groups mentioned the money collection and the digitalization aspect of the game. Interestingly, different teams used different strategies to decide the order of digitalizing the process. Most groups (A, B, D) observed the process using the heat maps and started to digitalize the least efficient task. However, group C looked at the task squares: if they saw that the jobs increased fast, they would digitalize those tasks first. Thirdly, team E considered the dependencies:

> *"we tried to digitalize the tasks in a logical order – that first we digitalize the input, then the processing, and then the output."*

After a task is selected for digitalization, players had to find a suitable technique. This is supported by the teammate's explanation and the options given.

E2 explains the need for the hints and explanation by the teammate:

> *"I was thinking it was for understanding – see if you understand how you can digitalize the task, if you can express what you see, then you can understand it more."*

Participants appreciated that there were options given.

C2 says:

> *"Yeah, indeed. That you do not have to come up with, but you can choose, or you already have a solution."*

E2 tells:

> *"I think, when we were playing the game, in the second part, I believe you came up with options for how do you digitalize certain processes, and I think that was an eye-opener I think for me."*

However, some participants commented that the descriptions and hits were a bit too technical. Therefore, the players did not understand the digitalization techniques fully. Another reason that players did not understand the game completely was that they worked with a different process. The new process and new digitalization techniques were too much to handle.

The blue nodes are connected to the game engagement code family presented on the bottom of figure 6.3.

Almost all players claimed that they were confused initially, but it became clear after the start. Only one participant did not reach the level of understanding.

Player B2 suggested that an introduction to digitalization before playing the game would be beneficial. Participant C2 advised preparing a tutorial round to do the steps instead of explaining it with slides.

After getting into the game, players seemed to enjoy it. They said it was interesting, fun, and wanted to win.

There was some distraction during some sessions because it was played during working hours. One player got distracted in the debriefing session via email. In the other case, the player did not have a good internet connection; thus, it was only possible to observe the game and give instructions on what to do in the game. However, it was not playful enough, and the player

was not concentrating on the game fully, which can also be a cause of not understanding the game.

A play session got distracted, and they could not finish the game because of the time limit. However, they liked the game and wanted to play it again, so at another time, the play session could be held without any distraction.

An important aspect of a serious game is realism. Therefore it is essential to evaluate if the metaphor was clear for the players and if they can connect the experiences from the game to reality. The discussion is presented on the left side of the figure with light green color. All players referred to real-life experience when discussing the game. Some of them mentioned the tasks, so the business process, some the digitalization techniques, other people shared stories.

D1 refers to previous work experience:

> "*Creating order can also be, I think, scripted. There was a script when I was working at previous companies to create orders in SAP.*"

E2 discusses the similarity of the business process to the game model:

> "*When I see the tasks, I can relate to what I do in real life.*"

C1 explains a story related to fear with digitalization:

> "*It is also with the macros in Excel that* [*the continuous improvement manager*]*, for example, created. Hence, people already left the company; it is very vulnerable if something crashes, you cannot repair it. However, there is also no alternative way of working because nobody knows how to do it in a different way.*"

An interesting insight was that task automation was already developed, but they do not use it in the company. A2 says:

> "[*the continuous improvement manager*] *already developed it – but it has never been used yet.*"

People not in the MTO process referred to the fact that they work with a different process. However, all participants working with the MTO process on a daily basis found the business process well represented in the game. E1:

> "*The way the whole game was constructed is pretty impressive because I think in many ways, it captures the whole process, and even more* (*some CBUs MTO processes are not the same, all of it are captured*)*, it's really interesting.*"

Several participants were asking about future aspects. Some also mentioned that they would like to see the proposed solution become a reality. B1:

> "*It would be nice if the techniques from the game would become a reality – is it possible?*'"

Summarizing the game related evaluation, it can be seen that the players could grasp the message of the game, and they were able to connect the experiences in the game to reality. The game engagement discussion shows what were the most engaging elements in the game, according to the participants. Moreover, players provide valuable feedback on the week points of the game, and they suggest further improvement ideas for the artifact. Finally, mentioning an interesting insight, Peng and Hsieh (2012)'s observation about reinforced goal commitment for teams set up of colleagues knowing each other, was confirmed to be applicable for a serious game as well.

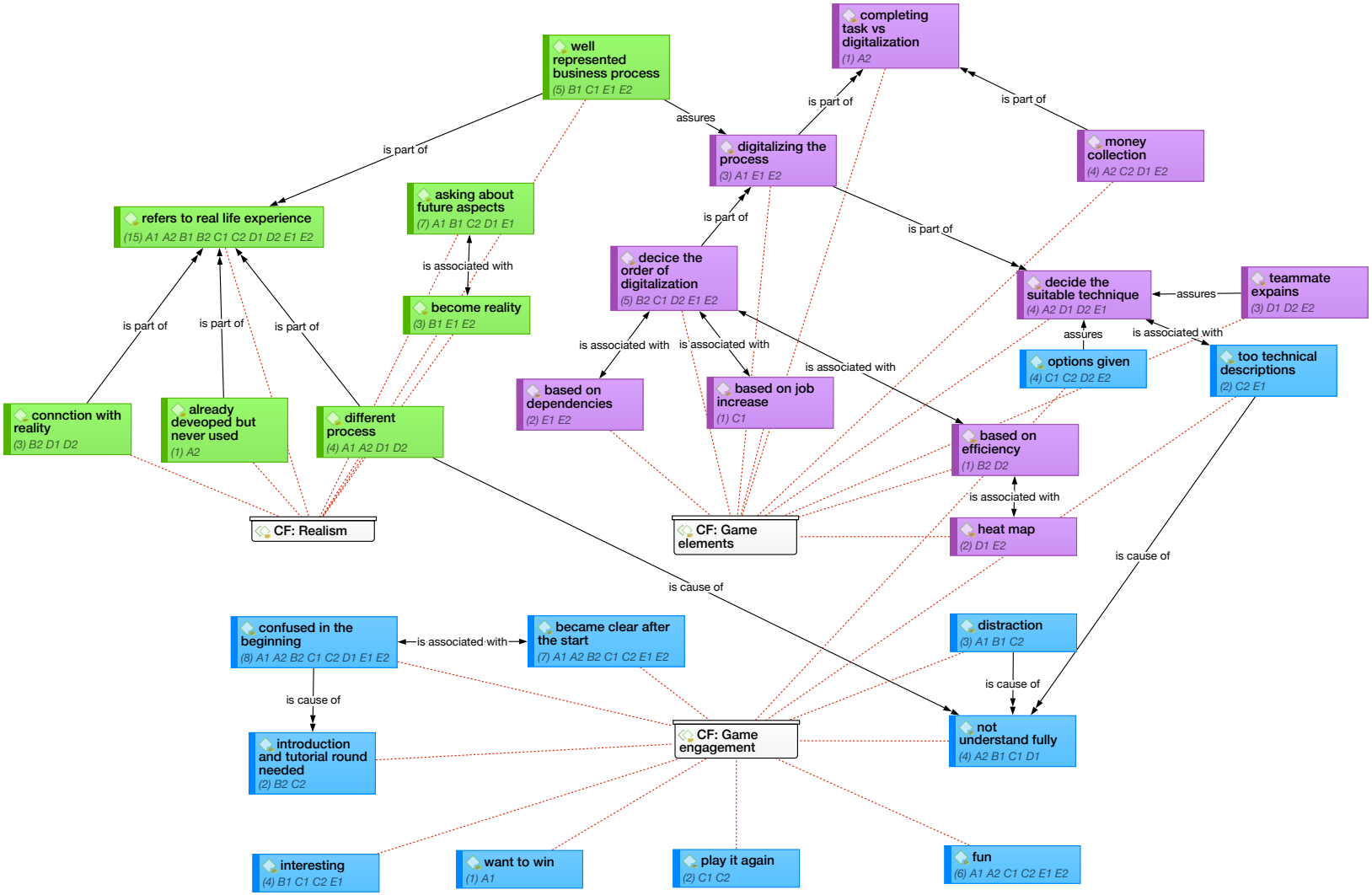


Figure 6.3: Game related evaluation

6.3.3 Conceptual implementation plan

Figure 6.4 represents the network view of the resulting prioritized digitalization list and its discussion in the collaborative debriefing session.

In the debriefing sessions after the game plays, the pairs discussed their priorities about the digitalization. Almost all players indicated that they would like to implement some digitalization techniques introduced in the game and provided a prioritized list. Only one participant had no comment on prioritization because the player has never worked with the indicated process.

Each list provided by the participants was collected from the transcripts. The proposed digitalization plan is colored orange . Based on the responses, two scenarios were defined.

The proposal was summarized considering their priorities: the solutions that individual groups considered more important were assigned to higher values. The values were summarized across all groups for each technology, and the one with the highest sum value was considered as the highest priority technique for a given task.

The second scenario was handled separately since it represents an integrated system.

A summary of the two scenarios was presented in the collective debriefing session. The participants were discussing the benefits and drawbacks of these two outlines. Scenario 1 was defined as a short term solution, which is feasible and can be already implemented. It was associated with some risks, as it is vulnerable if there is no support for the implementation. Secondly, data safety is identified as a risk, which can be managed with a sanity check and thinking through the way of implementation. Some critical issues with the process were highlighted by the participants, such as the order entry, MTO CBU, and rolling file are associated with double input. Moreover, in the case of the MTO rolling file and Supply Point confirmation, there is a waiting time. Participant E2 explains:

> *"Now we are waiting until the order gets to the file. I think we are losing a lot of time from the input to the actual decision and confirmation. That could be minimized."*

Scenario 2 was described as a more sustainable version that can benefit everyone and is associated with a lot of pluses; for example, the risks can be highlighted earlier in the process. In this case, the support for the service is essential.

The two scenarios were discussed regarding setup time and cost. Scenario 1 is easier to implement and more favorable regarding both time and moneywise. Both scenarios can ensure the improvement of the process on some level. Although, as participants identified that scenario 2 offers higher gains regarding process improvement, it is advisable to start with basic digitalization to determine how it works for them. Then, it is possible to proceed to more advanced digitalization later.

C2 :

> *"we can already start maybe with the Excel and start to automatize smaller, and in the meanwhile, find out what the costs would be of the web form or to see if it is possible."*

As the analysis showed, players were able to define a prioritized digitalization list during the first debriefing session. After, two scenarios were presented to all participants in the collaborative debriefing session based on their priorities indicated before. It was discussed during the session, and participants agreed on starting with the first scenario than proceeding with the second, more integrated approach. Defining the prioritized list and discussing the two approaches' benefits and drawbacks was the first step towards the conceptual implementation plan.

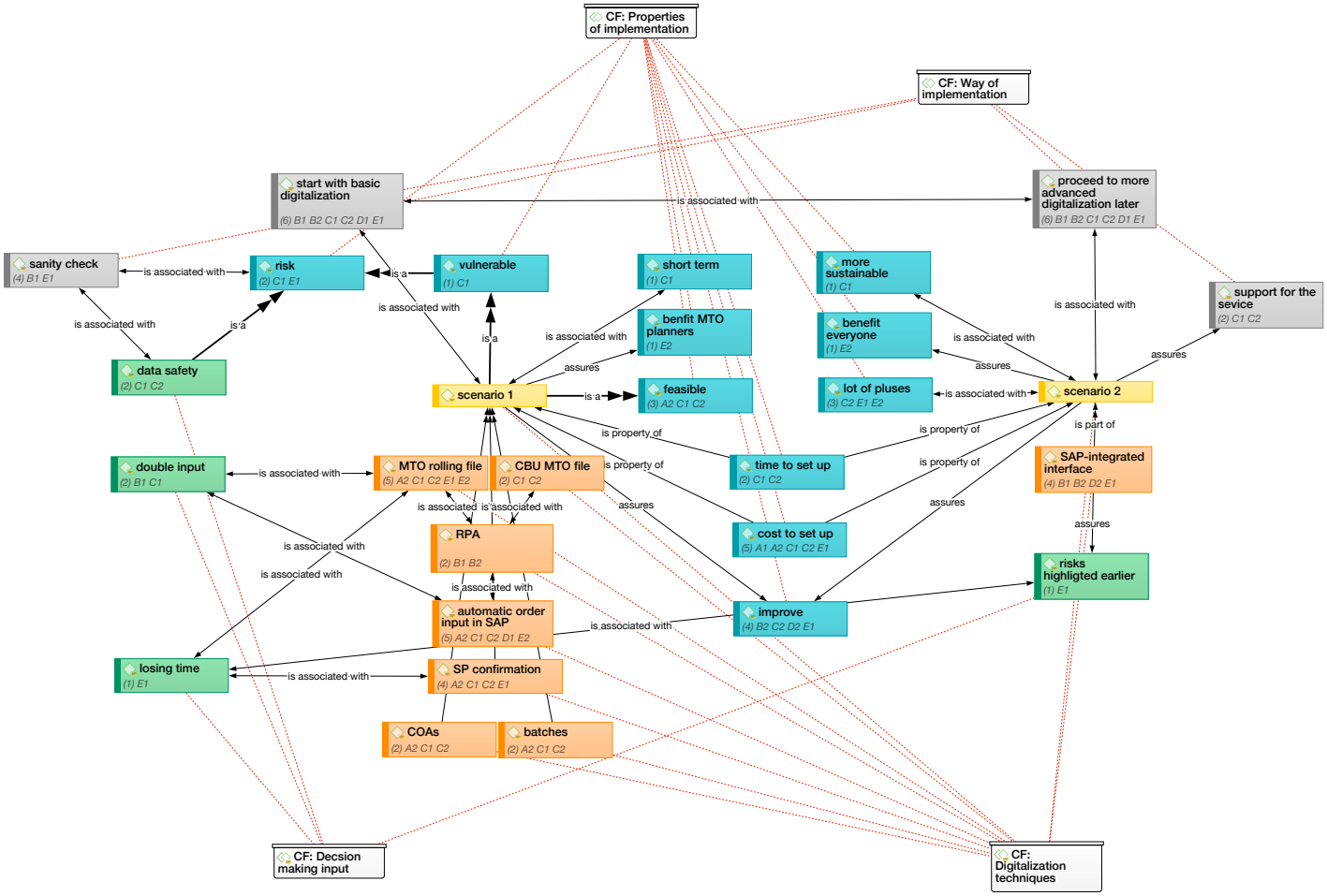


Figure 6.4: Resulting prioritized list of digitalization

6.3.4 Game session as a support tool for digitalization

Figure 6.5 represents the network view of the further discussion of the conceptual implementation plan. It shows that the game session can be used as a decision-supporting tool for digital transformation.

During the discussions, participants shared their ideas about their preferences on defining which tasks should be digitalized visualized in the left side of the figure with dark green color. These are the tasks that are high in mistakes and time-consuming. Double-input is a cause of both these attributes. The repetitiveness and complexity of the tasks should also be considered. Participant C1 notes:

> "*I think about, okay, what tasks I'm doing as a repetition every day or every week, which are not very complex but time-consuming, and you could also put that on the road map to digitalize.*"

Data safety and defining constraints are also essential criteria to reflect on.

The objectives with digitalization are to minimize mistakes, save time, highlight the risks earlier, and eliminate the non-value adding parts from the process. Therefore, resulting in a more efficient business process.

As mentioned before, in the debriefing session, participants succeeded in setting up a prioritized digitalization list. Furthermore, they started to discuss the way of implementation: a project approach should be taken. The conceptual implementation plan is further developed in the following section presented on the figure's right side with gray color.

Participant E2 suggested:

> "*I think this digitalization can become like a project-based thing. Because right now, I don't think that every person will just start doing it. So it should be made into a project, and the interested planners should apply to be part of the project, and that's how I think it should be taken from here.*"

Moreover, all digitalization opportunities should be taken into account.

Participant C2 explains:

> "*I think it gives at least some idea, maybe also on other processes, not only to MTO. Basically, if we are here at digitalization, everything should be as much as possible solved. I think that's the main point: that we have to really look at everything like nothing is nonsense, and then it can turn out that okay, some points cannot be digitalized and still has to be manual, but everything could be collected as an option.*"

After the relevant processes are selected, the project could be put on the agenda. The automated order input is considered feasible by the team leads, and participant C2 suggested putting it on the road map.

The analysis of the digitalization options for the selected parts of the process is the next step.

C2 :

> "*We already identified some steps also with the* [*Facilitator*] *that can be a start, and then in the background, we could start to check the possibilities of web forms.*"

Before the implementation, a sanity check is to be done.

As mentioned before, basic digitalization is identified as a start, and the more advanced and integrated digitalization projects can be implemented later. However, it is possible to already look into the integrated approach options while implementing the less complex digitalization.

The question of how to get support for the digitalization service also arose during the discussion. One suggestion was to outsource the implementation or execute it in-house, with a specific role.

Concluding the discussion, it can be observed that participants were able to create a conceptual implementation plan during the collaborative debriefing session. Therefore, the game was suitable in this environment to function as a decision-supporting tool for digitalization. Players could decide on what decision criteria are important to consider in selecting the improvable tasks. Their knowledge improved about the digitalization techniques and how to connect them to their business process and business needs. Finally, participants discussed possible ways of implementation during the session. They identified digitalization steps: they would already start with implementing basic digitalization defined in scenario 1 (figure 6.4). At the same time, they could look into opportunities on how to implement an integrated approach. Moreover, players agreed that all business processes should be considered with a digital mindset to find all digitalization opportunities in the department.

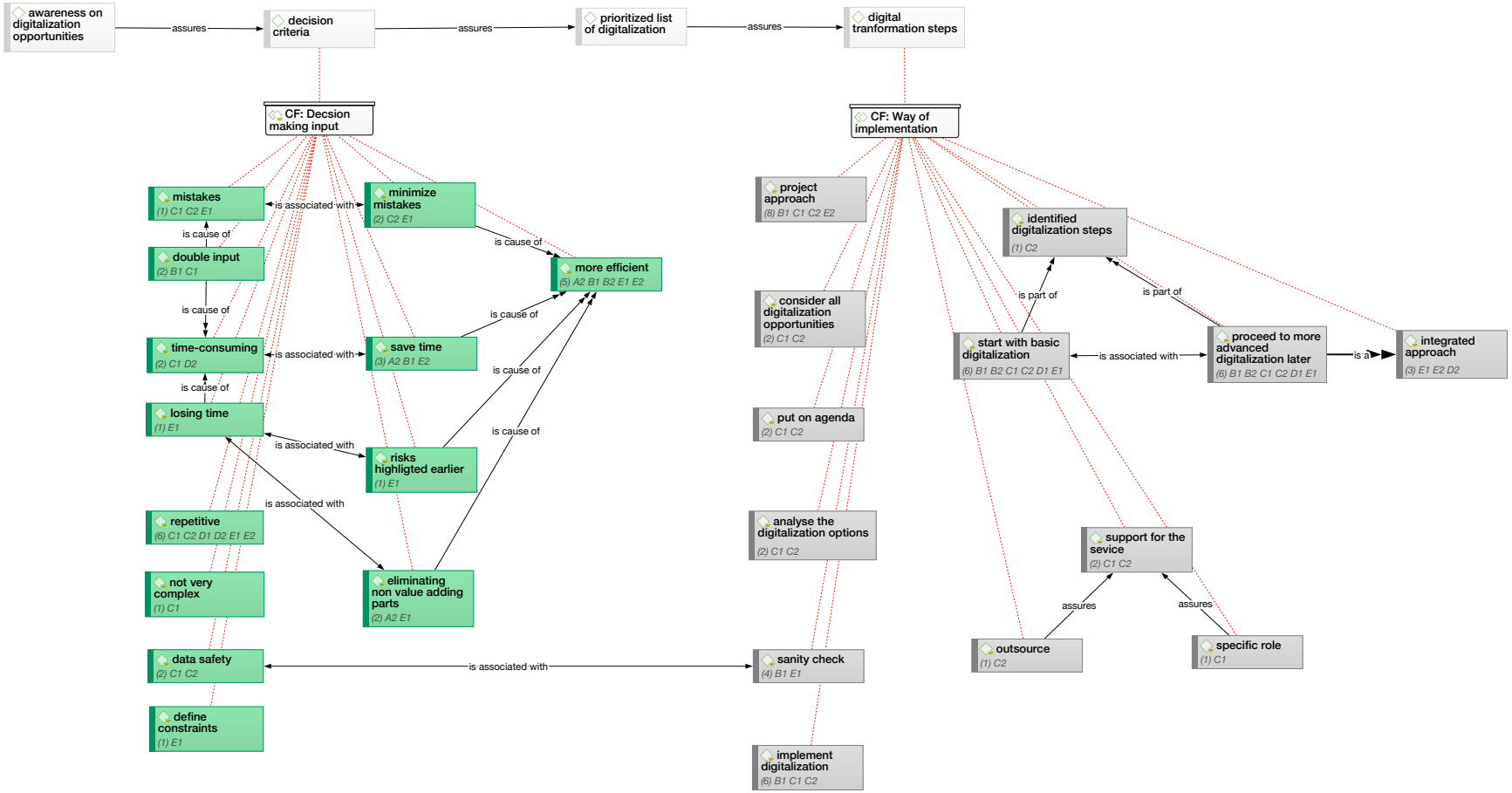


Figure 6.5: Game session a support tool for digitalization in the company

Chapter 7

Conclusion and recommendations

This final chapter concludes the study by answering the research questions, summarizing the contributions, and discussing the limitations, future research directions. The connection of the author's study program is discussed in the appendix A.1.

7.1 Findings

The report started by introducing the project idea and the intuition behind the work. Afterward, a research gap was identified using a systematic literature review.

Considering the research gap, a main research question and 4 subquestions were constructed (table 2.1). This section aims to conclude the work by recapping the most important takeaways and answering the research questions.

RQ#1: What are the requirements for a serious game for the Deployment team at Nutricia?

The first research question contemplates the optimal characteristics of an artifact that is able to fulfill the research objective.

A list of requirements was formulated considering multiple sources of information. First, the outcomes of earlier work revealed through the systematic literature review process proved to be useful to incorporate regarding serious game-related requirements. Next, requirements related to the subject of the game, digital transformation, were set up based on the relevant literature. Finally, further requirements were directly deductible from the research questions.

Overall, 15 requirements were identified during the theoretical problem analysis. The list of requirements includes the digitalization and game design aspects. Additional 6 requirements were derived from the practical analysis, providing requirements regarding the audience, process, and technology selection for the game. The requirements are comprehensively discussed in section 3.4.1 and 4.6. Finally, after synthesizing the requirement from the theoretical and practical analysis, 20 requirements were defined and were grouped semantically.

RQ#2 How to operationalize the requirements into a game?

Based on the requirements, utilizing the method presented by Dym and Little (2008) and an iterative design process, a low-tech, online playable game was developed.

In the development process, four prototypes have been built. The prototypes were iteratively refined to optimize between multiple, possibly contradictory requirements and based on experiences of demo sessions played with mentors and graduate students. During the process, multiple means have been assigned to the requirements when the initial mean was not sufficient to fulfill the requirement or proved to counteract another requirement. The time limit and the educational background of the company's employees was also a decisive factor at many points, leading to simplifications during the design process.

The final version presented in section 5.3 shows a trade-off across all requirements that is simple enough to be played during a 1.5-hour session with the selected participant group. This version serves as the final artifact for the analysis answering the upcoming two sub-research questions.

RQ#3 What are the impacts of playing the game on the employees involved in the digitalization process?

The starting point for the game design was that employees know that digitalization can improve business processes. Still, they are not aware of how digital technologies could be applied to their processes. Therefore, after a serious game has been developed to tackle their lack of awareness of digitalization opportunities, its functionality has to be evaluated.

The research question concerns the impact on each employee who took part in the game session; therefore, the individual learning aspect of the players is questioned.

The quantitative analysis has shown that the game provides an answer for most players on using digitalization technologies in their business context. However, not all participants fit the game regarding this design objective.

Two aspects can be considered to evaluate the success of DigiGame amongst the employees.

First, the business context seemed to be the most important factor. The game was played with both experienced and inexperienced participants with the presented business process. Experienced people learned about digitalization opportunities, became aware of dependencies in digitalization, and acquired a digital mindset during the game session. Some players even started to think about new digitalization opportunities for other business processes as well. However, the impact of the game on inexperienced people regarding the digitalization knowledge was negligible. It was too much for them to learn about the process and the digitalization techniques simultaneously. Recalling the flow discussion from section 3.3.5, they were probably in an arousal or even in an anxiety state, with the challenge being higher than their skills because of the lack of knowledge about the process. Nonetheless, they were also impacted by the game. Inexperienced players claimed that they have learned about the process itself. Moreover, some experienced participants described that they have become more aware of the complexity and inefficiency of the MTO process.

It can be concluded that different people gain different benefits from the game. Also, the game is suitable for a certain context it was built for. Players who were familiar with the context were able to learn how to digitalize.

The second factor is the prior knowledge of digitalization technologies. Since the aim was to show employees how certain digitalization techniques can be applied to their business context, a minimum level of knowledge with digitalization technologies is required. If players have no

idea about digitalization, they would be unable to select the automation solutions for the business context. However, this was not an issue in most cases of the digitalization techniques in the play sessions for the following reasons. First, as the pre-game design questionnaire confirmed, employees have minimum knowledge about digitalization. Second, throughout the prototyping phase, the knowledge level of the employees was considered to meet requirement R#8. The game was pre-tested, and simplifications were made to make the introduced technologies easily understandable with illustrations and descriptions. However, not all employees are on the same digitalization knowledge level. Therefore, the most complex technologies seemed to be slightly advanced for some players, as mentioned in the debriefing sessions.

It can be concluded that before playing the game, it is recommended to start with some learning about digitalization. Players also suggested that it would be nice to have an introduction to digitalization before the game.

RQ#4 What is the conceptual implementation plan constructed by the participants of the game session?

During the debriefing part of the game session, the pairs of players were asked to construct a prioritized list of digitalization techniques that they would like to implement in the future. Most groups constructed similar outcomes regarding digitalization preferences, prioritizing the tasks that can be solved with RPA technologies. However, some participants emphasized the benefits of the ERP-integrated interface, digitalizing the whole process to a fully integrated system. Therefore, in the collective debriefing session, these two outcomes were given for the participants for further discussion. The employees discussed the benefits and drawbacks of both approaches. Finally, they decided to first implement automation of the data inputs to Excel files and the ERP applying RPA technologies. Simultaneously, they advised taking a look into the possibilities of the integrated solution by checking the cost to set up and the implementation options. Furthermore, participants discussed that other processes than the MTO process should be considered with a digital mindset.

During the collaborative debriefing session, a project approach was suggested by several participants for the implementation. The project of digitalizing the MTO process would be put on the agenda, and the planners most experienced with the process would take part in the project and provide valuable insights for defining the criteria for the implementation.

Main RQ How to initiate business process digitalization in the Deployment team of Nutricia with a serious game?

The answers to the sub-research questions conclude the work and, in parallel, provide an answer to the main research question. The method presented in this work succeeded in the initiation of business transformation and made participants discuss digital opportunities at the company.

7.1.1 Discussion of quantitative analysis

From the beginning, it was planned that the main instrument for evaluating the game sessions is qualitative analysis. Therefore, when considering the type of game to be developed, the low-tech approach was taken. Thus, the game itself did not provide high amounts of quantitative data to suffice for a comprehensive analysis.

Still, on top of the data collection from the debriefing session, the participants filled pre- and post-game questionnaires. The results from these questionnaires open up the opportunity to conduct a limited quantitative analysis. The limitations mainly come from the small sample size, resulting in insignificant data in many cases. The summarized data is presented in the appendix section A.7.

Due to the small sample size, only the trends are taken into account in the difference between the pre- and post-game results.

Table A.3 shows that the game session slightly improved the motivation for digital transformation, which was already high before the game. Similarly, it became more believed that digitalization can make processes more efficient.

After the game, participants were more likely to state that digitalization can improve service quality for all but one task. Similarly, they increasingly had an idea on how to digitalize all tasks, with the same exception as earlier. The odd task was *Planning shipments*, which seem to be an interesting insight A.6, A.5). Although employees seemed to be motivated in the digital transformation based on their responses in the collaborative sessions and direct questions about their motivation in the questionnaire, their attitude to the *Planning shipments* might indicate hidden resistance in the back. As deployment planners, it is valid to think that they would not consider their main task automated, fearing their jobs to be obsolete. Similar effects have been observed by Loffler et al. (2018) where the students tended to support the digitalization of processes for a higher profit, only if their hypothetical position was not affected.

The game session did not positively affect the participants' thoughts on whether the tasks can be improved with digitalization. It varied depending on the tasks (table A.4).

The post-game questionnaire included additional questions about their experience with the game session. Since a difference between the experienced and inexperienced participants was visible from the qualitative analysis, a qualitative analysis is used to check how the experience affected the actual outcome of the game sessions. Since the difference between the two groups seemed to be high regarding several questions, a significance test was executed.

After collecting the data from the game sessions, the normality of the data has to be checked. As expected, with the small sample size of 5-5 participants, the data was not normally distributed. Therefore, the Wilcoxon rank-sum test was applied to the data, which is the nonparametric version of the parametric t-test for independent samples (McKnight and Najab, 2010). The difference between the experienced and inexperienced group regarding statement *'My knowledge about digitalization techniques improved'* shown to be highly significant and also statements *'The artifact was clear'* and '*The collaboration was valuable'* reveals significant difference on 95% confidence interval. The result of the analysis can be found in the appendix, table A.7.

In the qualitative analysis, it was found that the main takeaway from the game for the experienced participants were the leanings about the digitalization opportunities and the digital mindset. Similarly, statement *'My knowledge about digitalization techniques improved'* was rated to 4.8/5 by the experienced players, and only resulted in 2.5/5 by the inexperienced par-

ticipants.

For the inexperienced people, the main outcome was the learning about the MTO process, which was also confirmed by the questionnaire: statement *'My knowledge about the MTO process improved'* was rated to 4/5 by inexperienced, while only rated to 3/5 by the experienced.

Further aspect discussed in the qualitative analysis was to find an answer to why the game did not help the inexperienced people's learning about digitalization. It was assumed that the lack of flow experience during the gameplay could play a role. Players could have been in an arousal or anxiety state in the game because of the lack of skills to overcome the challenges of the game. It seems to be confirmed by the questionnaire outcomes, the statement *'The artifact was clear'* received 2.5/5 from the inexperienced players on average. Also, in contrast to the experienced people, who declared *'It was fun to play'* (4.4/5), inexperienced players gave 3.25/5.

The game's collaborative feature was appreciated by both groups, even though the experienced difference is still high between the two groups (exp. 4.8/5 and inexp. 4/5).

It can be concluded that the findings from the qualitative analysis show the same patterns as the qualitative analysis. Also, the analysis could provide interesting insights from the outcomes. However, it has to be emphasized that the qualitative analysis cannot provide statistical confirmation for the results because of the small sample size.

7.1.2 Design Science Guidelines application

Similarly to Bououd and Boughzala (2012), the seven guidelines were applied to the whole research process in this project. The reflection on the application of each guideline to this project is presented in this section.

Design as an Artifact The design science research has resulted in Digigame, a digital serious game. The artifact was created to raise awareness on digitalization opportunities amongst employees at the Deployment department at Nutricia. Furthermore, in a collaborative debriefing session, the participants were able to develop a conceptional implementation plan and discussed how to proceed with the implementation of the described technologies.

Problem Relevance The thesis topic was initiated by the author during the internship at Nutricia. The decision-makers at the company found the subject appealing and beneficial for the company and confirmed the need for the project. In the questionnaire to access the digitalization awareness of the Deployment team, according to the participants, the way of working regarding most tasks can be improved by digital transformation technologies. However, they claimed to have little knowledge of how to implement such a digital transformation. In this way, the need for a serious game for raising awareness on digitalization opportunities was confirmed. Thus, a vital business problem was addressed with the artifact. Furthermore, the lack of digitalization is an issue in other companies as well. Therefore, applying the designed artifact in different contexts can be beneficial.

Design Evaluation The game is evaluated in two ways. The first aspect is related to the individuals; if playing the game has changed the participants' perception of the digital transformation. Second, the game session results in a practical outcome; participants put together a conceptional plan of how to proceed with digitalization. The evaluation of the artifact is done

via qualitative data analysis. The evaluation is conducted with rigor; the analysis steps can be tracked back in Atlas.ti software in detail. Additional quantitative evaluation is performed as a supporting tool to confirm the patterns found in the qualitative analysis. However, the analysis can only provide analytical generalization and has no statistical relevance. The data collection for the evaluation - debriefing session questions - is grounded by the literature.

Research Contributions The contributions of the research are extensively discussed in section 7.2.

Research Rigor In the game development, the design decisions were supported by the knowledge base; relevant theories were used as the foundation of the design procedure: digitalization discussion and game design discussion. 20 design requirements were defined based on the theoritical and practical problem analysis. The requirements were operationalized into the game design with iterative prototyping grounded by Burgos (2006) and Roozenburg and Eekels (1995). The design alternatives were summarized based on Dym and Little (2008), showing what means are available to address the requirements. Constructing the debriefing session was based on relevant papers, and the evaluation of DigiGame was done through rigorous quantitative data analysis documented in Atlas.ti.

Design as a Search Process Designing DigiGame was an iterative process. To find suitable means to meet all requirements was challenging. Several prototypes were tested with the mentors to get the game to be playable. After the game was playable, it was tested with graduate students to get further insights on how to proceed with the game design.

Communication of Research The report will be made available to both the company and the scientific community. The thesis report will be available at the online repository of TU Delft. Furthermore, an online version will be shared with the participants of the game session and the management of Nutricia.

7.2 Contributions

This section summarizes both the practical and theoretical contributions of this work.

7.2.1 Practical contributions

The main contribution of this research is the design of a new artifact. The designed serious game aims to solve a relevant and unsolved business need - raising awareness on digitalization opportunities in the Deployment department of Nutricia. The artifact was applied in the business environment at Nutricia and produced significant value by making employees aware of the digitalization opportunities at the company. Furthermore, the game resulted in a practical outcome; a conceptional digitalization plan was provided by the participants during the debriefing sessions.

It is evident that the game contributed to the organizational learning of Nutricia. The session and the collaborative debriefing session was a unique experience for the Deployment team that resulted in a change in the knowledge of the organization. Employees were motivated to reconsider their routines; they were discussing the processes from a new perspective, how could the discussed digital technologies be applied in the company. Even if the game experiences

would not directly affect their business processes in the short term, the obtained knowledge is saved to the organization's memory to be recalled when a digitalization initiative comes up in the future. The learning and growth aspect of the Balanced Scorecard discussed in section 2.3.3.3 shows the possible effect of the newly acquired digital mindset in the company.

7.2.2 Theoretical contributions

The design research serves as an addition to the foundational knowledge base as well. The contribution is based on novelty: the designed artifact was the first game that initiated a digital transformation in organizations. During the literature study, it was revealed that no similar artifact was available to initiate business process digitalization at companies. Therefore, the study fills the research gap identified in the systematic literature review.

Additionally, DigiGame fills the demand revealed by Stadler and Rückel (2019), and confirms the identified potential of such a game in a practical scenario. The game was designed to be easily adaptable to other business contexts of different departments or companies by minor changes. The game master has to define new building blocks and the respective digitalization technologies. Optionally, an interface can be developed in the future where the game master can create business process models intuitively and set up the applicable digitalization techniques by selecting from a large pool of cards. This way, the potential identified by Stadler and Rückel (2019) can be exploited universally.

Considering DigiGame as an answer on the further research proposal of Loffler et al. (2018), it can be concluded that the application of a comparable game in a more weighty business context was successful. DigiGame received a positive reception, confirmed by a qualitative analysis and supplemented by a minor quantitative evaluation. This is in contrast to their method relying mostly on qualitative results.

Similarly to the earlier results from the literature on serious games (Boyle et al., 2016; Connolly et al., 2012), DigiGame succeeded in raising awareness. Additionally, the game resulted in a practical outcome similarly to the research of Bharosa et al.; participants constructed a conceptual implementation plan for digitalization.

Peng and Hsieh (2012) finds that playing with friends results in higher goal commitment than in the case of strangers in the cooperative goal structure in motor performance-centered computer games. The observation was confirmed for a serious game as well, colleges knowing each other showed higher goal commitment in the game sessions.

During the qualitative analysis in this work, multiple impacts of the game have been discovered. Most participants learned about the digitalization opportunities at the company. The more experienced employees at Nutricia gained more insight regarding the digitalization alternatives. Some players acquired a digital mindset during the game session and started to think about digitalization possibilities in other business processes as well. However, other participants with less experience in the presented business process gained little knowledge of digitalization technologies. Nonetheless, they claimed to get more familiar with the business process itself. Notably, in the research analyzed during the literature review, no work revealed similar observations. Thus, it can be concluded that the game sessions contributed to the development of the participants in a diverse way. This interesting insight can form the subject of further research.

7.3 Limitations

The research gap was identified using a systematic literature review. Additionally, the literature about competition and collaboration in serious games was studied systematically. On the other hand, the rest of the theoretical problem analysis only focused on finding an appropriate design without the completeness of the review. The digitalization technologies were selected based on an in-depth review of online articles targeted at professionals, without knowing whether the included solutions covered the whole landscape of possibilities in the rapidly changing environment. Additionally, the solutions were discussed with experts in the field.

In the qualitative analysis, coding, and categorizing was done by the author, supplemented by consultations with mentors. Performing the coding alone can be problematic. However, since the outcome was applied to evaluate a specific game design rather than generalization, the solo coding is suitable for providing deep insights for evaluating the game.

An additional limitation is that the game was specifically designed around the Deployment team of Nutricia. Therefore, for other companies, it is not usable in the current form. Additionally, the building blocks and digitalization technologies are built into the game and require some programming expertise from the game master to adapt to new processes.

The main evaluation instrument was the qualitative data analysis. Therefore, only analytical generalization is possible in this research.

Finally, there is no room for statistical generalization because of the small number of players. Therefore, only limited conclusions were drawn from the results of the quantitative analysis.

7.4 Recommendations

This section presents recommendations and further research opportunities.

In general, the game sessions proved to be successful in raising awareness for digital opportunities among employees. Still, significant differences could be observed across the performance of multiple groups and individuals. These differences can be explained with multiple factors. First, some players had issues with focusing on the game, which can either be caused by the lack of flow experience, probably caused by insufficient preliminary knowledge, or by the disturbances of e-mails and urgent tasks that came up during the session. To help the players focus, personal workshops are preferred over online workshops. Additionally, less experienced players should be given the opportunity to get familiar with all the essential information required to participate in the game, suggested by participants. This is possible using preparatory workshops or handing out material in advance.

Generalizing the game also forms the subject of further research. The first way is to keep the game relatively specific and customize it for each company before the workshops. A large pool of process building blocks and additional digital transformation technologies can be collected, making it easier for the game master to prepare a session. Alternatively, more flexible building blocks can be added, so players can build up a wide variety of processes. In this case, assigning the appropriate digitalization technologies is more complicated, and this approach also requires highly qualified employees who can take advantage of the freedom they have. The required time of the session is also expected to grow significantly.

An adapted game could be played in larger departments, where more employees are available for the gameplay. This way, larger amounts of data could be collected, resulting in a more comprehensive and accurate quantitative analysis.

Appendix A

Appendix

A.1 Management of Technology relevance

This section discusses the connection of the project to the Management of Technology (MoT) studies. The website of MoT [1] defines the objective of the master program clearly:

> *" The programme in MOT educate students as technology managers, analysts of technological markets (either as scientists or consultants), and entrepreneurs in highly technology-based, internationally-oriented and competitive environments for a variety of industrial sectors."*

The subject of the project is a multinational company. Additionally, novel digital technologies play a central role in the project, as well as business process development.

> *" The programme addresses challenging questions most companies face such as: "*

> *"1. What technologies do we need and when?"*

The work included the analysis of Nutricia's business process, and the selection of appropriate technologies to digitalize the process.

> *"2. Do we procure the technology we need with our own research capabilities, in collaboration with outside parties, or by acquiring it or licensing it from others?"*

> *"3. How can we use the abundant technological opportunities to affect our mission, objectives and strategies?"*

The latter question was also a central question of the game implemented.

Conclusively, the characteristics of project matches the objectives of MoT programme, as well as the topics considered in different courses.

A.1.1 Connections to courses

MOT1531 - Business Process Management and Technology The course has thought the author how to improve business processes. The teamwork during the course was valuable to learn about ways to analyse business processes and to find the route causes of the problems. Furthermore, it has provided knowledge about how to design a technology architecture for supporting the processes and the impact of technologies on the business processes. All of these

[1] `https://www.tudelft.nl/onderwijs/opleidingen/masters/mot/msc-management-of-technology/`

knowledge could be applied during the thesis project. Moreover, learning about the improvement methodologies, especially the lean thinking was beneficial, as it was foundation of the digitalization discussion of the thesis.

SEN9720 - Logistics and Supply Chain Innovation During this subject the author has learned the fundamentals of supply chains. Furthermore, during the teamwork project an imaginary company's supply chain was analysed and improved with innovative solutions. The course was essential to understand the supply chain of Nutricia and the provided innovative solutions were a valuable knowledge base to the thesis project.

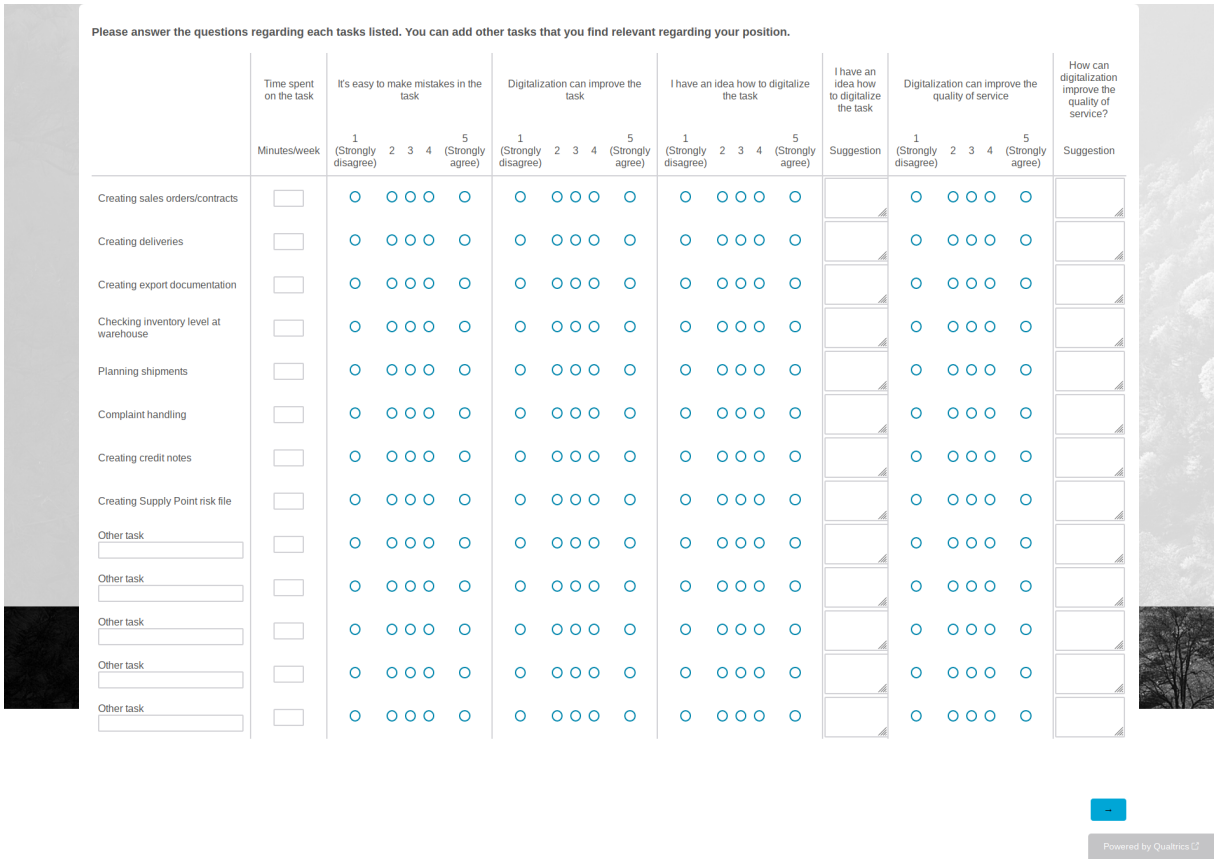
SEN9725 - Supply Chain Gaming This course motivated the selection of the project by designing a serious game. Naturally, it provided knowledge about both essential aspects of the thesis topic: how to design a serious game to address a supply chain related problem.

MOT1003 - Integration Moment The course was similar to the current thesis project: it teaches how to use every knowledge acquired in the MOT curriculum to design a serious game for the company's problem.

MOT2312 - Research Methods The subject was necessary to get familiar with the way of conducting a qualitative data analysis. It also supported the questionnaire development and the qualitative analysis. Additionally, it provided knowledge on the sampling methods.

MOT1524 - Leadership and Technology Management The course thought about knowledge management in companies, it provided knowledge about organizational learning.

A.2 Pre-game design questionnaire



Please answer the questions regarding each tasks listed. You can add other tasks that you find relevant regarding your position.

	Time spent on the task	It's easy to make mistakes in the task	Digitalization can improve the task	I have an idea how to digitalize the task	I have an idea how to digitalize the task	Digitalization can improve the quality of service	How can digitalization improve the quality of service?
	Minutes/week	1 (Strongly disagree) 2 3 4 5 (Strongly agree)	1 (Strongly disagree) 2 3 4 5 (Strongly agree)	1 (Strongly disagree) 2 3 4 5 (Strongly agree)	Suggestion	1 (Strongly disagree) 2 3 4 5 (Strongly agree)	Suggestion
Creating sales orders/contracts							
Creating deliveries							
Creating export documentation							
Checking inventory level at warehouse							
Planning shipments							
Complaint handling							
Creating credit notes							
Creating Supply Point risk file							
Other task							
Other task							
Other task							
Other task							
Other task							

→

Powered by Qualtrics

Figure A.1: The form for the pre-game design questionnaire

A.2.1 Pre-game design questionnaire qualitative outcomes

Suggestions by participants how to digitalize and how can it improve the quality of service :

Creating sales orders/contracts

- IT has been working on automatic order uploads from Excel orders
- is it technically possible to upload PO form into SAP?
- proramme called esker, using in other entity in Danone
- Automate the order in the system, comparing the stock and GR with the order.
- less errors, quicker response

Creating deliveries

- So automatically created into DNs
- less errors, quicker response

Creating export documentation

- Stratech implementation will help a lot
- Uploading pl/ALS/inv to
- less errors, quicker response

Checking inventory level at warehouse

- An automated extract to be shared with CBUs to avoid stock questions
- Maybe running stock report for multiple SKUs simultaneously
- Excel output of inventory level

Planning shipment

- For some countries Excel is used for planning. Optimization - if it is an MTF country, SAP TLB should be sufficient for planning, or if Excel is used, it would be helpful if there would be an easier way to extract data for planning (e.g. reports)

Complaint handling

- Automatic value threshold determination to block tasks/cross-checking value in SAP to ensure value reporting
- I believe that visualisation and making the tool more user-friendly would help more than digitalization
- Excipio should become more user-friendly
- excipio is not a user friendly program, other program could be better
- if easier to use, people will take quicker action

Creating credit notes

- Credit notes should be fully extracted with a script once per month, any remaining information should be supplied by DP
- Once CN created, a copy could be sent to shared-drive to the folder with respective month
- less errors, quicker response
- With digitalization we might can issue credit notes quicker for auditing and checking evidence digitally.

Creating Supply Point risk file

- More optimization in quality and supply information to ensure less questions from CBUs
- QC releases could be copied in from QC release update file directly; SKUs with stock in Venlo could be highlighted.
- we already have many macro's to run it but further digitalisation of the tasks is still possible
- less errors, quicker response

A.2.2 Post-game Debriefing Session

1. How did you feel?
   - How did you experience the game?
   - Do you have any questions? Any doubt? Any suggestions?
2. What has happened?
   - What decisions did you make?
   - Based on what events was this decision triggered?
3. How are the game and reality connected?

- Please discuss the relationships between gaming simulation elements and system elements (in real life).
- Reflect on similarities and differences between the experience and reality.

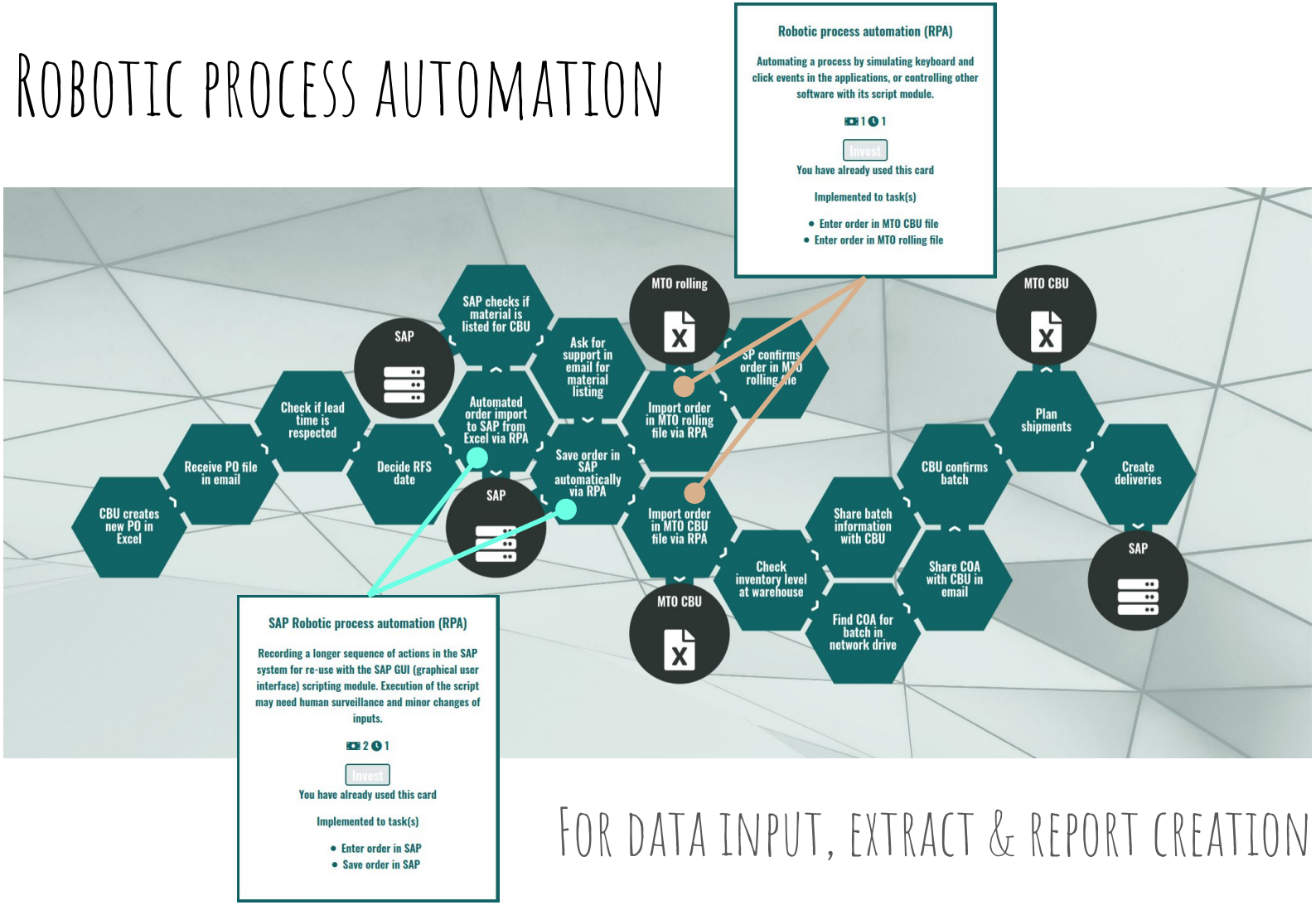
4. Did you learn something?
5. How do we proceed from here?
   - Would you like to implement any digitalization technique introduced in the game?
   - If yes, please provide a prioritized list of the digitalization techniques for the tasks.

A.2.3 Collaborative Debriefing Session

1. Do you think your perception on digitalization opportunities changed after this play experience?
2. In the discussion after the game session, in the final question, you were discussing a prioritized list of the digitalization techniques - I summarized the suggestions you made. As an outcome of the experience, we had two different scenarios:
   What do you think of it?
   - I would like to know if you have any comments on that – are these priorities interesting for you?
   - Do you think this is feasible?
3. What can be done from now?
   - What do you think should be done?
   - Do you think you will apply any of the digitalizations discussed?

A.3 Digitalization opportunities of Nutrica's business process

Robotic process automation



For data input, extract & report creation

Figure A.2: Digitalization techniques: RPA

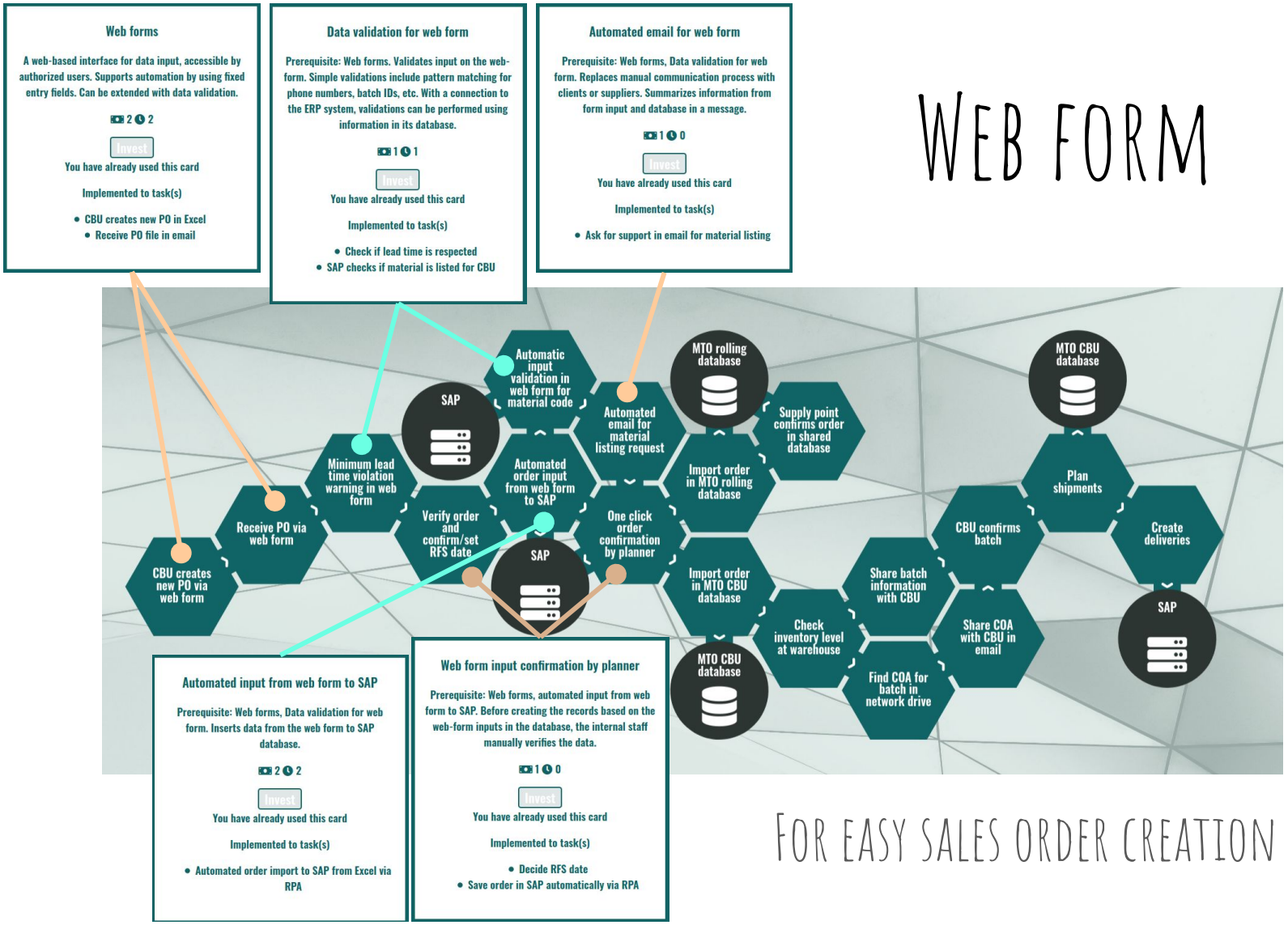
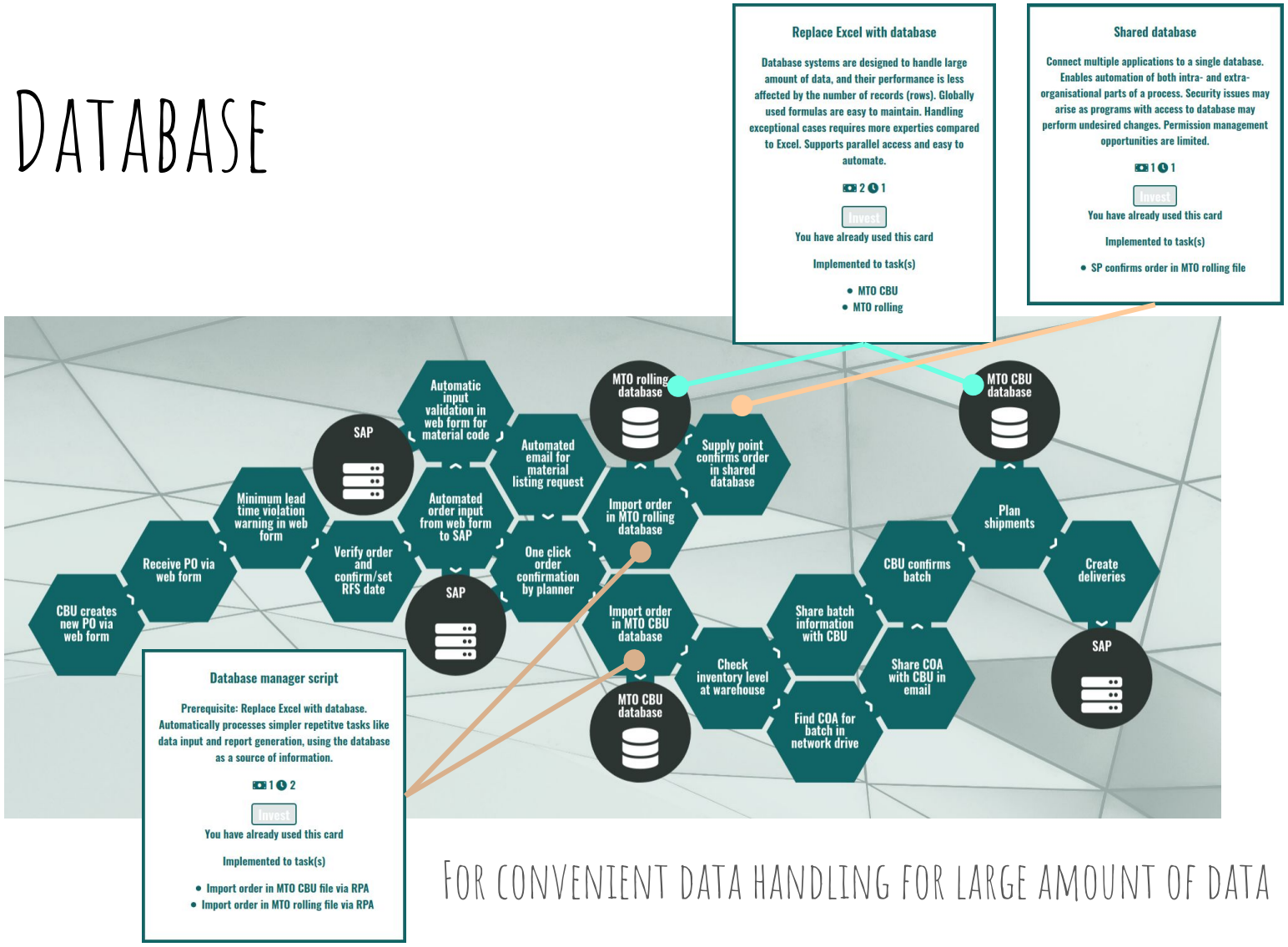


Figure A.3: Digitalization techniques: Web form

DATABASE



FOR CONVENIENT DATA HANDLING FOR LARGE AMOUNT OF DATA

Figure A.4: Digitalization techniques: Database

INTEGRATED INTERFACE

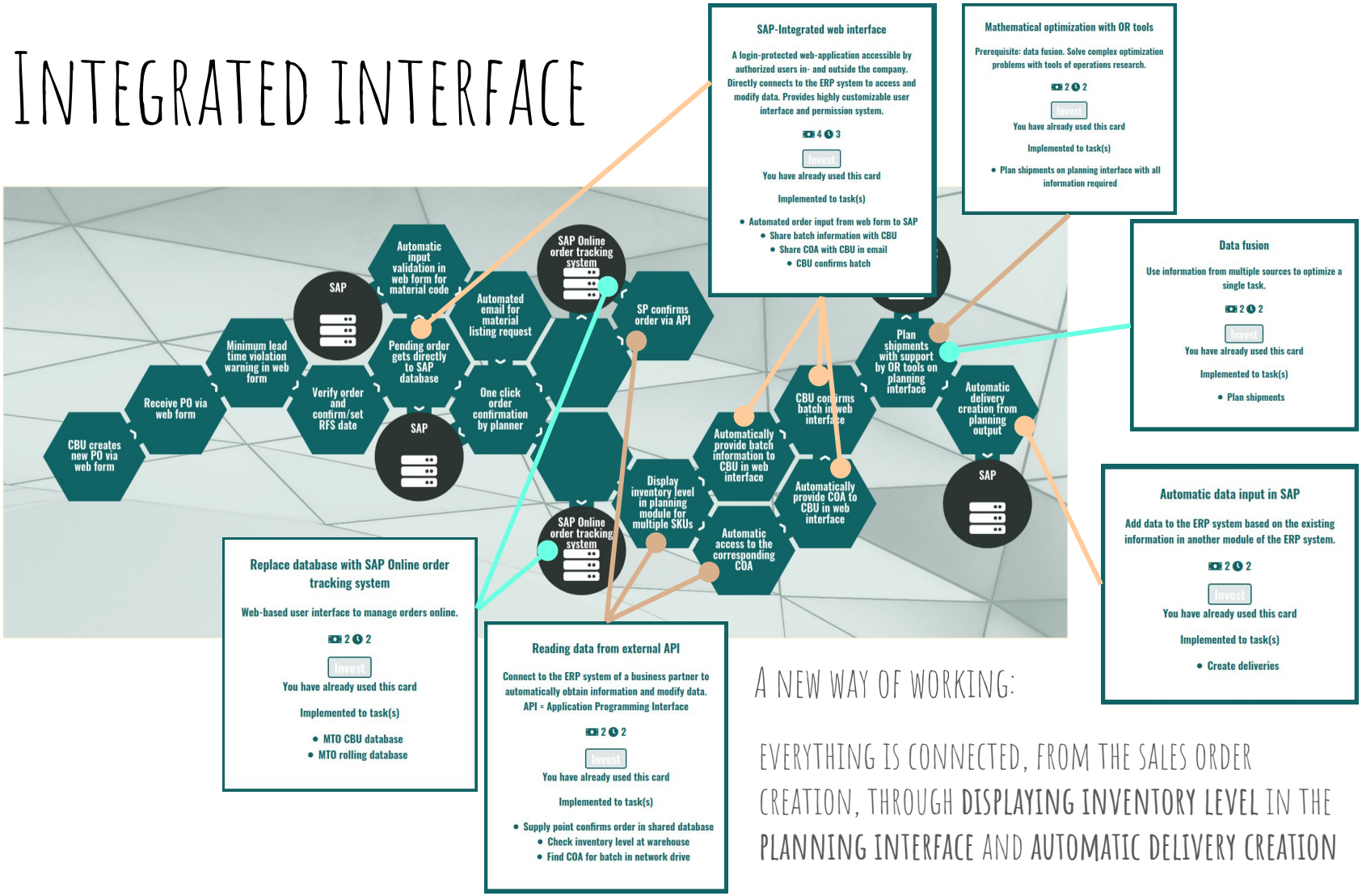
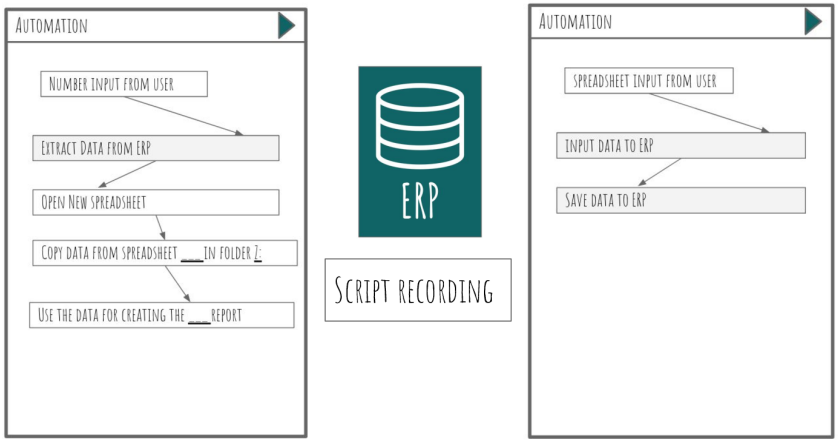
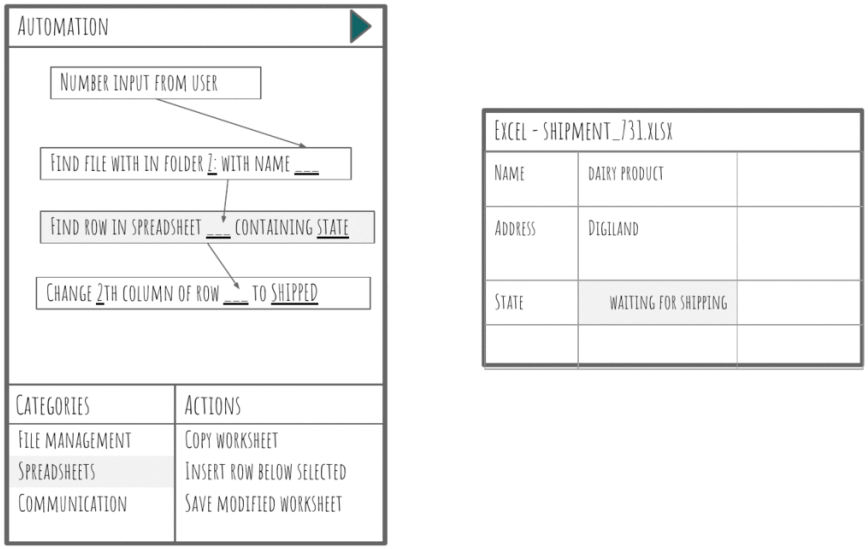
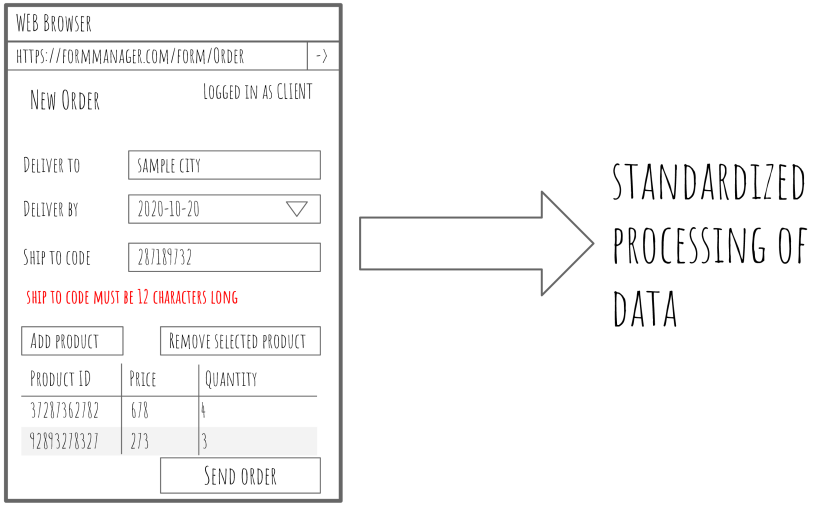
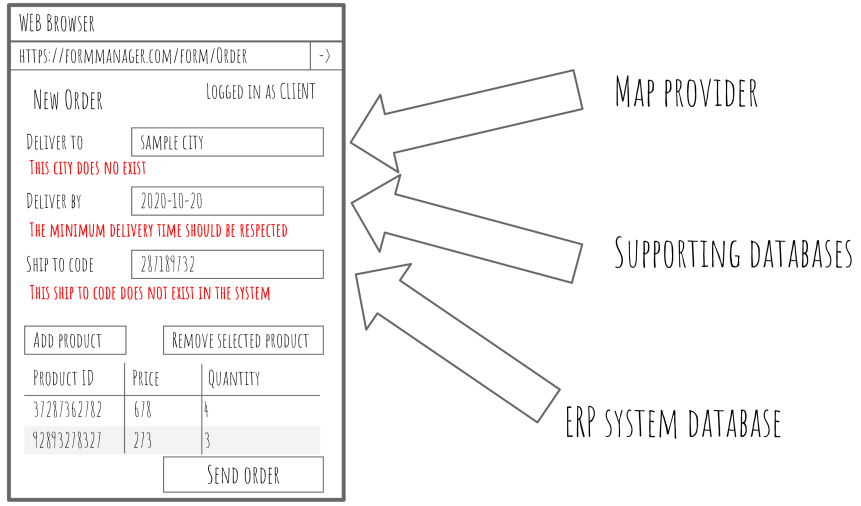
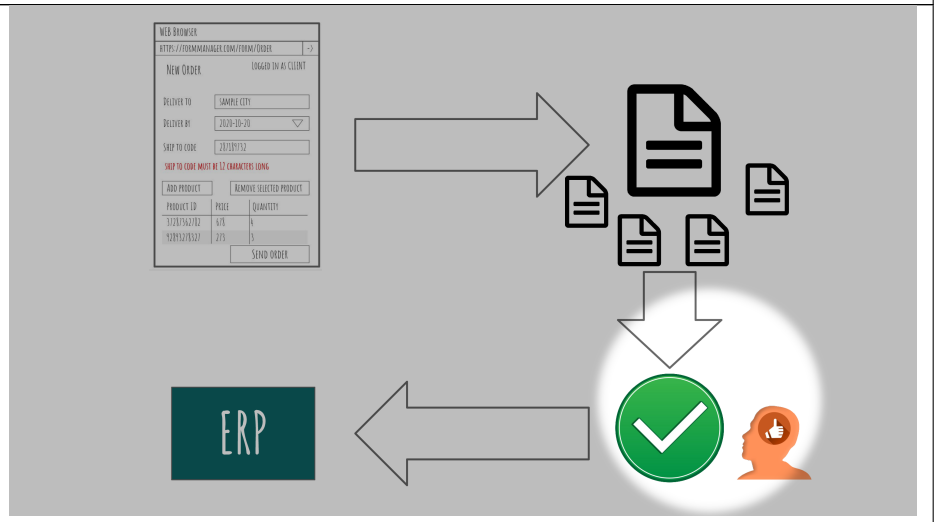


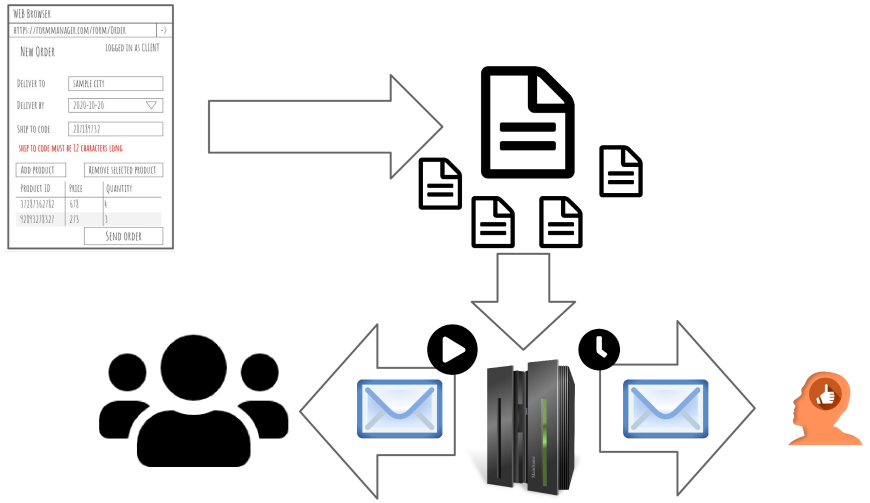
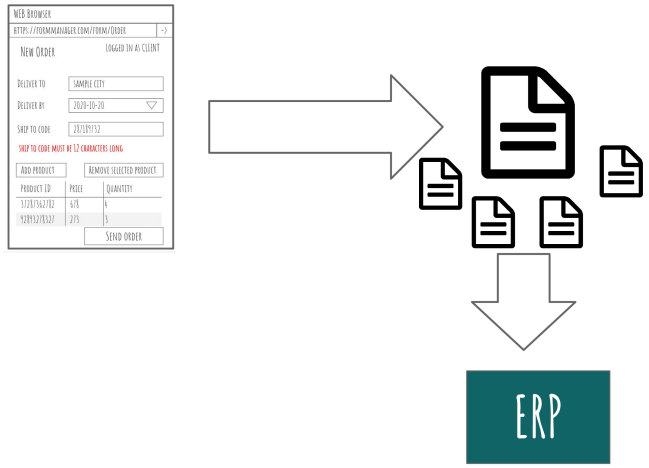
Figure A.5: Digitalization techniques: Integrated interface

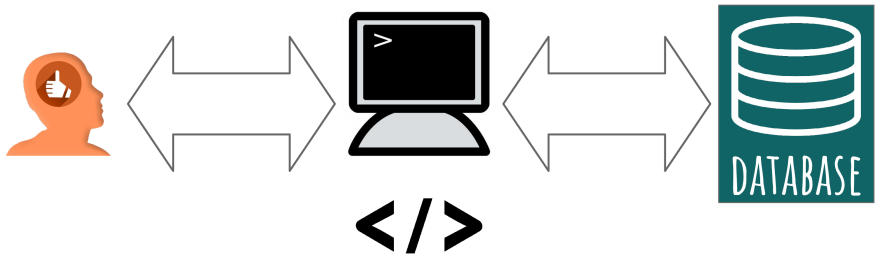
A.4 Digitalization techniques in the game

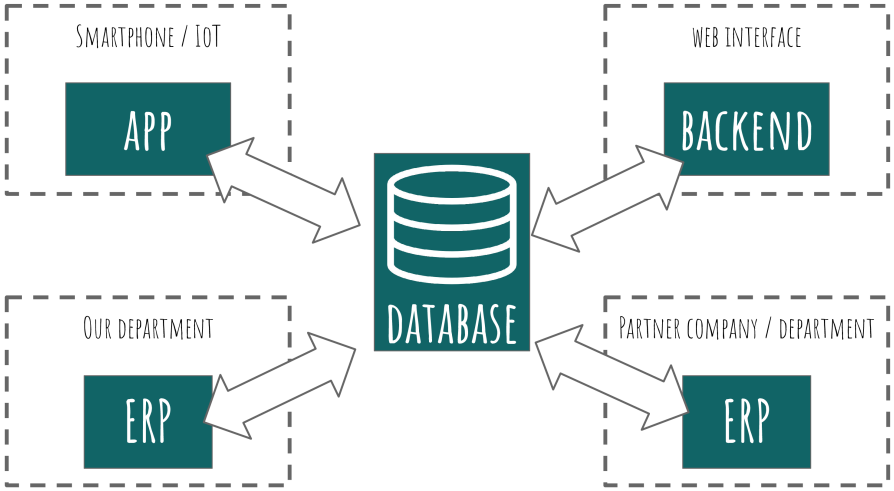
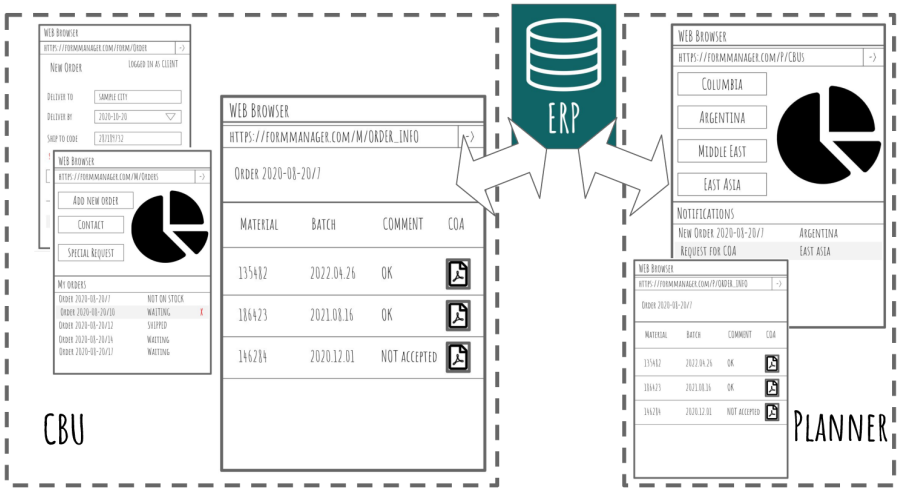
Round	Name	Description	Descriptive image (help)
1	SAP Robotic process automation (RPA)	Recording a longer sequence of actions in the SAP system for re-use with the SAP GUI (graphical user interface) scripting module. Execution of the script may need human surveillance and minor changes of inputs.	

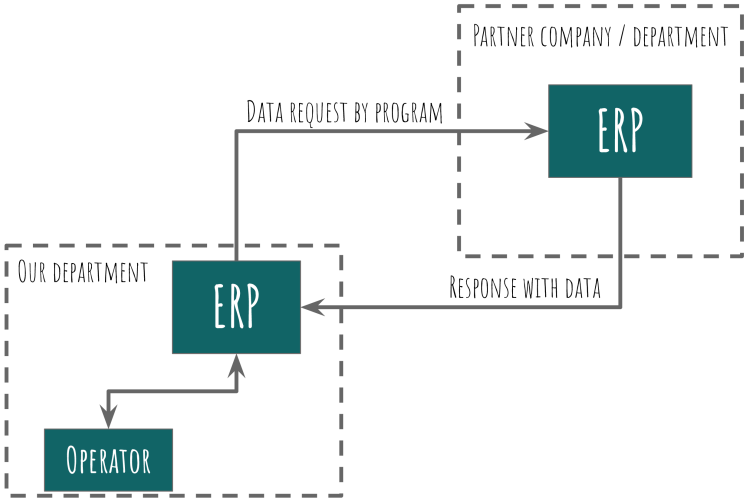
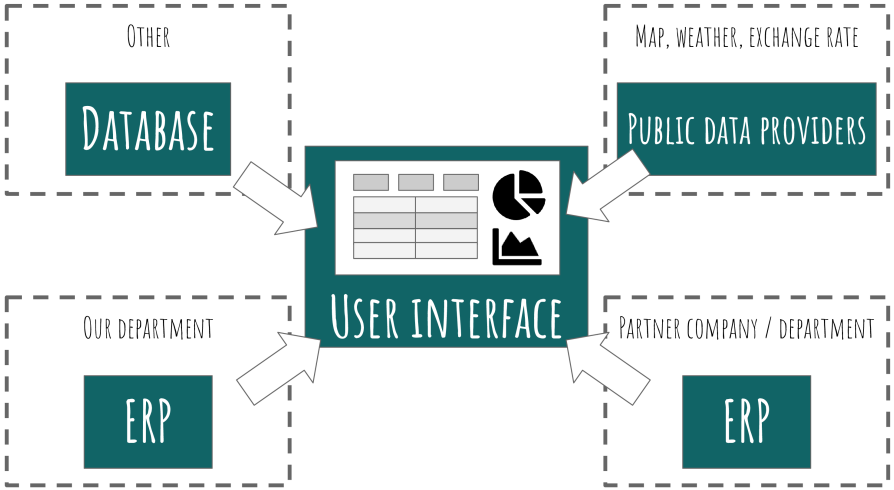
Round	Name	Description	Descriptive image (help)
1	Robotic process automation (RPA)	Automating a process by simulating keyboard and click events in the applications, or controlling other software with its script module.	
2	Web forms	A web-based interface for data input, accessible by authorized users. Supports automation by using fixed entry fields. Can be extended with data validation.	

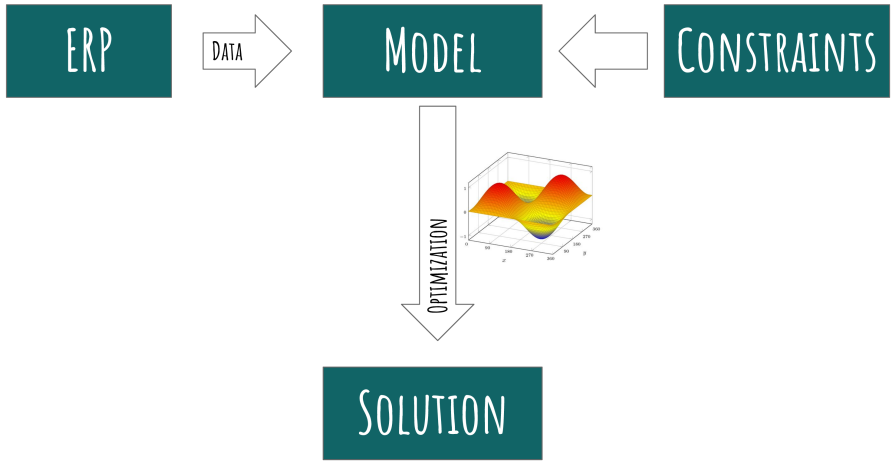
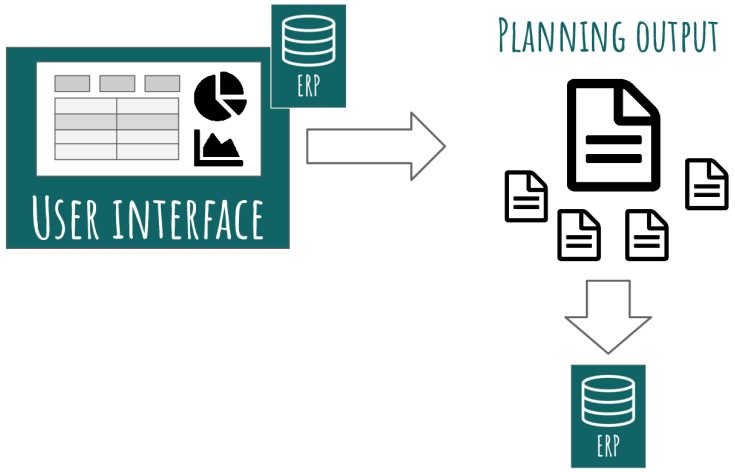
Round	Name	Description	Descriptive image (help)
2	Data validation for web form	Prerequisite: Web forms. Validates input on the web-form. Simple validations include pattern matching for phone numbers, batch IDs, etc. With a connection to the ERP system, validations can be performed using information in its database.	
2	Web form input confirmation by planner	Prerequisite: Web forms, automated input from web form to SAP. Before creating the records based on the web-form inputs in the database, the internal staff manually verifies the data.	

Round	Name	Description	Descriptive image (help)
2	Automated email for web form	Prerequisite: Web forms, Data validation for web form. Replaces manual communication process with clients or suppliers. Summarizes information from form input and database in a message.	
2	Automated input from web form to SAP	Prerequisite: Web forms, Data validation for web form. Inserts data from the web form to SAP database.	

Round	Name	Description	Descriptive image (help)
2	Replace Excel with database	Database systems are designed to handle large amount of data, and their performance is less affected by the number of records (rows). Globally used formulas are easy to maintain. Handling exceptional cases requires more experties compared to Excel. Supports parallel access and easy to automate.	
2	Database manager script	Prerequisite: Replace Excel with database. Automatically processes simpler repetitve tasks like data input and report generation, using the database as a source of information.	

Round	Name	Description	Descriptive image (help)
2	Shared database	Connect multiple applications to a single database. Enables automation of both intra- and extra-organisational parts of a process. Security issues may arise as programs with access to database may perform undesired changes. Permission management opportunities are limited.	
2	SAP-Integrated web interface	A login-protected web-application accessible by authorized users in- and outside the company. Directly connects to the ERP system to access and modify data. Provides highly customizable user interface and permission system.	

Round	Name	Description	Descriptive image (help)
2	Reading data from external API	Connect to the ERP system of a business partner to automatically obtain information and modify data. API = Application Programming Interface	
2	Data fusion	Use information from multiple sources to optimize a single task.	

Round	Name	Description	Descriptive image (help)
2	Mathematical optimization with OR tools	Prerequisite: data fusion. Solve complex optimization problems with tools of operations research.	
2	Automatic data input in SAP	Add data to the ERP system based on the existing information in another module of the ERP system.	

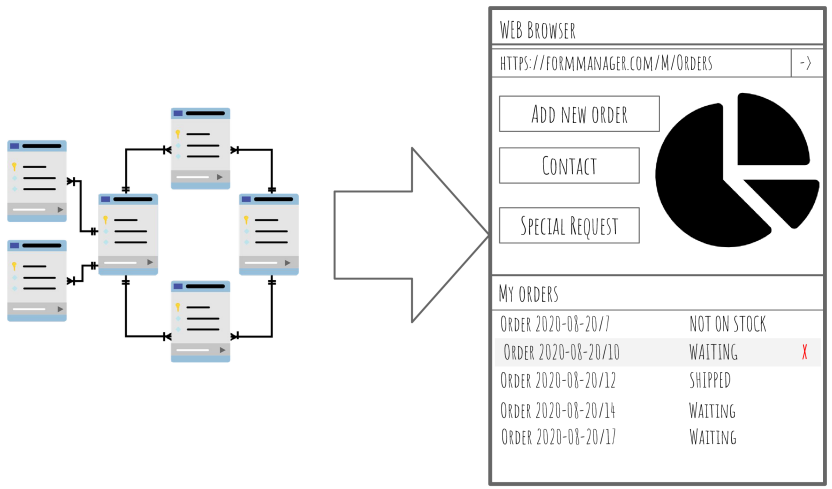
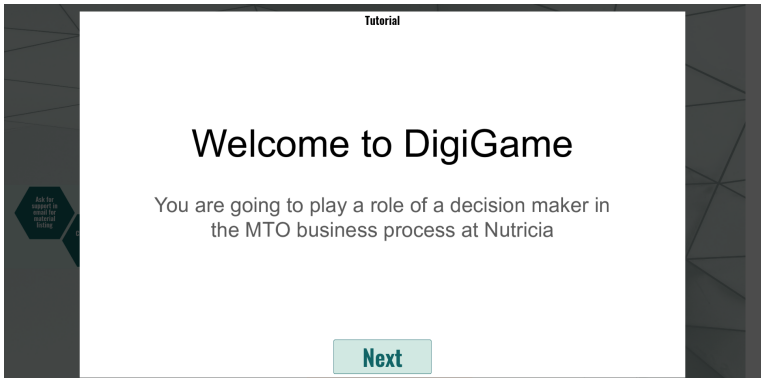
Round	Name	Description	Descriptive image (help)
2	Replace database with SAP Online order tracking system	Web-based user interface to manage orders online.	

Table A.1: Digitalization techniques

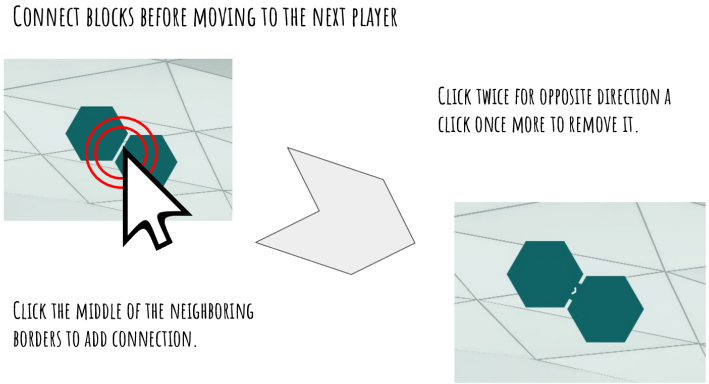
A.5 DigiGame description

The game starts with a tutorial, introducing the first phase. After the tutorial, players can select a role (Player 1 / Player 2)



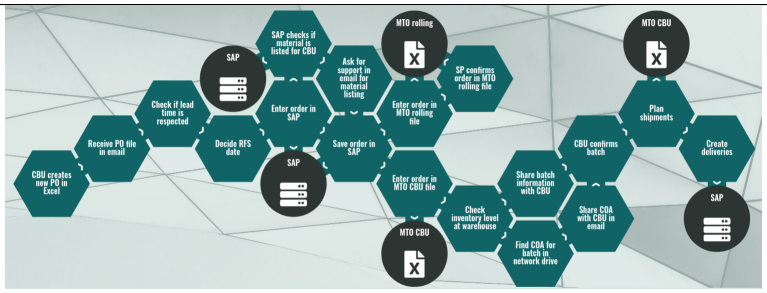
In the first phase both players see different building blocks. A player has to drag a block to the "game board". Once the player drops the block, it appears for the other player. Then, players can end the turn by clicking next player. There are two types of components: steps of the process and information systems.

Next, the blocks should be connected to each other.

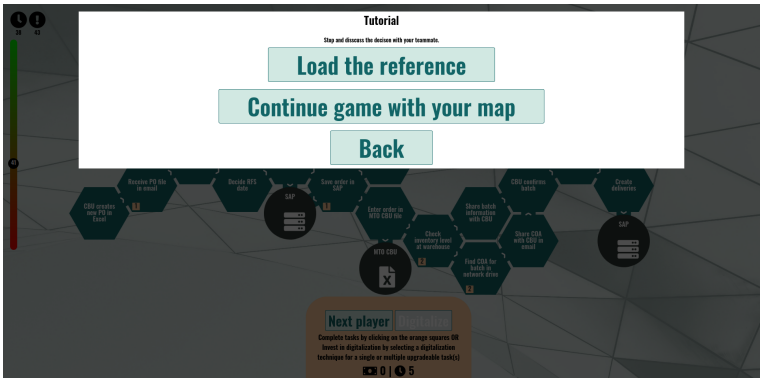


Players can request help by clicking the help button, highlighting the neighbor components for both players, so they can build up the process.

After finishing the construction of the process, players can move to the next phase.

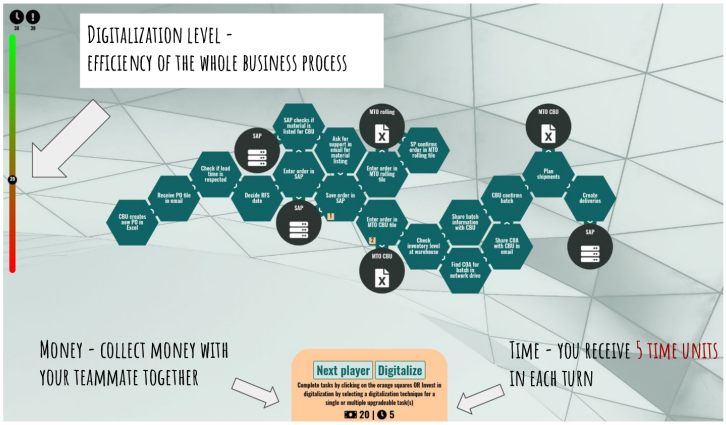


The 2nd phase also starts with a tutorial. At the end of the tutorial, players can choose to continue with their own process map, or load the reference implementation.



The players can analyze the process by hovering the performance indicator icons (time efficiency, erroneousness).

The digitalization meter on the left side symbolizes the efficiency of the business process, which is improved during the digitalization. On the bottom, players can observe the quantity of the available resources.



Daily tasks appear as orange squares. By clicking on them, players receive money but loose time. After digitalizing, blue squares also appear, however players do not loose time by clicking them, representing the time saved by digitalization. Tasks have to be completed before their number reaches 4 per component.

If players A wants to digitalize a part of the business process, they have to click "Digitalize" button. Then, the components digitalizable in the given round get highlighted.

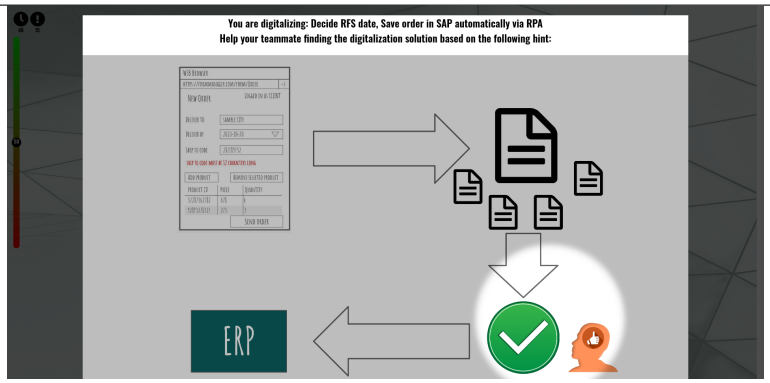
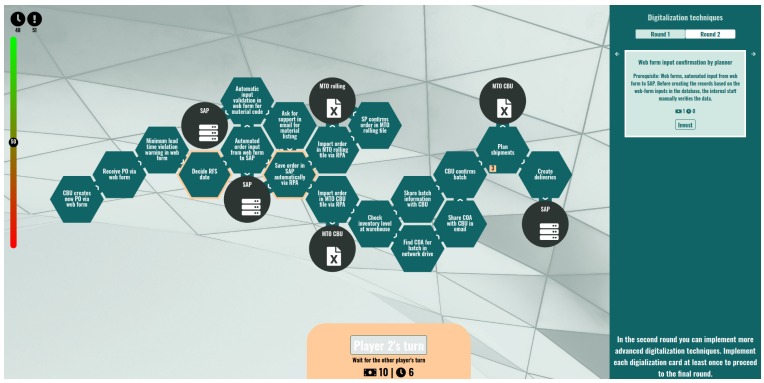
After selecting a part of the process, Player A sees a hint describing the applicable digitalization.	
Player B sees the list of digitalizations available in the actual round and can select a digitalization technique to implement, after a discussion with Player A.	
With the help of the heatmap, players can monitor the time efficiency and erroneousness of the process.	

Table A.2: Description of DigiGame

A.6 Transcripts of debriefing sessions

A.6.1 Debriefing session A

Facilitator notes:

- nice gameplay
- discussed the tutorial together, explaining the rules in details
- players tried to complete the tasks in the beginning
- digitalization and completing the tasks were balanced
- Player 2 was motivated for digitalization in the play session
- realized that turning to the next player, they get more time, therefore can collect more money (they can see the long term effects of digitalization)

- they have collected the most money
- struggled to find the digitalization in round 3
- they used the dependencies for deciding what to digitalize next
- checked the heat map just for feedback

Debriefing

1. **Facilitator:** How did you experience the game? How did you feel?

Player 2: In the beginning, it looked complicated – but I am a person who starts doing it; I'll get easier used to it (learning by doing),once we started, I understood the game.

Player 1: Same feeling; the strategy could have been different if, in the beginning, I had a better understanding of the game.

Maybe we would use other strategies after playing the game; we would target to eliminate all the dependencies.

The way the whole game was constructed is pretty impressive because I think in many ways it captures the whole process and even more (some CBUs MTO processes are not the same, all of it are captured), it's really interesting.

2. **Facilitator:** What has happened? What decisions did you make?

Based on what events was this decision triggered?

Player 1: My teammate wanted to digitalize a lot.

Player 2: Yes, I was looking at the time that we have and how many points I can collect, and also I think in general, I know that when you digitalize something, it saves you time from the task itself, and in this case, you can get money – so I was like why don't we just digitalize more?

Player 1: In the beginning, we did not have a good comprehension that there are interdependencies that we should take into account; there are certain prerequisites. I found the descriptions a bit too technical. That's why at some point (in the 3rd round), it was hard to find suitable digitalization techniques. Once we understand how the game goes, we tried to digitalize the tasks in a logical order – that first we digitalize the input, then the processing, and then the output.

Player 2: What was the purpose of showing one person the picture and to the other person the text?

Facilitator: To make the game more collaborative: if you explain what you see and the other person reads the description of possible techniques, explaining it to someone can make you understand it more, make it more interactive, maybe more interesting, more fun. It's kind of an 'Activity' – how can you explain to the other the thing you see in the picture.

Player 1: I thought you created that to fill in the gaps for noise: normally you don't execute the tasks in perfect sequence, all the time, so you always have interruptions – to compensate, to offset those noises, interruptions actually, no, because we never follow it in the perfect sequence. Yes, I see your point.

Player 2: I was thinking it was for understanding – see if you understand how you can digitalize the task, if you can express what you see, then you can understand it more.

We found out that if we click the next player faster, we can get more time and, therefore, more money.

Facilitator: Yes, you did great there; you have collected the most money of all groups. It is also part of the game to realize what the best strategy is to collect more points. In this way, you could see the long term effects of digitalization.

Player 1: What would have been the optimal pattern of digitalizing the tasks?

3. **Facilitator:** How often did you check the heat maps?

Player 2: I was checking the heat map the whole time because we were going up like we were moving to more efficient. But I did not use it for deciding the order of digitalizing.

Facilitator: So, there were at least two ways to decide on the sequence of digitalizing the tasks. The one you have picked as a strategy was finding the dependencies, to find the logical order of digitalizing the tasks. Another way would have been checking the heat map and choosing the next task to digitalize based on the task's efficiency level.

Facilitator: How are the game and reality connected? Please discuss the relationships between gaming simulation elements and system elements (in real life). Reflect on similarities and differences between the experience and reality.

Player 2: When I see the tasks, I can relate to what I do in real life.

Player 1: Yes, the tasks are well represented, and I would be glad to see the digitalization implemented in the future. I think you can profit the most if you take the integrated approach. So do it in one go or maybe in some stages but the ones relevant for everyone. If you do it individually, you will not profit as much.

Player 1: What is the future of this? These are the things you will work on then? Or just kind of leave legacy and somebody at the managerial level have to think whether they want to invest in that?

Facilitator: I will just leave this for you to think about. I also have a question connected to this.

4. **Facilitator:** How do we proceed from here? Would you like to implement any digitalization technique introduced in the game? If yes, please provide a prioritized list of the digitalization techniques for the tasks.

Player 2: When I joined the team, I realized that we use a lot of Excel – we could digitalize – someone should take that as a task and work on it to make this a reality. I could be taken as a project because, as a planner, I'm just working with it. What I thought should be digitalized is the MTO rolling file and the automatic order input into SAP. If I could do the project, I would prioritize that first, and I think we also prioritized as first when we were playing the game.

Player 1: I support because we were losing at least one week – from the moment the order is created to the one it is put into the file, and it is visible there. Also the more we copy – paste, the more mistakes there are. If there is a standardized input that can be transferred, the person who makes the input can make a mistake. Therefore, some kind of validation or sanity check should be there. That could maybe – I don't know – do you know how to validate – maybe the person who puts the input needs to have some kind of control – after the input to verify that the volumes are correct – criteria for the sanity check. It would minimize mistakes when creating the contract.

For the second, the rolling file, of course, should be automated to the SupplyPoint's direction. There should be, of course, certain criteria and certain constraints, but the module should have some integrated parts with the Supply Point; they should talk to each other. Now we are waiting until the order gets to the file. I think we are losing a lot of time from the input to the actual decision and confirmation That could be minimized. And of course – things like forming the loads – so something that is purely mathematical – you just need to define well the constraints, for example, documentation and so on, and then a system can suggest a load – don't have to

drag every single thing manually.

I think the order management is a very good idea – I know many companies already started integrating that because that allows everyone to look at the same information at a given point of time. You don't have to write an email asking what batches are available – everything is there. I see a lot of pluses in that. It's pretty integrated, so that's a huge work and a huge process, but if Nutricia supports it, I think that in the end, that would work out well.

5. **Facilitator:** Did you learn something from the game?

Player 1: It really surprised me how many steps we are making from input actually to plan something. Because when you break it into steps – we can see that the steps involved are so inefficient. Meanwhile, if we would take an integrated approach, I think we can minimize it, maybe half of those steps – or we can run it in the background that nobody has to bother.

Player 2: I also agree with that - one point when we are looking at the digitalization, and I had the pictures in front of me – I was thinking like – we input so much data, and it goes to different stakeholders before coming all – instead we have just one database where everything was in – it would be so much more efficient.

Player 1: And I think the risks can be highlighted much earlier – like if the production moves, and so on, you already see – we used for compliance at my previous company – so if there is a certain lead time – for each step, there is a certain lead time that does not meet or there is a constraint or extra information needed – it already puts it from the green to yellow color – you see action in each side – we need to push it to the next step. First, you have to get used to the interface, but then it optimizes the whole workflow.

A.6.2 Debriefing session B

Facilitator notes:

- nice gameplay
- get into the game soon
- finding the suitable techniques quickly
- using the hints well
- good conversations in the play
- checking the heatmaps regularly
- used the heatmaps to decide the sequence of digitalizations
- mainly focused on implementing digitalizations, not completing the tasks manually
- not that interested in the future aspects

Debriefing

1. **Facilitator:** How did you feel?

Player 2: Okay, cool; I have to say I'm quite impressed.

Player 1: It was really well set up, I think, good job!

Player 2: When we started, I was super confused, didn't really know where to start, then as soon as the game has started, and we were working on it, I actually thought it was quite fun.

Player 1: Yeah, I think I had the same, like in the beginning I was like okay, all these blocks and what should I do but then once you get the game going, it's quite fun, and you really want to win, of course, at least I always want to win, in this game as well, so it is a good game.

2. **Facilitator:** Do you have any questions? Any doubt? Any suggestions?

Player 2: Yeah, actually these orange boxes, what would have happened if I clicked it more? I would have got more money but less time, right?

Facilitator: Yes, indeed.

Player 2: I think we didn't use it because we didn't really understand it

Player 1: for me, it wasn't clear that the aim was to collect as much money as you could. That was the end goal, right?

Facilitator: yes, one goal was to collect the money while digitalizing the process, and you have digitalized the process to the maximum. I can see that you were more focused on the digitalization part.

Player 2: Let just say that if we focused more on completing those time tasks, there would have been the chance that we would have failed the digitalization?

Facilitator: yes

Player 2: then we did well

Facilitator: You had two options: to go for digitalization and go for remaining at your basic work, completing the tasks with the current way of working – in this way, you would have stuck at this level and would not have the digitizations done. On the other hand, if you would not have completed any of the tasks and disregarded those tasks, you would not have enough money to digitalize.

Player 1, 2: Okay, cool.

3. **Facilitator:** What has happened? What were your perceptions, observations, current thoughts about the activities in the game?

Player 1: The process was set up, and we tried to digitalize that. I'm wondering what is the end goal of the game? Do you want to implement these kind of steps to optimize the process as it currently is?

Facilitator: Yes, it's up to you, but that is the plan.

Player 2: My thought was that the process as it was picked, it doesn't apply for every single MTO CBU. For my CBU the whole part with the COA was completely not relevant for me when I was planning Romania. It definitely makes sense for the traditional MTO countries, but for my MTO CBUs it was a bit different. Besides that, I obviously like the integrations, I'm gonna study data tools, so I liked the proposed solutions, but I do wonder a little bit – I think, for the most part, it's an optimistic dream, right? For some solutions, they would obviously work, but they would be hella expensive to implement.

Facilitator: Did you learn something?

Player 1: Can you repeat that please? Sorry, I was reading an email.

4. **Facilitator:** Did you learn something during this game session?

Player 1: For me, of course, the way of working for an MTO process that was quite new. I gained for many sides in what possibilities could be in further optimizing the planning process. What kind of automatons are available. Maybe very hard to implement or very costly to implement. So that was cool.

Player 2: Actually, my question to answer that question would be: Are these real solutions, or did you just hypothesize them? Are these actually implemented by other companies also?

Facilitator: Yes, these are used by other companies. The more integrated parts – I know it from experience – they are used by smaller companies. Also, the ideas presented in the first round of the game were implemented for my tasks during my internship. I've created some

scripts to digitalize the report creations, data inputs to SAP, and Excel cleaning. These are solutions that are easy to implement but hard to maintain without expertise. If you go further to more complex solutions, providing more integrated systems, they need more thoughts to implement and are more expensive; these are for long term gains.

Player 2: Okay, cool. Then I definitely learned some extra features of SAP that I was not aware of.

5. **Facilitator:** How do we proceed from here?

Would you like to implement any digitalization technique introduced in the game? If yes, please provide a prioritized list of the digitalization techniques for the tasks.

Player 2: I would say that assuming a certain attitude from stakeholders, the process could be made more efficient. So I think a huge benefit or gain to be made eliminating the stakeholders that do not want to be in this process. For example, from my experience, the SP, they don't want to be included proactively in this process – they only want to step in if they see something problematic. So the one where the SP was confirming – that should be completely eliminated. For my MTO CBU I didn't use the MTO rolling file because it had no added value for me.

Secondly, things like COAs and batches – really low added value from the planner side – can be very easily automated and essentially save time and maximize efficiency.

Thirdly, automatic order processing in the system – where we do everything via Excel – can be eliminated – it's a low hanging fruit essentially because we know it's possible – [continuous development manager] already developed it – but it has never been used yet.

Player 1: I've never worked with this process, so I have no comments on the prioritization.

A.6.3 Debriefing session C

Facilitator notes:

- did not understand the game
- they had no prior knowledge of neither the MTO process, nor the digitization process
- checking the heatmaps regularly
- used the heatmaps to decide the sequence of digitalizations
- chaotic gameplay
- not talking to each other enough, therefore the collaborative part is useless
- clicked invest without discussing with the partner – trying to solve the problem individually
- fact – they do not know each other
- conclusion: without the connection between the players, and understanding of the process – the game is not effective

Debriefing

1. **Facilitator:** How did you feel? How did you experience the game?

Player 1: It was a little bit difficult. The idea is very good. It took a little bit longer than I thought. First, I was lost; I didn't know what to do. During the game, it got better, but I'm not 100% sure if I understood correctly. But the ideas are very good. You made all this, right?

Facilitator: Yes

Player 1: Yeah, that's amazing

Player 2: I had the same thing.

Player 1: The idea is, you have an actual idea to make automation like this or..? Do you know how to do it, or it's just an idea?

Facilitator: So the digitalization techniques showed in round one were actually implemented for some of my tasks during my internship, and my successors are also using the scripts I've created.

Player 1: The Python scripts that you made?

Facilitator: Yes, indeed. So this is how you can imagine the Robotic Process Automation: creating reports and extracting data from SAP automatically.

Player 1: Creating order can also be, I think, scripted. There was a script when I was working at previous companies to create orders in SAP.

Facilitator: Yes. A webform is also an option that I know used by other companies presented in the second round in the game. So for the first part when the CBU creates an order until it gets directly to SAP can be done via web form. The supporting tools introduced in the game, like the data validation, are really important. You can imagine what would happen if everything goes into SAP without any validation or confirmation by the planner. Then, the planner's task regarding the data input is reduced to one-click confirmation of the orders; it can save a lot of time and mistake opportunities. Also, the automated email from a web form could be quite useful. Every time you don't have the material listed for the CBU, and you realize that when entering the order in SAP, you cannot save the order until it is solved. You have to go back to the beginning of the process, ask for listing and when the listing is done, enter the order again. If we can find out earlier in the process that the listing is not done, we can save a lot of time and effort with it.

As you might notice, there are some problems with the Excel files; we process huge amounts of data in these Excel files. For this amount of data, it would be useful to use databases instead. And as we interns, we put all of these data manually to these files; it's quite time consuming and has a lot of mistake opportunities.

Player 1: I have one question. When you create an order, and you have to enter multiple lines, like, for example, 40 lines, do you know how to enter the 40 lines at one time?

Facilitator: You can just copy-paste them.

Player 1: If I copy-paste 40, it will be only 20. Is there any way I can paste all the 40 lines?

Facilitator: Yes, indeed, this is a problem in our SAP that only the number of rows that are visible at the moment can be filled out. There is the possibility to paste all of them in other modules even though only fewer rows are visible than the lines you want to paste. I don't know about this function by order creation, but it can be programmed in if there is a need for it. This is a good remark; it could be considered as part of the improvement project.

2. **Facilitator:** What has happened? What decisions did you make?

Based on what events was this decision triggered?

Player 2: So for me, the first thing I understand what my teammate described, and if I couldn't imagine what should I do next, I read through the descriptions and also the process that we need to digitalize and pick the most suitable one

Player 1: I'm not sure if I understand the whole thing correctly, so I when my teammate told me what she sees, I chose the technique I think was suitable.

So when I hovered the clock, the least efficient was shown with the red color, that part I understood. But the money collecting part, I'm not sure. I clicked the orange part because I was told to do so, but not sure.

Facilitator: When you clicked the orange cubes, it means that you completed the task man-

ually. And when you digitalized, you got the tasks automatically done. Either manually or automatically, if a task is done, you receive money for it.

As I've noticed, you decided the digitalize the tasks more, so you preferred to digitalize tasks compared to completing tasks manually. Right?

Player 1: Yes

3. **Facilitator:** Do you feel the same? Would you use the same strategy?

Player 2: Yes

Facilitator: How are the game and reality connected? Please discuss the relationships between gaming simulation elements and system elements (in real life). Reflect on similarities and differences between the experience and reality.

Player 1: I only have one MTO country, and it's like once a month. Some of the processes described are a little bit different than mine. It's not completely the same procedure that is described here as my portfolio. Overall it is similar.

So, in one of my previous companies, they had script to create order in SAP (like sales order, return, or credit note etc) and had internally developed tools that's connected to SAP, so we could create return or credit via the tool as well. And also server(?) that can generate report automatically with scheduled job.

However, The script to create order/ return/ credit / delivery etc –we need to have data entered in excel for the script to read and enter in SAP, so it can be very useful if we have many orders to create but if it's only 1 or 2 orders, it will not make much difference than creating via SAP manually.

Player 2: For me, the most matching procedure is taking care of the sample mailbox. I recognize some things from that procedure. Everything is completed manually. If we put a program to make it easier, I think it would be better.

I can process the given options from the game, but I don't know how to apply in real life, though; it's pretty vague for me.

4. **Facilitator:** Did you learn something from this game?

Player 2: I have learned the tasks of the planners. Because I don't know what planners are doing with the shipments, and sometimes I don't know who is responsible for which order. I mean for the counties I know, but for the specific tasks, I don't know. I've learned about the MTO business process. I also learned about digitalization techniques and business process improvement. So I would start by improving the least efficient task first.

Player 1: Yes, I guess some techniques can be used for automating the process.

5. **Facilitator:** How do we proceed from here?

Would you like to implement any digitalization technique introduced in the game? If yes, please provide a prioritized list of the digitalization techniques for the tasks.

Player 2: I think I would use the website, the SAP-integrated interface. You can find everything on the website, and you can coordinate with the CBU easier.

Player 1: Creating a script for creating new order and delivery because that would be the easiest thing to implement. Start with easier than proceed to the more integrated ones because integrating data would probably cost more money.

Facilitator: Since the MTO this is not your main process, I would like to ask you if you have any idea improving other processes you are more familiar with.

Player 1: I think what can be done is report generation can also be automated.

Player 2: It is really hard to say for the sample mailbox because for different samples they request different things. Maybe it is possible; it can have a program that CBU can fill on their own, create a purchase order, and then we can approve it and create the delivery. Currently, some CBU doesn't know if the product is available in the DSV warehouse or not, and they just send a request. And it takes a lot of time to send the email to another person or ask somebody to solve it, so it would be nice if the CBU could create the order by the program, so they can control the situation with the product.

Facilitator: Thank you for the nice ideas!

A.6.4 Debriefing session D

Facilitator notes:

- During the game play there was a technical problem: Player 1 did not have a stable internet connection without VPN
- Therefore the facilitator showed the gameboard and possibilities to the player – it was not efficient – the player's attention was not entirely in the game.
- checking the heatmaps regularly
- used the heatmaps to decide the sequence of digitalizations

Debriefing

1. **Facilitator:** How did you feel?

Player 1: It was a nice game, I enjoyed it. I did not understand how digitalization work fully – but I find it interesting. I got motivated for digitalization and want to know more about how these digitalization techniques would work in practice. It would be nice if we could receive a list of the possibilities presented in the game – so the digitalization techniques for the tasks.

2. **Facilitator:** Do you have any questions? Any doubt? Any suggestions?

Player 2: I think there could be a better introduction before the game, to get more familiar with the topic and the game. It would have been difficult to play it without a facilitator. With you, we understood what has to be done, but we could not play it alone.

Other than that, I think it was a well developed, well-designed game – I can see how things are connected.

3. **Facilitator:** What has happened? What were your perceptions, observations, current thoughts about the activities in the game?

Player 2: I observed the process for deciding which task is worth to digitalize first. Than we got a basic introduction of the techniques and had to decide which technique is suitable for the chosen task. I could see how the digitalizations are connected – for example; we can validate and confirm the data before it gets into the SAP system in case of the web forms.

Player 1: For my side, I can see that this digitalization would make the processes more efficient and save time with it.

4. **Facilitator:** How are the game and reality connected?

Player 1: It would be nice if the techniques from the game would become reality – is it possible?

Facilitator: The techniques introduced in the game are technologically feasible. At this point it's up to you as a team and to the management to decide to implement the digitalization.

Player 2: I can see the connection with the reality with the building blocks of the actual MTO business process described in the game.

5. **Facilitator:** What did you learn?

Player 2: I learned that there is a lot of room for innovation in our processes and get to know the possibilities how to digitalize.

Player 1: Yes, same for me. With implementing the digitalization, the process can be made more efficient.

Facilitator: How do we proceed from here? Would you like to implement any digitalization technique introduced in the game? If yes, please provide a prioritized list of the digitalization techniques for the tasks.

Start with the basic digitalization techniques than proceed to more advanced ones once we know better. priorized list:

- RPA
- web form
- database
- Sap integrated interface

A.6.5 Debriefing session E

Facilitator notes:

- 2 play sessions
- mangers
- much more motivated in the digitalization compared to the planners
- have better understanding of the process because of the higher experience level
- enthusiastic in the game
- took long time to understand the game
- checking the heatmaps regularly
- used the heatmaps to decide the sequence of di

gitalizations

Debriefing

1. **Facilitator:** How did you feel? How did you experience the game?

Player 2: Well, it took me some time that I started to understand what I need to do, to be honest.

Player 1: Yeah, I had similar. In the beginning, it's a lot of information. But I really like it!

Player 2: Yeah, I like it too, now that I understood. But maybe that would be something that for you it's really obvious but for me it was very difficult to understand, so when you started to explain how it works I understood. But it's nice; I liked it too! Just it was a bit difficult to understand for me, but I'm stupid like hell, so that is not a surprise.

Player 1: And it gets some good ideas, I think, to digitalize. I really liked the form, the automatic for the CBUs to fill in, the web form.

Player 2: Yeah, indeed. That you do not have to come up with, but you can choose, or you already have a solution.

2. **Facilitator:** What trade-offs did you face in the game?

Player 1: I think the time versus the money, but to be honest, I didn't really look at that. I just clicked whatever I thought would be nice. I was just curious to see the different options and whatever seemed to fit as a next step. So I did' t really checked, do I have time, do I have money? For me, that was less important actually.

Player 2: I was collecting money in the meantime. For me, what you also told me that you pointed out that I cannot just go and digitalize whatever I want, but first, there is a certain sequence in it. That you cannot go ahead and digitalize lets see how to find the COA before digitalizing other parts. That is irritating me, to be honest. But in the sense of, that sometimes for real we need a certain part to be process improved and really a lot of other things hanging on it that you have to pick up. Sometimes it's not okay that for one single simple thing, what I think you just have to improve a lot of other parts. But maybe it's just for the game now, but I don't think so because I see it in other cases as well, like for Stratech and Maco that there are small steps that need to be solved first and that can take a lot of time just to get to the point that we wanted to digitalize or improve.

Facilitator: Yes indeed, there are some dependencies, but for example, in this game, the digitalization techniques were sorted by complexity. So later, if you feel that you would start with a more complex, integrated approach, it is possible to implement that solution already and do not have to start with the more basic techniques.

Player 2: I was thinking that we could play again because I find it very interesting and now that I understand, I wouldn't mind starting it again. Because in the first round, I was just clicking whatever. It would be a good idea to play it again.

Player 1: Yes

Player 2: And we can switch off the workplace and focus on this one.

After the whole play:

Player 1: Yes, that's very interesting. And how feasible do you think these applications are?

Facilitator: I think it's quite feasible. If you have outside of the company some programmers it can be done and can be customized for your needs.

Player 1: It is based on a lot of things that we are not using at all, like web-based forms.

Player 2: But you know that there are restrictions; as Danone is very private on IT things, for example, they are not going to allow to use outside web forms. They are not going to allow others to have access. That's the problem that it could have been that everything can't be done, just because of the restrictions of the data safety. The problem is that all the CBUs are in different systems. Did you calculate in that not every CBU is on SAP, for example?

Facilitator: Yes, exactly, this is why the web form can be used in this case. CBUs do not need to have access to SAP; they can fill out the web form with the new order, and the structured data from it can be transferred to SAP.

Player 2: So basically, then the question is if it is allowed by IT security that an outside web form where everybody can have access to and add information in it could be interfaced with SAP, right?

Facilitator: Yes, and my suggestion is first to have data validation, so only valid SAP codes can get to the system with a warning for lead time violation and ask planners' confirmation for the orders before it gets to the SAP system. So it is really important when you implement a solution like that to take into account what kind of risk can occur and what kind of restrictions you want to have to manage the risk. Then based on the arranged solution, the customized implementation can be made.

Player 2: How much time would it take to set it up?

Facilitator: I cannot say that exactly. The digitalization techniques in the first round – so the Robotic Process Automation – I have already implemented a few scripts for report creation

during my internship in a few days. For the digitalization techniques from the second round – web forms and databases – much more time is needed. Also, preparation is essential to find the requirements for the implementation. I would say a half year is required for these to set up.

Player 2: And money-wise?

Facilitator: I would say that in a few years, the cost would be covered.

Player 2: Okay. And if you look at the complexity, timelines, and the restrictions, which part do you think we could already think about? Which one would be the easiest part to digitalize and the quickest?

Facilitator: In that case, I would suggest starting with the basic ones – for example, the RPA – just to see that it works and how does it work for you.

Player 2: The order entry?

Facilitator: Yes, the order entry and updating the MTO CBU and MTO rolling Excel files.

And taking a more complex technique, the web form could also be used for other processes and could be implemented together – for example it could be used for the samples requests, one time deliveries as well besides the MTO process.

If we have the SAP-integrated interface, the automatic COA fining, and sending it to CBUs - I think it would save a lot of time.

I would like to know what do you think, which one do you think would be the most beneficial for you.

Player 2: For me, once the ones where the mistakes are high.

Player 1: Order entry. But also creating the CBU MTO file and the Rolling MTO file.

Facilitator: The currently used Excel files contain a lot of data, which are difficult to process in this way. It can have a lot of mistakes indeed by the data entry, and there can also be difficulties regarding the formulas when this much data is processed in Excel. It is time-consuming to fix the formulas.

If it would be changed to database, it would be more convenient to process the data, but at the same time, planners would have to learn how to use it.

Player 2: To be honest, as long as the input starts with someone typing into either Excel or web form, there can always be a mistake. I don't mind that. So you cannot fully automate that.

Player 1: No, but you have than the CBU put the information in an Excel, and the intern from the Excel have to put it to SAP. So the first step, indeed, garbage in garbage out, but if that is okay, then it's actually the transfer from that to SAP, where also mistake can happen. For example, the delivery date is not adapted.

Player 2: Okay, but I was thinking like there would be an option, which we could already do, to upload automatically the PO from Excel into the system. So basically, CBU filling the Excel or putting into web form, I don't see much difference.

Player 1: No, that is still garbage in garbage out; you cannot put data validation in it.

Player 2: If we could just do that, the first part, [continuous improvement manager] said already three years ago, that it's possible. We could just start doing it, so to create one sort of Excel form that could be just uploaded to SAP, that would be already a start. To be honest, we have no idea if they fill it in good or not; we just take over what they tell us. So we should push on that, and that could be a project now, that someone help us to create one Excel form and show us how can we import it to SAP. Because basically, SAP is also one big Excel file in a way.

Player 1: There are CBUs going into Themis, which means they already put their order into

SAP. Only Nutricia Worldwide and Asian CBUs are non-themis. For the others, we are just adjusting their orders.

Player 2: But Nutria Worldwide is also a lot. So maybe in this case, a web form would be more elegant, and easier I think because than you do not have to upload anything. But maybe we could check the costs because it can be that the cost of creating a webform is sort of balancing out the manual work that you still have to do uploading the Excel into SAP. Is it correct?

Facilitator: Yes, exactly. Another benefit of the webform is that you have systematic data that you can use for other purposes later, for example, integrating it with an SAP online tracking system and SAP-integrated web interface. So, in this case, everything can be connected.

While with simple digitalization techniques, you accelerate the current business process, rethinking the business process with a digital mindset can be more beneficial and profitable in the long term.

Player 2: Yeah, of course. But you know, this is not one or the other; we can already start maybe with the Excel and start to automatize smaller, and in the meanwhile, find out what the costs would be of the web form or to see if it is possible.

Player 1: What is the biggest risk at the moment, for example, [Facilitator], you created some RPA, which is absolutely great, but if something crashes, of course, you have created work instruction, and it helped me, but if something worse happens, there is no support, so you're very vulnerable. It is also with the macros in Excel that [continuous improvement manager], for example, created, so people already left the company, it is very vulnerable if something crashes, you cannot repair it but there is also no alternative way of working because nobody knows how to do it in a different way. That is, for me, the scary part of digitalization. Maybe that's my old mindset, being from a different generation.

Player 2: But I think the thing is that this web form and stuff you can think about it like Stratech, right [Facilitator]?

Facilitator: Yes.

Player 2: So when you buy it, you have to have support. So maybe it can be a Stratech type of thing, they can provide this kind of service.

Player 1: Or there has to be a specific role in the team.

Player 2: Yeah, well, that is what I have been thinking too, that it might be better to outsource it because the way we are outsourcing the Maco because we do not have enough people. And you know, people can go away. But for example, at Stratech, there are 15 people, and if one goes away, they still have 14 who can help out, but if we have one and he or she gets hit by a bus, then okay. For everything we are digitalizing and we do not have the knowledge in house, it's better to outsource. And it's not that expensive, mostly the costly part is to build this kind of things, but then the maintenance is mostly not that bad.

Player 2: Nice! I have no idea how did you put this together, but it's very impressive.

Player 1: I feel very old when I do these kinds of things.

Player 2: Just one question, did the others understand it easier and quicker than us? How the exercise went with the other couples?

Facilitator: It was really diverse, for some pairs, it was nice and they understood it well; for others, it was more challenging to play: someone did not have internet without VPN.

Facilitator: How did you feel about the game?

Player 2: It was good. I understood it, and now it was much quicker because I knew what to do from the beginning.

Player 1: Yeah, but still, I feel that I'm not on the full level of understanding. I was still sort of guessing a bit, okay, this must be it, this is what I need to do.

Player 2: Yeah, the flow chart? Sometimes it was also for me; I wasn't 100% sure what was drawn there.

Facilitator: Yes, it is prepared in a way that it's not obvious for the first sight which one is the solution. It has to be challenging, and with cooperation from both players is needed to guess the solution; it is part of the game. And since you did every guess right, I think you understood the essential part of it.

Player 1, 2: Yeah

3. **Facilitator:** Do you have any questions? Any doubt? Any suggestions?

Player 1: I really liked it, but I think it needs a certain level of expertise and knowledge to play the game. For people who have no idea about the MTO process, I think it is very hard to understand.

Player 2: And for me, to be honest, I'm also working like that, so for me, this PowerPoint tutorial, it doesn't work, I have to do it, and then I understand. So maybe you can calculate that not everybody understands just from theory but needs to be done. I found it quite difficult that I read, and then I was like I don't get that. And then we were doing it and then okay, now I understand. So maybe the only thing that I would suggest to play a tutorial round, maybe with some examples, and then play it for real.

And also, what I think that the flow chart you gave us for the hint could be more dummy; you have to think as a layman. What is for you totally obvious, I'm like what? So give a bit more information on these flowcharts to give hints. It is just a suggestion for the future, that for the next time, make it a bit more stupid. For an ordinary planner or employee, it might be too high level. It came out as an outcome that this is a very sophisticated game, just not everybody is as sophisticated. It is very interesting, very fun to do, and very nice, and I wouldn't mind if I have to play it even more, but it could be less complex or a bit more user friendly, dummy-proof.

Player 1: I think it has been a very tough situation, playing the game for you. Being the one hand away from the office not knowing some people, never having met those people, and also the high rotation of the people in the department. Because I think the most experienced people that you played the game with was us, all the other people are new, so I give you all the credit for that, and I think if you have some outcome that is not expected, it could be really linked to the level of experience of the people that you played the game with. The most experienced planners have been working here for one year. So the level of the people playing the game is very limited.

4. **Facilitator:** What has happened in the game? What decisions did you make?

Based on what events was this decision triggered?

Player 1: When I saw the number of jobs increasing, I wanted to digitalize those ones, but most of the times, I chose them randomly, being curious about the digitalization possibilities.

Facilitator: How are the game and reality connected? Please discuss the relationships between gaming simulation elements and system elements (in real life). Reflect on similarities and differences between the experience and reality.

Player 1: The game is based on actual process and it seems that all digitalization proposals could be implemented if we have no time and cost constraints. Double check to be done if Danone would allow interfaces with other companies / systems (for security reasons). SP vali-

dation of the orders is currently not done by Zoetermeer but if this can be done in the system by just 1 click of the button this would improve the process as well.

5. **Facilitator:** What did you learn?

Player 1: That there are a lot of possibilities to digitalize and also how to do this. This was a real eye-opener.

Facilitator: How do we proceed from here? Would you like to implement any digitalization technique introduced in the game? If yes, please provide a prioritized list of the digitalization techniques for the tasks.

Player 1: Yes! Priority:

- Automated order input into SAP
- Automated order input in rolling MTo file and CBU file
- Validation of order by Supply point
- Share batch info + COA with CBU's

A.6.6 Collaborate debriefing session

Facilitator: Hi everyone, Welcome to the discussion of the game sessions. First of all, thank you very much for participating in this experiment; I really appreciate your input.

This experiment is conducted for my Master thesis at TU Delft. I've developed DigiGame during my internship at Nutricia taking into account your input and my own experiences.

With your input for conducting the research and thanks to your participation, I was able to test the game with ten people with different experience levels.

Now, I'm progressing doing my thesis with the experiment, and I'm looking for a final discussion with you to validate my work.

Three questions will be discussed in this session.

Please feel free to join the conversation if you have any thoughts or comments.

We'll have 8 minutes to discuss the first question.

Do you think your perception on digitalization opportunities changed after this play experience?

Player E1: I can share. I thought that certain things could be digitalized, especially like forming the load and certain input like that we don't need to support with copy-paste to certain files or chasing people by mail. But I think that would be valid if there is a sanity check at the initial input. For example, to eliminate mistakes that can be there when the person creates PO and also once the formal load is formed, there should be some sanity check to validate before submitting for DN creation. For the rest, to a certain extent, that's a very good flow and opportunities that can be there to digitalize and improve the flow in general.

Player C1: When it comes to my perception, it has changed a lot because I remember filling in the questionnaire that I thought a lot of steps probably could be digitalized, but I had no idea how and now, after playing the game, I saw a lot of opportunities and I think it gives a bit more foot for thoughts and some support to also think about other digitalization opportunities, not only in the MTO process but in general I think within our job because it gives some tools to use for some of the tasks that we do. So for sure, it has changed my perception for future opportunities on other processes as well.

Player E2: I think for me, I always knew that there were digitalization opportunities on the job, but one thing I get to learn from the game when I was playing, how it actually works. I think,

when we were playing the game, in the second part, I believe you came up with options for how do you digitalize certain processes, and I think that was an eye-opener I think for me.

Player A1: For me, it was quite new, the entire MTO process, since I don't work with the MTO process, and I'm also not that long here in Nutricia. So it was quite abstract for me how these steps could be digitalized; I haven't experienced these steps myself. But overall, it gave me a bit of understanding of how the MTO process operates and where there are gains to digitalize. So that's my experience with the game.

Player C2: I'm very interested in what [Player B1] finds about this because she is a main MTO user.

Player B1: So let's do it!

Player C2: So that's clear.

Facilitator: So [Player B1], do you have any comments on it, or would you just digitalize from tomorrow?

Player B1: Yeah! I do agree that we first need to have certain checks to be sure that it is implemented in a right way without a double input on it, than it will work. I also realize that it will take some time, and we need to find the way to do it and probably where to start. But it was a good lesson, a good experience.

Facilitator: Anybody else has a comment? If not, then we can proceed to the next question:

In the discussion after the game session, in the final question, you were discussing a prioritized list of the digitalization techniques - I summarized the suggestions you made. As an outcome of the experience, we had two different scenarios:

What do you think of it?

I would like to know if you have any comments on that – are these priorities interesting for you? Do you think this is feasible?

Player E2: I think scenario 1 is more for the people planning MTO because it will come in very handy for them because it automates most of their tasks. And I think the second scenario requires much bigger project and it's much more complicated, but I think in turn it also enables to benefit everyone, I guess.

Player E1: Yeah, I agree, but I think eventually it is a business decision and it is also related to budget, I guess. I see a lot more pluses in the second scenario for order management in an integrated approach, but I also see that if the budget is limited and I don't know, there is the business strategy not to jump straight into a fully integrated approach than I think scenario 1 would give already a taste of what it can be and how it can optimize. So maybe if aligned properly then certain input and what is done in scenario 1 can be also utilized if it ever gets submission to scenario 2.

Player C1: Yeah, I think the first scenario is something that we can actually implement in the short term with the knowledge we have ourselves and maybe a little bit of external knowledge on the RPA. Scenario 2 is probably more sustainable eventually because we would have proper support from the IT department. Because I think scenario 1 is heavily dependent on the knowledge of the people who work with it and picks any issue that happens because some processes can be quite sensitive to users' mistakes. If there's not enough knowledge and it cannot be fixed it blocks the whole process. And I think in scenario 2, as a set, it will be supported by the IT department, and it can be fixed in a proper way.

Facilitator: Yeah, I also think for scenario 1 it would be nice to have support.

In the case of no further comments, I have an additional question for you:

What can be done from now? What do you think should be done? Do you think you will apply any of the digitalizations discussed?

Player E2: I think this digitalization can become like a project-based thing. Because right now, I don't think that every person will just start doing it. So it should be made into a project, and the interested planners should apply to be part of the project, and that's how I think it should be taken from here. That's my opinion.

Player E1: Yes I agree, but I think also probably it depends on the whole Nuticia and Danone outlook on digitalization. I think if it comes from as one of the business goals to increase the digitalization level, then I think it is a lot easier to implement or roll out certain projects. I'm a little bit skeptical, starting the digitalization at the department level because from own practice; they see that a lot of input is done, and a lot of work is directed. In the end, also if someone is leaving certain knowledge leaves and there is no consistency, and it's very labor and cost-inefficient in the longer run. But if that would help so set a motion for digitalization in Danone and Nutricia in general, then I think it is a good initiative. Otherwise, I think it should have come on a corporate level as one of the goals. Then it would be cascaded down to see what options there are and for the implementation – and as said before – it should start either as a big project or certain areas that can be digitalized and then on project bases, planners can also contribute.

Player C1: There is actually a digitalization project defined for D&L team: I think the automated order input in SAP is actually one of the first steps to be done. Maybe not as proposed by the [Facilitator] via webform, I think it's the automatic upload via Excel to SAP.

Player C2: So you do not have to look straight into gigantic big things, and this is also not a global Danone thing, it's our own process so we can just automate. It's the same as documentation: that it's only ours so we can automate it as we would like, that's the good about it. And also, we can start right now if we want to. And as said before, maybe not exactly the way, how in the game was shown right away. We already identified some steps also with the [Facilitator] that can be a start, and then in the background, we could start to check the possibilities of web forms. So there is a possibility to do this, for everybody is agreeing on that this is a lot of manual work and this would be much better to do it automatically, already starting with the order input, then that's not such a big thing to do: it is basically an Excel file that can be uploaded into SAP, could be done quite quickly. For the rest, indeed, a project could be set up with colleges working with it and have the knowledge like [Player E2] and [Player B1] because you are basically the biggest MTO users. So I think that's how it could start. I think this is a very feasible part, the automated order input; I think that would be something that we should put on the agenda, on the road map as a new project, and figure out quickly how it could be done. I don't know what [Player B1] and [Player E2] you think about that.

Player E2: I myself don't use the MTO rolling file anymore, but I do think like in my case, I use the shipment plan. If they can be automatically entered into SAP, that would be amazing because I feel like the steps are quite repetitive, especially when it is the same distributor. And I know for sure that for the MTO rolling file – because I worked with it for a while – and that would also be beneficial to have it automated.

Player B1: I have experience with everything that comes to MTO: I use everything: MTO rolling file and all kind of CBU files. So if you combine the expertise and the knowledge, I think we can start the project. I think [Player E2] and me would be in it and maybe some supervisors: And yeah, I think that would be a good idea.

Player C1: Maybe it's too early to say that we should implement all of it know, but I think it

gives at least some idea, maybe also on other processes, not only to MTO. I think about, okay, what tasks I'm doing as a repetition every day or every week, which are not very complex but time-consuming, and you could also put that on the road map to digitalize.

Player C2: Basically, if we are here at digitalization, everything should be as much as possible solved. I think that's the main point: that we have to really look at everything like nothing is nonsense, and then it can turn out that okay, some points cannot be digitalized and still has to be manual, but everything could be collected as an option. Basically, that's why this game was good because I did not even realize that this whole MTO process has so many different aspects. So that was very useful for me because mostly, the MTO process is just the irritating entering orders in the system and then taking batches and then deliver. But yeah, there are a lot of things, really. And that's why the knowledge and experience of [Player B1] and [Player E2] is good because then you know that it's okay, but I still have to check it with the CBU, than they still have to say okay, and I still have to make sure it's available, then I need every kind of documents with it. So I think we should digitalize everything and as soon as possible. That's what I think; this is really what showed me your game and your research [Facilitator].

A.6.7 Pre- and post-game questionnaire


Please rate the sentences.

	1 (Strongly disagree)	2	3	4	5 (Strongly agree)
I think my tasks are well supported by IT.	○	○	○	○	○
I am motivated for the digital transformation.	○	○	○	○	○
Digitalization can make business processes more efficient.	○	○	○	○	○
I am familiar with the MTO (make to order) business process at Nutrcia.	○	○	○	○	○

Figure A.6: The form for the pre- and post-game questionnaire, first section

Please answer the questions regarding each tasks listed.

	Digitalization can improve the task					I have an idea how to digitalize the task					I have an idea how to digitalize the task	Digitalization can improve the quality of service					How can digitalization improve the task?
	1 (Strongly disagree)	2	3	4	5 (Strongly agree)	1 (Strongly disagree)	2	3	4	5 (Strongly agree)	Suggestion	1 (Strongly disagree)	2	3	4	5 (Strongly agree)	Suggestion
Creating sales orders/contracts	○	○	○	○	○	○	○	○	○	○		○	○	○	○	○	
Data input to SAP	○	○	○	○	○	○	○	○	○	○		○	○	○	○	○	
Order management in Excel	○	○	○	○	○	○	○	○	○	○		○	○	○	○	○	
Checking inventory level at warehouse	○	○	○	○	○	○	○	○	○	○		○	○	○	○	○	
Planning shipments	○	○	○	○	○	○	○	○	○	○		○	○	○	○	○	
Creating deliveries	○	○	○	○	○	○	○	○	○	○		○	○	○	○	○	
Creating Supply Point risk file	○	○	○	○	○	○	○	○	○	○		○	○	○	○	○	

Figure A.7: The form for the pre- and post-game questionnaire, second section

Did you learn something? During the game session .... improved.

	1 (Strongly disagree)	2	3	4	5 (Strongly agree)
my knowledge about digitalization techniques	○	○	○	○	○
my skills to improve business processes	○	○	○	○	○
my knowledge about the MTO process	○	○	○	○	○

What do you think about the artifact?

	1 (Strongly disagree)	2	3	4	5 (Strongly agree)
I think it is a game.	○	○	○	○	○
It was fun to play.	○	○	○	○	○
It was clear.	○	○	○	○	○
It was easy to use.	○	○	○	○	○
The business process was well represented by the building blocks.	○	○	○	○	○
I was motivated to perform well.	○	○	○	○	○
The collaboration was valuable.	○	○	○	○	○

Future aspect

	1 (Strongly disagree)	2	3	4	5 (Strongly agree)
I would use the technologies introduced to improve my business process.	○	○	○	○	○

Figure A.8: The form for the post-game questionnaire, third section, questions only asked after the game

A.7 Quantitative data analysis

	$\overline{x}_{pre}$	σ_{pre}	$\overline{x}_{post}$	σ_{post}	$\overline{x}_{post} - \overline{x}_{pre}$
I think my tasks are well supported by IT.	3.00	0.87	3.00	0.76	0.00
I am motivated for the digital transformation.	4.22	0.83	4.38	0.92	0.15
Digitalization can make business processes more efficient.	4.44	0.73	4.75	0.46	0.31
I am familiar with the MTO (make to order) business process at Nutrcia.	3.88	1.13	4.13	0.83	0.25

Table A.3: How much do you agree with the presented statements?

Digitalization can improve the task					
	$\overline{x}_{pre}$	σ_{pre}	$\overline{x}_{post}$	σ_{post}	$\overline{x}_{post} - \overline{x}_{pre}$
Creating sales orders/contracts	4.56	0.73	4.33	1.00	-0.22
Data input to SAP	4.83	0.41	4.57	0.53	-0.26
Order management in Excel	4.83	0.41	4.43	0.79	-0.40
Checking inventory level at warehouse	4.33	0.50	4.22	0.83	-0.11
Planning shipments	3.78	0.97	4.00	0.87	0.22
Creating deliveries	4.17	1.17	4.71	0.49	0.55
Creating Supply Point risk file	4.33	0.71	4.11	0.78	-0.22

Table A.4: Digitalization can improve the task

I have an idea how to digitalize the task					
	$\overline{x}_{pre}$	σ_{pre}	$\overline{x}_{post}$	σ_{post}	$\overline{x}_{post} - \overline{x}_{pre}$
Creating sales orders/contracts	3.56	1.33	3.75	1.28	0.19
Data input to SAP	3.17	1.17	3.67	1.03	0.50
Order management in Excel	3.33	0.82	3.33	1.03	0.00
Checking inventory level at warehouse	2.89	1.17	3.67	1.06	0.78
Planning shipments	3.11	0.93	3.00	0.83	-0.11
Creating deliveries	3.67	1.03	4.00	1.38	0.33
Creating Supply Point risk file	2.89	1.05	3.17	1.06	0.28

Table A.5: I have an idea how to digitalize the task

Digitalization can improve the quality of service					
	$\overline{x}_{pre}$	σ_{pre}	$\overline{x}_{post}$	σ_{post}	$\overline{x}_{post} - \overline{x}_{pre}$
Creating sales orders/contracts	4.11	0.78	4.56	1.01	0.44
Data input to SAP	4.20	0.45	4.86	0.38	0.66
Order management in Excel	4.33	0.52	4.67	0.82	0.33
Checking inventory level at warehouse	4.11	0.78	4.33	0.87	0.22
Planning shipments	4.00	0.50	3.78	1.20	-0.22
Creating deliveries	4.17	0.75	4.57	0.79	0.40
Creating Supply Point risk file	3.67	1.00	4.22	0.97	0.56

Table A.6: Digitalization can improve the quality of service

	Experienced		Inexperienced				
	Mean	$\sigma =$	Mean	$\sigma =$	Mean diff. (exp - inexp)	p	Significance
My knowledge about digitalization techniques improved	4.8	0.45	2.5	0.58	2.3	0.0143	Y
My skills to improve business process improved	3.6	1.14	3	0.82	0.6	0.3913	N
My knowledge about the MTO process improved	3	0.82	4	0.82	-1	0.1489	N
I think it is a game	3.6	0.55	2.75	0.5	0.85	0.0864	N
It was fun to play	4.4	0.55	3.25	1.26	1.15	0.1416	N
The artifact was clear	3.6	0.55	2.5	0.58	1.1	0.05	Y
The artifact was easy to use	3.2	0.84	3.25	1.5	-0.05	1	N
The business process was well represented in the game	4.4	0.89	4.25	0.5	0.15	0.6242	N
I was motivated to perform well	4.4	0.55	3.5	0.58	0.9	0.0864	N
The collaboration was valuable	4.8	0.45	4	0	0.8	0.05	Y
I would use the technologies to improve my business process	4.4	0.548	3.75	1.26	0.65	0.4624	N

Table A.7: Post-game survey

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