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Concept Design of a Learning Factory to Develop Customer Awareness for Service Products

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Affidavit

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Acknowledgment

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Elma Alexandra Sadaj

Abstract (EN)

The automation of warehouse processes, the increased complexity due to e-commerce or the development towards paperless warehousing are just some of the factors that the logistics industry is facing. Intralogistics system providers offer new warehouse systems and logistic products that deliver solutions with increased efficiency – for higher, faster and more accurate output. However, this comes with a high operating complexity and unknown new tasks, which lead to wrong operation of the facilities. The situation challenges not only new warehouse operators but also experienced ones. A bad operation of the plant leads to dissatisfaction of the customers of intralogistics system providers.

Various service products are offered by intralogistics system providers to assist the warehouse operators but the lack of understanding the services and the costs involved, causes customers to refuse acceptance of the services. The logistics manufacturers are, therefore, confronted with the challenge to introduce effective and sustainable methods to transfer the service related knowledge to their customers. This offers companies new opportunities to increase customer satisfaction and further develop customer relationships.

The demand for practice-oriented training and education of customers is key to master upcoming challenges of warehousing facilities. This thesis intents to develop comprehensive, versatile and hands-on trainings on service products for awareness building. The aim is to build a learning environment to experience the services for different logistics needs and tailor these to warehouses, as well as, to train customers to understand the new systems and use the services correctly. The new environment helps customers to gain back empowerment over their facilities. Furthermore, the learning environment will help to train new and existing employees on service products and their importance on nowadays logistics plants. Additionally, the customer-oriented approach fosters new insights into the customers' plants. This knowledge might be used to improve and innovate service products further.

In the framework of this project, a practice- and customer-oriented training concept has been developed. The focus of this concept will be on innovative teaching concepts for developing the customers awareness of service products.

The basis for the selection of the learning method is a theoretical examination of learning environments and teaching methods. For the implementation and realization of the final concept the following has been developed:

- a layout of the training environment,
- training curriculum,
- course packages,
- a detailed curriculum of the training for two service packages

Further, a pilot prototype has been implemented and tested.

Among other things, the concept promises lower training costs, improved transparency as well as improved learning success through higher motivation of the training participants.

Abstract (DE)

Die Automatisierung von Lagerprozessen, die zunehmende Komplexität durch E-Commerce und die Entwicklung hin zu papierloser Lagerhaltung sind nur einige der Faktoren, mit denen die Logistikbranche konfrontiert ist. Intralogistik-Systemanbieter bieten neue Lagersysteme und Logistikprodukte an, die erhöhte Effizienz liefern – für einen höheren, schnelleren und genaueren Output. Dies führt jedoch zu einer hohen Bedienkomplexität und noch unbekannten, neuen Aufgaben, die zu einer fehlerhaften Bedienung der Anlagen führen. Die Situation stellt somit nicht nur neue, sondern auch erfahrene Lagerbetreiber vor große Herausforderungen. Ein unzweckmäßiger Betrieb der Logistikanlage führt zu Unzufriedenheit bei den Kunden der Intralogistik-Systemanbieter.

Diverse Dienstleistungsprodukte werden von Logistikanlagenherstellern angeboten, um den Lagerbetreibern zu helfen, jedoch führen das mangelnde Verständnis für die Produkte und die damit verbundenen Kosten dazu, dass Kunden von der Annahme der Dienstleistungen absehen. Die Logistikhersteller stehen daher vor der Herausforderung, effektive und nachhaltige Methoden einzuführen, um das Wissen über die Services an ihre Kunden weiterzugeben, die Kundenzufriedenheit zu erhöhen, und in weiterer Folge die enge Kundenbindung weiter auszubauen.

Der Bedarf an praxisorientierter Aus- und Weiterbildung der Kunden ist der Schlüssel zur Bewältigung der anstehenden Herausforderungen an Logistikanlagen. Diese Masterarbeit beabsichtigt sich damit umfassende, vielseitige und praxisnahe Schulungen der Serviceprodukte zur Bewusstseinsbildung anzubieten. Ziel ist es, sowohl eine Umgebung zu schaffen, in der die Dienstleistungen für verschiedene Logistikbedürfnisse und Lager zugeschnitten werden können, als auch die Kunden darin zu schulen, die neuen Systeme zu verstehen und die Dienstleistungen richtig zu nutzen. Darüber hinaus wird die Lernumgebung dazu beitragen, neue und bestehende Mitarbeiter in Bezug auf Serviceprodukte und deren Bedeutung für die heutigen Logistikanlagen zu schulen. Weiters fördert der kundenorientierte Ansatz neue Einblicke in die Anlagen der Kunden. Dieses Wissen kann in weiterer Folge genutzt werden, um Serviceprodukte weiter zu verbessern und zu entwickeln.

Im Rahmen dieses Projektes wurde ein praxis- und kundenorientiertes Trainingskonzept entwickelt. Im Mittelpunkt dieses Konzepts stehen innovative Unterrichtskonzepte zur Bewusstseinsbildung der Kunden für Dienstleistungsprodukte (Services).

Grundlage für die Auswahl der Lernmethode ist eine theoretische Untersuchung von Lerntheorien und Lehrmethoden. Für die Umsetzung und Realisierung des endgültigen Konzepts wurde ein Layout der Trainingsumgebung, der Trainingsablauf, Schulungspakete und eine detaillierte Übungsbeschreibung der Schulung für zwei Servicepakete entwickelt und ein Prototyp des Konzepts aufgebaut und getestet.

Dieses Konzept verspricht unter anderem niedrigere Trainingskosten, mehr Transparenz sowie einen verbesserten Lernerfolg durch höhere Motivation der Trainingsteilnehmer.

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1 Introduction

"The only source of knowledge is experience." Albert Einstein

The present master's thesis is written at the Institute of Innovation and Industrial Management (Graz University of Technology) in cooperation with the partner company KNAPP AG. Within the scope of this project, a customer-oriented and hands-on training concept will be designed with the focus on service products of KNAPP AG for logistic warehousing. The focus of this concept will be on innovative teaching concepts to build awareness for service products in the operation logistics plants.

Knapp AG was founded in 1952 in Graz. The international company with Styrian roots employs 2700 people currently and has experienced enormous growth in the past years. The corporate strategy is continuous development and research.

Knapp AG considers itself to be a developer and a service provider. Hence, it is essential to offer the right services to clients in an understandable way. At the same time, it is important for customers to become aware of service products and apply these correctly.

Following this corporate culture, this thesis is in the field of innovative teaching concepts as well as the implementation of a hands-on teaching environment.

1.1. Task

Customer satisfaction is an important factor in successfully differentiating a company from the competition. KNAPP AG intends to offer its customers comprehensive, versatile and practice-oriented service product training for increasing the awareness on service products.

The high degree of automation confronts both experienced customers and new warehouse operators with unknown tasks. The objective is to offer customers services that are as specific as possible and tailored to their warehouse, and also to train customers to understand these services and purposefully use them. The service products will be experienced by the customer.

1.2. Objectives

The purpose of this work is the development of practice- and customer-oriented training concept with the focus on developing awareness of service products. Therefore, the following objectives have been defined:

- Theoretical research on learning and learning methods,
- Analysis of learning factories,
- Identification of KNAPP services and their benefits for customers,
- Generation of requirements of KNAPP services for a learning infrastructure,

- Development of 4 rough concepts of learning environments to make KNAPP Services a tangible experience,
- Designing and Outlining of the detailed concept for a learning environment (structure, procedure, etc.).

Non-objectives with the framework of this work are:

- Physical creation and/or virtual construction of the learning environment,
- Preparation of detailed training equipment and material,
- Development of new service products.

1.3. Structure of the Thesis

The thesis is structured in three parts – Theoretical Foundation, Analysis of Learning Factories and Concept Design Approach.

The first part starts with the theoretical definitions of the main terms, such as didactics, knowledge, qualification, competency, experience, and learning. It is followed by an overview and description of different learning theories and methods.

The second part builds the foundation for the conceptual design. The first half of this chapter gives the definition, characteristics, and benefits of the learning factory. While the second half describes a concept used for awareness development within a learning factory, features of this concept will be used in the practical design process.

Based on the thorough research of the final method, an action plan is developed. The design and implementation of the task will be described in the last part of this thesis. The practical part is sectioned into three phases. The first phase provides an analysis of the current state, including a benchmark on learning factories, and the review of two on-sites visited learning factories. The purpose of the first phase is to derive a requirement catalog for the training system. The second describes the ideation process. Different idea concepts and realizations models are developed and evaluated. The last part presents the actual concept design phase of the learning environment and the testing and setup of the pilot prototype.

This thesis finishes with a short outlook and future challenges chapter.

2 Theoretical Background /Foundation

Throughout history, industrial revolutions and inventions call for changes in the knowledge of individuals. Human capital has become the most significant potential of companies. In the twenty-first century, the knowledge of the individual and the organizational knowledge of the company is of high importance, and work procedures are no longer dependent on manual skills.[1] Therefore, the leading resources for social and economic progress are knowledge and education.[2] And fast changes and increasing complexity of systems in all industries make the development of knowledge more difficult and requires a quicker knowledge transfer.[3] To keep up with the new dynamic, that is challenging all business, and to generate knowledge faster, new and innovative learning methods and tools are crucial.[4]

Figure 1 shows the positive effects of education for all affected levels (individual, organizational and national) from short to long term. The most significant impacts of high-quality education are individual income, competitiveness of enterprises, and economic growth.[5]

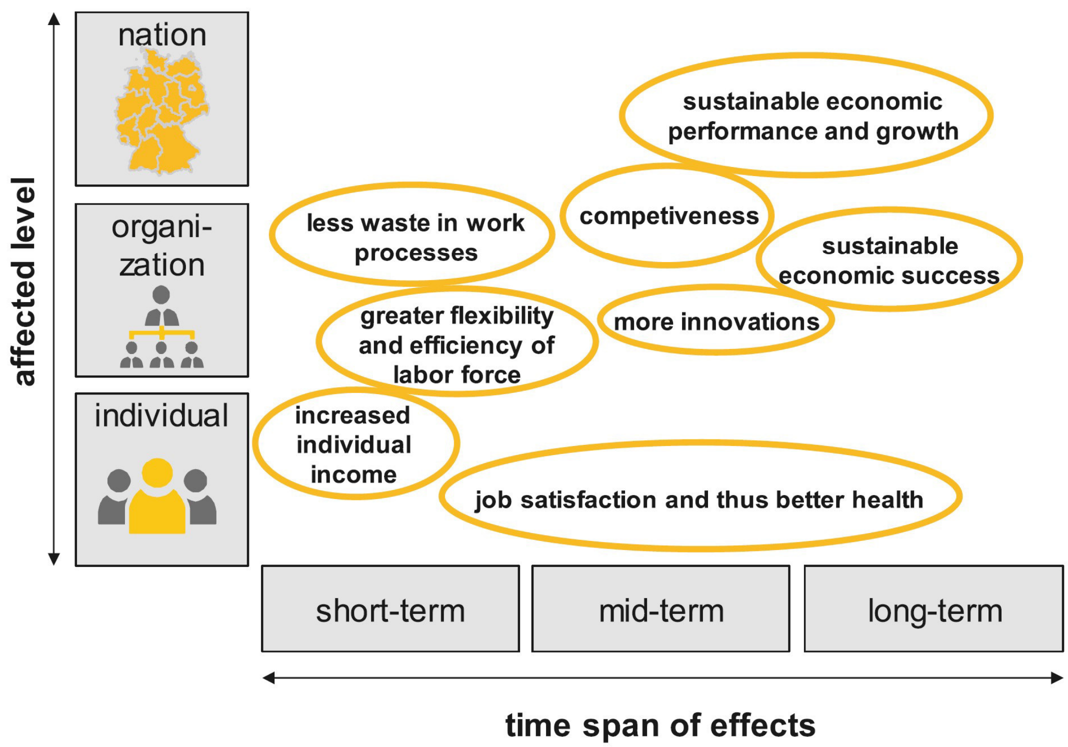

Figure 1: Effects of Education on National, Organizational and Individual Level[6]

[1] Bullinger, Spath, Warnecke, & Westkämper, 2009, pp. 197-210
[2] Abele & Reinhart, 2011, pp. 150-166
[3] Adolph, Tisch, & Metternich, 2014, pp. 101-110
[4] Abele & Reinhart, 2011, pp. 219-226
[5] Gylfason, 2001, pp. 847-859
[6] Abele, Metternich, & Tisch, 2019, p. 1

The future success of companies is directly connected to the capability and the knowledge of employees and managers.[7] The reason for the high demand of education is the shift from skilled manual labor towards more knowledge- and competency-intensive workplaces.[8]

This chapter forms the basis and starting point for further research in the field of training and education with the focus on learning factories. The following section of the thesis provides the theoretical background for the selection of the concept approach. It starts by defining the most critical terms and offers a classification of various methods following a description of the different teaching methods.

2.1. Didactics

In order to learn something, the process needs to be planned. Didactics is responsible for covering the planning. According to Dagger, didactics is the science of teaching and learning in general and deals with learning in all its forms and teachings of all kinds.[9] The following sub-chapter defines the term didactics.

2.1.1. Definition of Didactics

The term "didactics" has its roots in the Greek language and originates from the word "didàskein" which can be translated “to teach”.[10] Didactics is the art of teaching and the core element of didactics is the organization of learning and teaching processes. Didactics, however, does not only mean the theoretical approach to the processes but also their practical implementation.[11]

Riedl further adds: "Didactics as action science attempts to clarify who, what, by whom, when, with whom, where, how, with what and what to learn.”[12]

The process of learning and teaching can be structured into two main sections:

- the goal-dimension and
- the path-dimension.

The goal-dimension determines which learning contents and learning goals are pursued and thus provides answers to the questions of what and why. The path-dimension determines which methods and which instruments are used in the teaching (learning) process and answers the how and with what should be taught or learned.[13]

[7] O’Sullivan, Rolstadås, & Filos, 2011, pp. 663-674
[8] CEDEFOP, 2010, p. 68
[9] Dagger, 1965
[10] Jank & Meyer, 1991, p. 16
[11] Riedl, 2004, p. 8
[12] Riedl, 2004, p. 8
[13] Riedl, 2004, p. 8

Figure 2 shows the different views on didactics. In a narrow sense didacts is seen as the specification and implementation of goals and contents in the learning environment. The methodology which is responsible for the design of the environment is a separate area. This view on didactics has lost much of its significance nowadays. The more common view is the didactics in a broader sense. It includes both learning goals and contents as well as learning instruments and media. In this case the methodology becomes part of the didactics itself.[14]

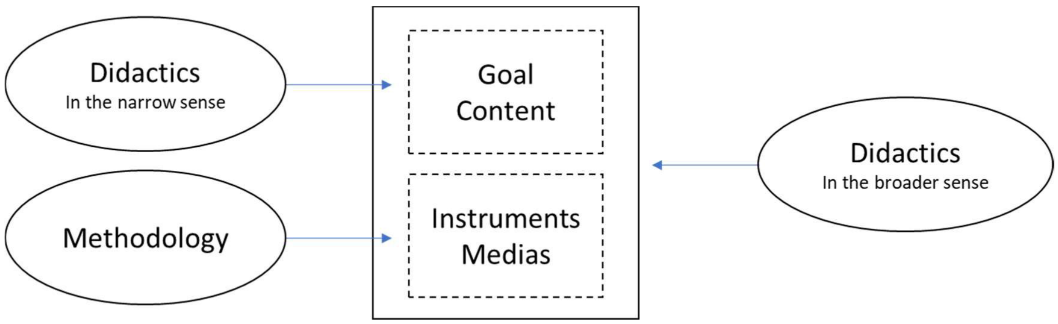

Figure 2: The Different Views on Didactics[15]

2.2. Knowledge, Qualification, Competency and Experience

In today's environment knowledge, qualifications, competencies, and experience are often used to express the same. In literature, however, they are differentiated in their meaning. In general, knowledge in the narrower sense and qualifications are the necessary prerequisites for education.[16] To deal with a complicated situation includes more than transferred knowledge. It is a comprehensive competency development, and this competency is developed through experience, in some way.[17]

Figure 3 shown the concept of competence is based on knowledge (in the narrow sense). The competency is influenced by rules, values, and norms of individual persons or entire groups when they are internalized and affects the actions of the individuals. Non-internalized rules, norms, or values have no relevance to the actions of the individual. The higher the experience, the more consolidated are the competences.[18]

[14] Riedl, 2004, p. 8
[15] Riedl, 2004, p. 8
[16] Kuhlmann & Sauter, 2008, pp. 21-25
[17] Heyse & Erpenbeck, 2009, pp. 12-20
[18] Heyse & Erpenbeck, 2009, pp. 12-20

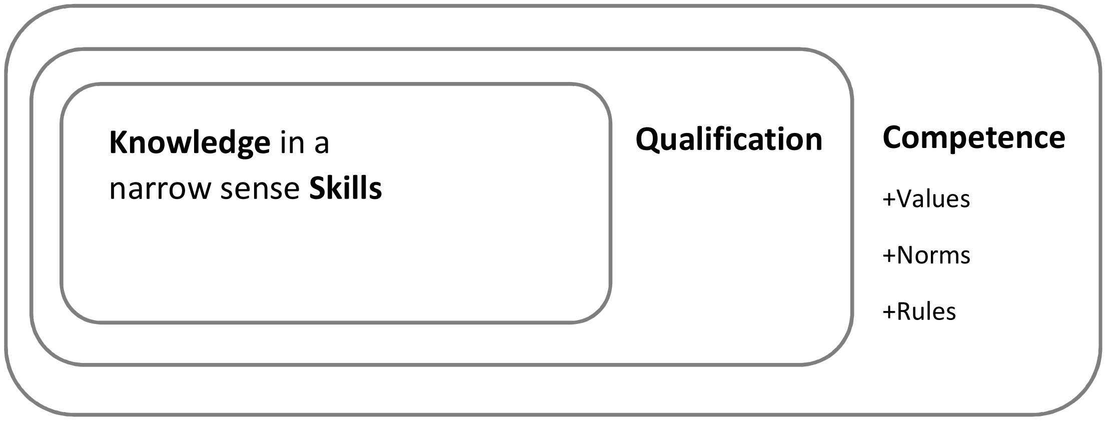

Figure 3: Relation of Knowledge, Skills, Qualification and Competency[19]

2.2.1. Definition of Knowledge

Knowledge has very contradictory definitions depending on whether business scientists, educators, politicians, philosophers, or managers describe the term.[20] For this thesis, the definition provided by the European Commission will be used. Knowledge is defined as an "*outcome of the assimilation of information through learning. Knowledge is the body of facts, principles, theories, and practices that are related to a field of work or study*." [21]

A similar definition is also used in knowledge management. Figure 4 depicts the "Knowledge Stairs" which shows that knowledge is built on signs and data. [22]

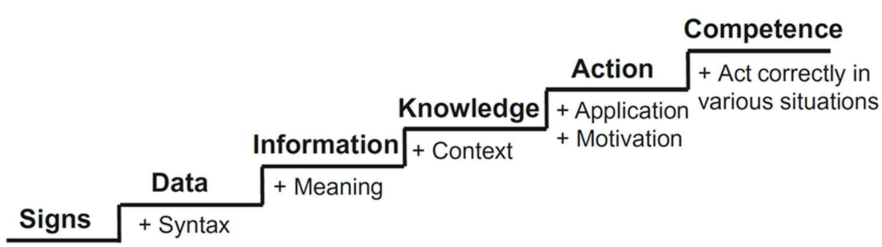

Figure 4: Knowledge Stairs [23]

2.2.2. Definition of Qualification

Qualifications are a prerequisite for competencies. Furthermore, qualification can be tested and verified through certification procedure, on the job training, etc.[24] The necessary requirements to operate a job can be defined as the qualifications.[25]

[19] Heyse & Erpenbeck, 2009, p. 12
[20] Kuhlmann & Sauter, 2008, pp. 23-25
[21] CEDEFOP, 2008, p. 106
[22] North, 2011, p. 35
[23] North, 2011, p. 36
[24] Kuhlmann & Sauter, 2008, p. 25
[25] Hacker, 1973, pp. 380-395

Baethge defines qualification as the ability to perform work. In other words, qualification thus means the prerequisites of the production and reproduction process tied to the working subject. The term "qualification" is characterized by the dualism of the requirements of the workplace and field of work as well as the preconditions (potential for action) of the individual to overcome them. The requirements are defined externally and require individual adaptability and adjustability to the work environment and the functions to be fulfilled. The dualism mentioned implies the demands for coordination of functional requirements and individual requirements. Qualification is a static concept, a product and result of what is and should be.[26]

2.2.3. Definition of Competencies

The concept of competency or competence plays a role in psychology especially when the performance of a task is crucial. In educational research, this term has gained considerable importance for the definition of the goals of educational systems and the development of educational standards.[27,28] In this context, competencies are used to define educational goals in education systems.

For better clarification of competency (or competence), three concept approaches are classified:[29,30]

- The behavioral and performance-oriented approach understands competences as specific job-related and measurable behavior that ignores the underlying attributes.
- It is a generic approach that includes underlying attributes such as knowledge in the competence concept and ignores specific application contexts.
- A holistic approach in which competencies are designed based on knowledge, attitudes, skills, and achievements in explicit application contexts of professional life. The approaches mentioned above are integrated.

2.2.4. Definition of Experience

According to Jürgen Mittelstraß, experience usually means "*the gained ability of secure orientation [and] being familiar with certain action and contexts without referring to an independent theoretical knowledge*".[31]

[26] Baethge, 1974, pp. 478-484
[27] Klieme, E., Avenarius, H., Blum, W., Döbrich, P., Gruber, H., Prenzel, M. Reiss, K., Riquarts, K., Rost, J., Tenorth, H.-E. & Vollmer, H. J., 2003, pp. 55-85
[28] Klieme, 2004, pp. 10-13
[29] Short, 1984, pp. 201-207
[30] McMullan, M., Endacott, R., Gray, M. A., Jasper, M., Miller, C. M. L., Scholes, J., et al., 2003, pp. 283-294
[31] Mittelstraß, 1980

The experiential theory was introduced by David A. Kolb, who defines experiential learning as "*the process whereby knowledge is created through the transformation of experience*".[32] The mentioned transformation undergoes four stages (see Figure 5):[33]

a. Concrete experience is the actual situation that an individual has experienced in personal or professional life, whether it's a new situation, a given task, or a new cooking recipe.

b. Reflective observation means to reflect on the experience to learn from it. In this stage, it is observed what was right and wrong, but also to find out how to improve or do it differently.

c. Abstract conceptualization is the understanding of the root cause and to set up a future strategy.

d. Active experimentation is the stage where the individual acts and sets the plan into action. The individuals experiment with the acquired knowledge and translate the gained knowledge into a prediction.

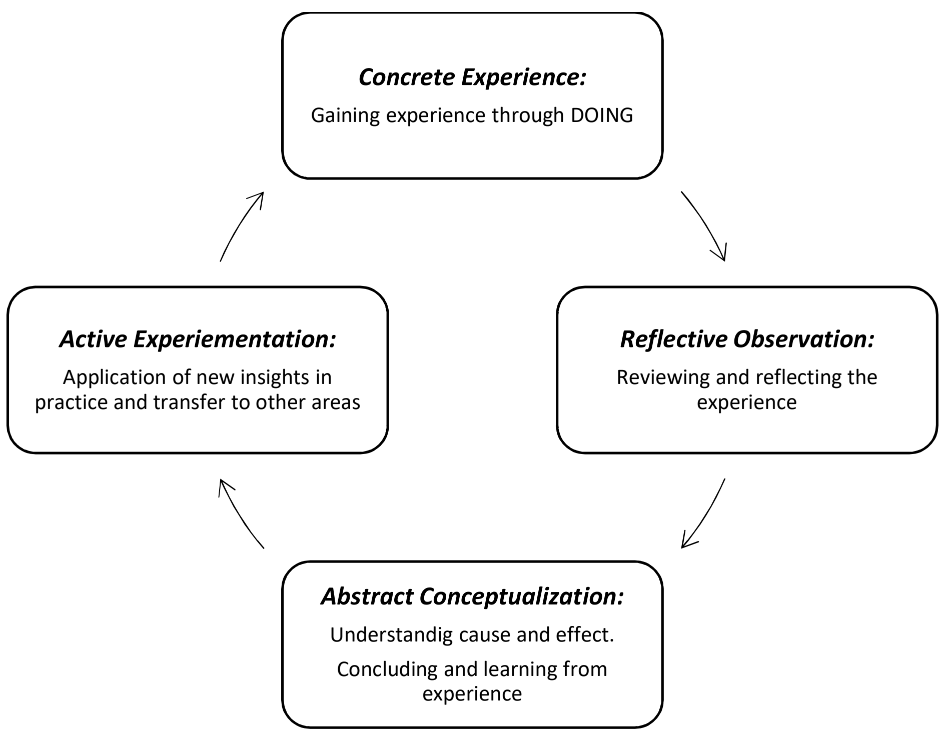

Figure 5: Kolb's Experiential Learning Cycle[34]

[32] Kolb, 1984, p. 41
[33] Kolb, 1984, pp. 42-50
[34] Kolb, 1984, p. 50

2.3. Learning

Learning affects us every day and in every situation. It can be anything from developing theoretical knowledge to practicing a motor skill.[35] This subchapter covers the basics of learning, starting with the definition of the main term.

2.3.1. Definition of Learning

The literature offers different meanings depending on the author. In the following the definition of Richard Mayer is chosen, which describes learning as the permanent change of a person's knowledge or behavior through experience. This definition consists of three components:[36]

1) the duration of the change is long-term rather than short-term,
2) the place of change is the content and structure of knowledge or the behavior of the learner,
3) the cause of the change is the learner's experience in the environment.

The term learning is regularly used as a modification of [37,38]

- knowledge
- behavior
- beliefs
- views
- capabilities
- strategy
- values
- and other.

Modification and adaptation of knowledge comes in different forms, and might affects linguistic, cognitive, motor and social areas.[39] Commonly the areas are divided into a cognitive, a psychomotor and an affective learning dimension.[40] Learning forms links to and between experiences and knowledge. The effects of learning can be seen as relatively permanent since changes in learning can have profound and lasting effects.[41]

[35] Richard E. Mayer, 2016, pp. 1-10
[36] Richard E. Mayer, 2016, S. 108-126
[37] Kirkpatrick, 1996, pp. 54-57
[38] Schunk, 2003, pp. 22-23
[39] Schunk, 2003, pp. 100-101
[40] Bloom, 1969, p. 7
[41] Schaper, 2000

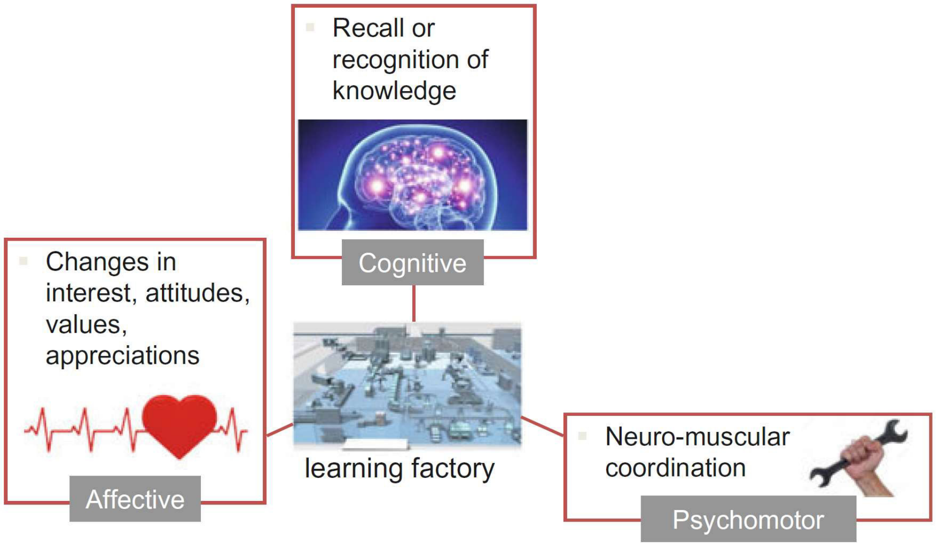

Figure 6: Cognitive, Affective and Psychomotor Dimensions in the Learning Factory[42]

2.3.2. Formal, informal and non-formal learning

According to the OECD (Organization for Economic Co-operation and Development), learning is divided into formal, informal and non-formal learning. Between formal and informal learning, the non-formal learning concept provides a combination of the other two.[43, 44]

Formal learning is planned and regularly carried out by related objectives. It is performed in educational institutions, and the knowledge transfer happens hierarchically, meaning the learner acts as a knowledge receiver and it happens intentionally. [45]

Informal learning is usually random and happens experiential and implicit. The settings are not educational, and knowledge transfer occurs unplanned in segments. The learning happens unintentionally by experience or carrying out a task. Therefore, the learning outcome has no set objective.[46]

However, non-formal learning contains elements of both formal and informal learning. Although the untraditional educational setting, learning takes place organized. The learning situations within the learning environment are planned, but the process of learning occur unplanned alone or in groups. The learning is transferred hierarchically and segmented.

[42] Abele, Metternich, & Tisch, Learning Factories, 2019, p. 30
[43] http://www.oecd.org/education/skills-beyond-school/recognitionofnon-formalandinformallearning-home.htm
[44] Eraut, 2000, pp. 114-115
[45] Dehnbostel, 2007
[46] Dehnbostel, 2007

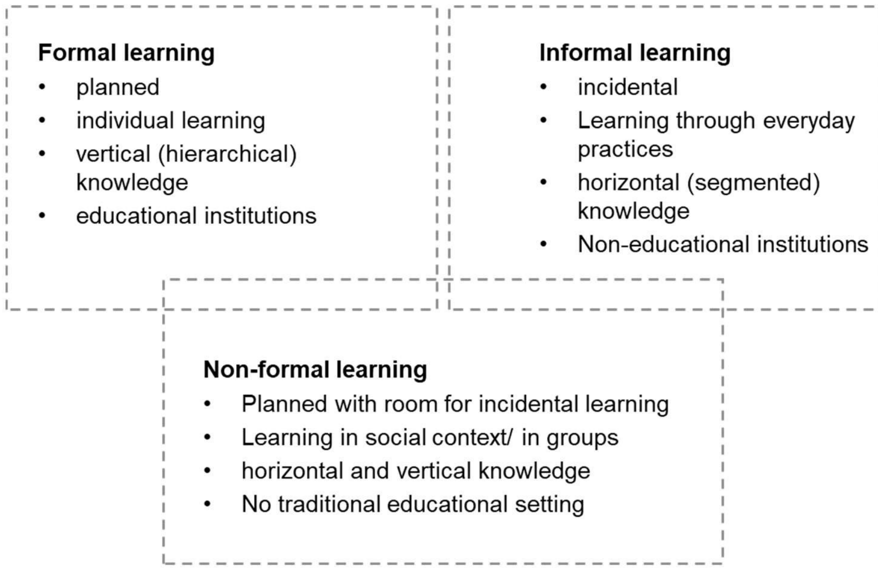

Figure 7: Formal, Informal and Non-formal Learning [47]

2.3.3. Learning theories

The literature offers a wide range of learning theories. These theories can be seen as a conceptual framework for the interpretation of learning processes.[48] The most famous theories such as behaviorism, cognitivism, and constructivism are discussed briefly below.

Behaviorism is a theory of learning psychological theory. It explains the behavior or change of behavior of the person. Learning happens by the expected consequences and not by the result of cognitive processes.[49] Three key types of learning can be identified in behaviorism: [50, 51, 52]

- Reactions/behaviors are modified by the use of stimuli. (classical conditioning)
- Behavior is determined by reward or punishment. (operant conditioning)
- Behavior is changed through observation and imitation of other people's actions. (Modelling Theory)

In contrast to behaviorist learning theory, cognitive learning theory deals with the investigation of cognitive processes within the learner, who is considered a black box by behaviorists. In this theory, also known as cognitivism, the starting point for explaining certain behavioral changes are the thinking processes of an individual.[53] [54]

[47] Eraut, 2000, pp. 113-136
[48] Ainsworth, 2006, pp. 183-184
[49] Skinner, 1976, S. 209-219
[50] Pavlov, 2003, S. 14-15
[51] Thorndike, 1965, S. 269
[52] Bandura, 1974, S. 33-46
[53] Cooper, 1993, S. 12-19
[54] Neisser, 1967, S. 271-277

Behaviorism and cognitivism are objectivist learning theories. Theories of objectivism are based on the understanding that the learner processes external realities during the learning process. This understanding is challenged by the learning theory of constructivism. Contrary to objectivism, in constructivism, the individual experiences of the learner define the individual reality.[55]

2.4. Learning and Teaching Methods

The learning is further divided into two different forms, teacher-centered learning and student-centered learning. [56]

In teacher-centered education, learners concentrate entirely on the lecturer. The lecturer talks, and the learners listen exclusively. During the activities, the learners work alone, and cooperation is hindered. [57]

In the student-centered approach, the teacher is not eliminated but performs the role of a moderator. A student-centered environment empowers participants to collaborate better in learning. It is the individual who decides how and with whom he wants to learn, and which method is suitable for him. The learners answer each other's questions, give each other feedback and, if necessary, use the lecturer as a resource. The teacher gives instructions, provides feedback and answers questions if necessary.[58, 59]

Table 1 compares the differences between teacher-centered and student-centered learning.

Student-centered learning	Teacher-centered learning
The focus is on the trainer/instructor	Both the trainer and the student are in focus
The primary objective is the linguistic forms and structures	The main objective is on the use of language in standard situations
Teacher speaks; Students listen to	Various models for the Instructor use; the students interact with the instructor and with each other
Students work alone	Students work in pair, groups or alone depending on the given task
Instructor monitors and corrects every statement of the student	Students communicate without the constant supervision of the teacher; the teacher gives feedback/corrections on demand
Instructor answers the questions of the students	Students answer each other's questions and use the lecturer as an information resource
Teaching contents are set	Teaching contents are picked by the students from a predefined list
Learning environment is silent	Learning environment is lively

Table 1: Comparison of Teacher-centered Learning and Student-centered Learning [60]

[55] Jonassen, 1991, pp. 5-14
[56] https://education.cu-portland.edu/blog/classroom-resources/
[57] Schreurs & Dumbraveanu, 2014, p. 38
[58] Keiler, 2018, pp. 2-3
[59] Jones, 2007, pp. 25-28
[60] https://knowledgeworks.org/resources/learner-centered-learning/

Both forms of learning offer different methods depending on the degree of technology used. The graph in Figure 8 shows the different methods and their use of technology.

Teacher-centered learning is divided into:[61]

- Flipped classroom
- Kinesthetic learning
- Direct Instruction

Student-centered learning methods is split into:[62]

- Personalized Learning
- Game-based Learning
- Inquiry-based Learning
- Expeditationary Learning
- Differentiated Instruction

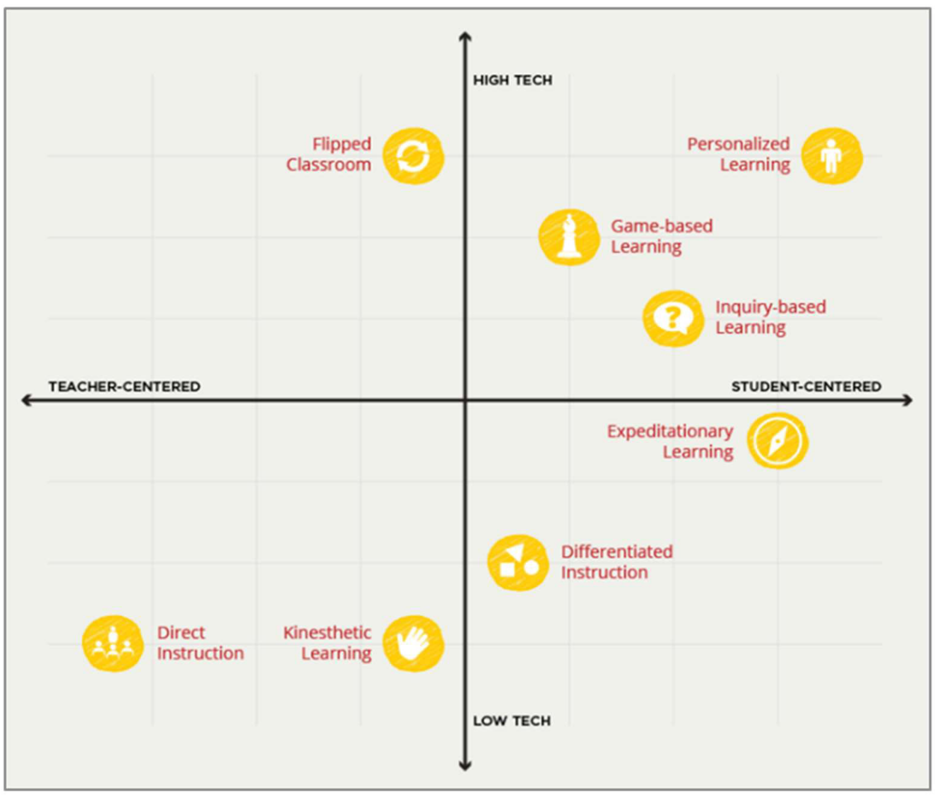

Figure 8: Overview of Teaching Methods[63]

[61] https://teach.com/what/teachers-know/teaching-methods/
[62] https://teach.com/what/teachers-know/teaching-methods/
[63] https://teach.com/what/teachers-know/teaching-methods/

The following subchapters describe the different student-centered methods of learning in more detail.

2.4.1. Personalized Learning

Personalized learning is a new, sophisticated method of teaching content. Like all disruptive innovations, personalized learning has varying definitions depending on the author. The National Educational Technology Plan, published in 2016 in the US provides a general and broad definition and therefore, will be used in this thesis. They define personalized learning as following:

"Personalized learning refers to instruction in which the pace of learning and the instructional approach are optimized for the needs of each learner. Learning objectives, instructional approaches, and instructional content (and its sequencing) all may vary based on learner needs. In addition, learning activities are meaningful and relevant to learners, driven by their interests, and often self-initiated. " [64]

Comparing this definition with others, personalized learning can be summarized in the following points: [65]

- The learning pace is adjusted to the student.
- Learning is driven by the interests of the student.
- Learning goals, approaches, contents and tools are tailored and optimized for each individually.
- Learners have the choice of what, how, when and where to learn.
- Learning is mostly supported by the use of technology.

To be able to use personalized learning, different learning techniques are combined.[66]

Personalized learning offers two major advantages for students: [67]

- The contents and techniques are always individually designed.
- And optionally adjusted during learning.

The following disadvantages result from the increased expenditure: [68]

- The time intensity results in higher costs.
- A high individuality of the structure increases the time spent enormously.
- The contents have to be constantly and continuously adapted.

[64] Education, U.S. Department of, 2016, p. 7
[65] Abbott, et al., 2015, pp. 3-4
[66] https://www.iste.org/explore/articledetail?articleid=124
[67] Abbott, et al., 2015, pp. 5-21
[68] Abbott, et al., 2015, pp. 5-21

2.4.2. Game-based Learning

Game-based learning methods wrap a certain topic of the teaching content in a game. The concept must include the three elements of the game: performance, competition, and fun. For game-based learning, three components - person, task and object - are important and must be considered when designing the content. In general, the goal of an educational game is to challenge the learner. These challenges must be associated with the main task. It should be possible to establish a connection to the knowledge that is to be learned. If both the task and the use of the game are too complex, then the attention of the user for the essential is affected.[69]

Game-based learning has many advantages, such as: [70]

- High motivation and high enthusiasm result from the playful act.
- Immediate feedback is given to the learner.
- The teaching content is defined and controllable by the teacher.

However, there is also a downside that needs to be considered: [71]

- The development costs are very high.
- There is a danger that not all content can be communicated.
- To design a high-quality end-product, a lot of effort and resources are required.

2.4.3. Inquiry-based Learning

Inquiry-based learning, also called problem-based learning, can be described as a process of discovering new causal connections in which the learner formulates hypotheses and tests them through experiments and/or observations.[72] The students perform a learning process by carrying out self-directed experiments to investigate the interrelationships between variables.[73] This technique of learning stimulates the active participation and responsibility of the student for the discovery of knowledge.[74]

Questions, problems or scenarios are asked, and not just facts are presented. The process is supported by an instructor. Problems and questions are identified and researched to generate knowledge or solutions. Participants prepare a synthesis, interpret and evaluate the results.[75]

The most well-known and widely-used learning technique for inquiry-based learning is the case study method.

[69] Kiili, 2005, pp. 13–22
[70] https://tophat.com/blog/gamified-learning/
[71] https://tophat.com/blog/gamified-learning/
[72] Pedaste M. , Mäeots, Leijen, & Sarapuu, 2012, pp. 81-86
[73] Wilhelm & Beishuizen , 2003, pp. 381-388
[74] de Jong & van Joolingen, 1998, pp. 179-186
[75] https://teach.com/what/teachers-know/teaching-methods/

This learning technique offers many advantages for learners: [76]

- A long-term understanding is built up by versatile information of the topic.
- The student is continuously involved.
- The team spirit is strengthened by the joint development of a solution.
- The knowledge is gained through experience.
- The knowledge and the situation can be transferred to real cases.

The disadvantages of inquiry-based learning are as following: [77]

- The knowledge transmitted is very concentrated and therefore only useful if the problem is precise (only one problem can be presented).
- A well-trained instructor is necessary for successful training.
- Previous knowledge is required to solve a problem.

2.4.4. Expeditationary Learning

Expeditationary learning - also called project-based learning (PBL) - is learning through experiences, experiments, expeditions and/or exercises that are done by oneself. It is a form of situated learning and is based on the constructivist realization that learners gain a deeper understanding if they actively develop their understanding. In project-based learning, learners deal with real problems.[78]

Project-based learning is a comprehensive approach to the design of learning environments. These learning environments have five main objectives: [79]

1. There is one basic task that needs to be solved.
2. Students explore the problem given by working in a real environment.
3. All persons involved are actively working together to find solutions to the problem. This reflects the complex social situation in a real work environment.
4. While the individuals participate in the investigation process, the necessary learning technologies and materials are provided to help them carry out the tasks that usually go beyond their capabilities.
5. The end-product is a physical outcome (a product) that represents a solution to the task at hand. Thus, the students have a visualization of their work.

The advantages of expeditationary learning are: [80, 81]

[76] Pedaste M. , et al., 2015, pp. 50-59
[77] Pedaste M. , et al., 2015, pp. 50-59
[78] Krajcik & Blumenfeld, 2006, pp. 317-325
[79] Marx, Krajcik, Blumenfeld, & Soloway, 1997, pp. 341-358
[80] Krajcik & Shin, 2014, pp. 275-297
[81] Marx, Krajcik, Blumenfeld, & Soloway, 1997, pp. 848-851

- A real topic is dealt with.
- There is a better learning effect through self-development of the knowledge.
- Teambuilding is initiated.

The disadvantages of this form of learning are: [82, 83]

- In most cases, time-consuming preparations are necessary.
- An experienced instructor is necessary.
- Developing and setting up a learning environment is very expensive.

2.4.5. Differentiated Instruction

The adaptation of content, process or product for individual needs, interests and learning profile is seen as a definition of differentiated teaching. The needs of the students are accommodated by using simple, already known learning approaches, which should not additionally confront the student with a new challenge. In this context, technologically complex solutions are avoided.[84] For the effective implementation of differentiated learning, it is necessary to fulfill some conditions: [85]

- The training schedule consists of a task that is split in multiple stages.
- Learners should be able to adjust the degree of complexity of the tasks given.
- The degree of complexity and the criteria for learning outcomes should be explained to learners.

During the practical lessons, the students are provided with tasks of varying degrees of difficulty (from simple to complex). A further prerequisite for level differentiation is the student's ability to select the level of difficulty of the tasks according to their understanding. To make this possible, each exercise variant offers multi-stages of the tasks.[86]

Differentiated learning has the advantages that: [87]

- It is generally suitable for all types of learners (visual, auditory, communicative, motoric).
- The different learning approaches stimulate different parts of the brain and help understanding.

The disadvantages of this form of learning are the following: [88]

[82] Marx, Krajcik, Blumenfeld, & Soloway, 1997, pp. 341-358
[83] Krajcik & Shin, 2014, pp. 275-297
[84] Basye, 2018
[85] Arzhanik, Chernikova, Karas, & Lemeshk, 2015, pp. 287-291
[86] Arzhanik, Chernikova, Karas, & Lemeshk, 2015, pp. 287-291
[87] Basye, 2018
[88] Basye, 2018

- The individual type or even types of learning must be known in advance or have to be recognized correctly.
- New planning is necessary for each class.
- Experience in teaching is necessary in order to act didactically correctly.

2.5. Conclusio

After comparing the different methods, the inquiry-based learning is considered to be the right learning method to create a hands-on experience service for the customers of KNAPP AG. The continuous involvement, the teambuilding aspect, the use of a real case situation and the versatile content fulfill the requirements necessary to transfer the complex knowledge. For the selection of the right learning method and technique Dale's "Cone of Experience" is used (Figure 9).

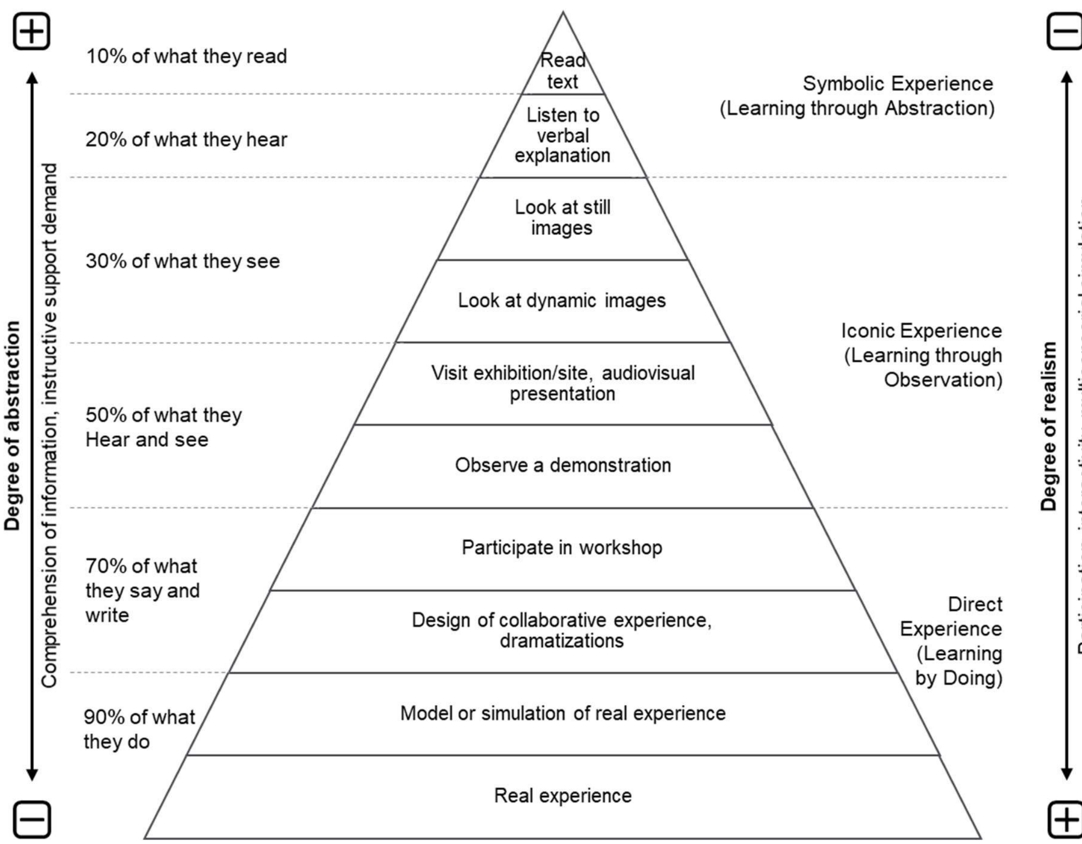

Figure 9: Learning Effect of a Learning Factory[89]

To reach the maximum learning output a model or simulation of the real experience needs to be recreated. And therefore, the learning factory is chosen to be a suitable inquiry-based learning technique, that displays services in a more hands-on environment.

[89] Dale, 1969, p. 108

Both objectivist and constructivist learning theories can be of assistance for learning factories. A different view on the learning process may be useful, depending on the objectives pursued by the learning factory, the target group that is active and the learning objectives and contents that are to be transmitted.[90]

According to the explanation from the chapter 2.4, a learning factory is categorized as student-centered learning and the concept of a learning factory can be placed in the non-formal learning field, even though depending on the structure of the exercises can make use of formal and informal learning as well. [91] Figure 10 shows a summary and the mixed elements used for learning factories.

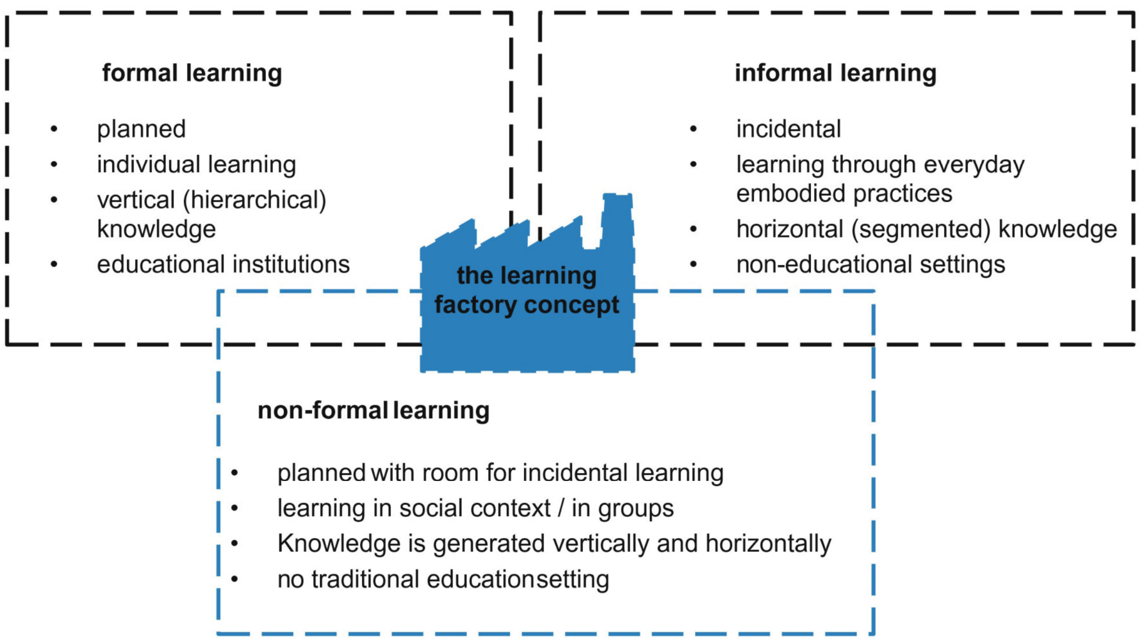

Figure 10: Formal, Informal and Non-formal Elements within a Learning Factory[92]

[90] Jonassen, 1991, pp. 5-14
[91] Eraut, 2000, pp. 113-136
[92] Eraut, 2000, pp. 113-136

3 Analysis of the Learning Factories

In 1988 the German wording "Lernfabrik" was first used to describe the training center, the CIM learning factory, of the company Fa. FR. WINKLER KG in Germany. The company build the center to train and further educate their employees. The goal was to develop methodical didactic concepts in order to be able to train interdisciplinary employee qualifications in the use of new technologies in production in small and medium-sized enterprises. [93]

Six years later, in 1994 the term "learning factory" was first introduced by the NSF (National Science Foundation). The NSF offered the Penn State University a grant to develop a hands-on and interdisciplinary facility for engineering education. The first learning factory, named "Bernard M. Gordon Factory" was built at the Penn State University the same year. However, the concept of this learning factory differs a lot from the nowadays definition of a learning factory environment. [94]

Only a decade ago learning factories started becoming more popular in Europe.[95] In 2007 the Process Learning Factory CiP (Center for Industrial Productivity) at the Institute of Production Management, Technology and Machine Tools (PTW) - TU Darmstadt – opened.[96] The Process Learning Factory transfers knowledge in the field of lean manufacturing and Industry 4.0.[97] Learning Factories are mostly based in the field of production and were created as an experience of real factories to teach engineers.[98] Figure 11 shows the grown of learning factories over the years.

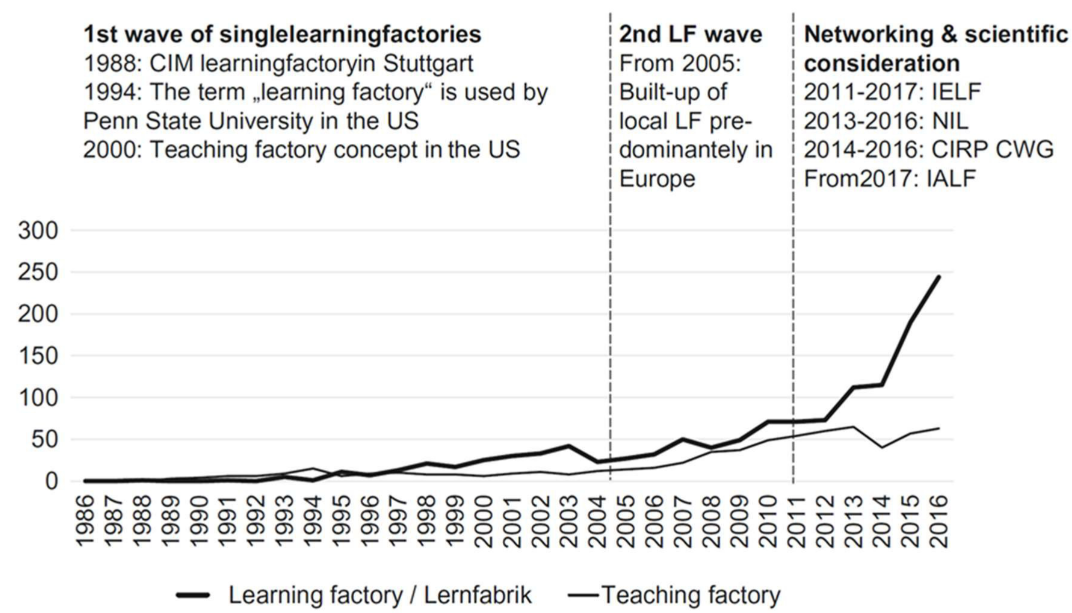

Figure 11: Historical Development of Learning Factory Approaches over the Time [99]

[93] Reith, 1988
[94] Penn State University, 2018
[95] Wagner, Al Geddawy, El Maraghy, & Müller, 2012, pp. 109-113
[96] Abele, Eichhorn, & Kuhn, 2007, pp. 37-41
[97] Abele, Metternich, & Tisch, 2019, p. 83
[98] Reith, 1988
[99] Tisch & Metternich, 2017, p. 90

In the next subchapters, the learning factory is discussed in more detail. Starting with the definition and characteristics of learning factories and will go further with the description of the Darmstadt approach.

3.1. Definition of a Learning Factory

Learning factories are realistic representations of industrial environments and allow participants to practice theoretically learned skills in an experiential environment actively and to identify the impact of their decisions immediately and without risk. Since the development of learning factories, several definitions have been generated. While early definitions are largely based on learning factory use case descriptions, a vivid exchange of scientific approaches has happened in recent years.

For this thesis following definition by a corresponding CIRP Collaborative Working Group (CWG) will be used:

A Learning Factory is described by the specifications of its learning environment, which include:[100]

- Authentic process with multiple stations, as well as comprise technical and organizational aspects,
- a changeable setting that resembles a real value chain,
- a physical or service product being manufactured/ developed, and
- a didactical concept that has aspects of formal, informal and non-formal learning and enables own actions of the participants in an on-site or remote learning environment.

Learning in the learning factory environment takes place through teaching, training and/or research. The learning outcomes can be competency development and/or innovation. They are further divided into learning factory in a narrow and in a broader sense. Learning factories in a narrow sense are real factory environments, on-site and representing a physical product, whereas learning factories in a broader sense describe a virtual instead of a physical value chain, or a service product instead of a physical product.[101]

Learning factories are a physical and authentic simulation of a real factory environment used for educational, training and/or research purposes. [102]

The process of the learning factory is not exclusively a technical but includes organizational and process-oriented aspects. The learning within the factory has to happen based on experience, and therefore, it has to be changeable to enable learners to make their own decisions.[103, 104]

[100] Abele, 2016, pp. 1-5
[101] Abele, 2016, pp. 1-5
[102] Tisch, Hertle, Abele, Metternich, & Tenberg, 2015, pp. 1-21
[103] Hempen, S., Wischniewski, S., Maschek, T, & Deuse, J. , 2010, pp. 71-77
[104] Tisch, Hertle, Cachay, Abele, & Metternich, 2013, pp. 580-583

3.2. Characteristics of Learning Factories in General

The following Figure 12 displays the core characteristics of the learning factory in a narrow and broader sense. The following six dimensions of the learning factory are described in more detail in the subchapters:

- Purpose
- Process
- Setting
- Product
- Didactics
- Operating Model

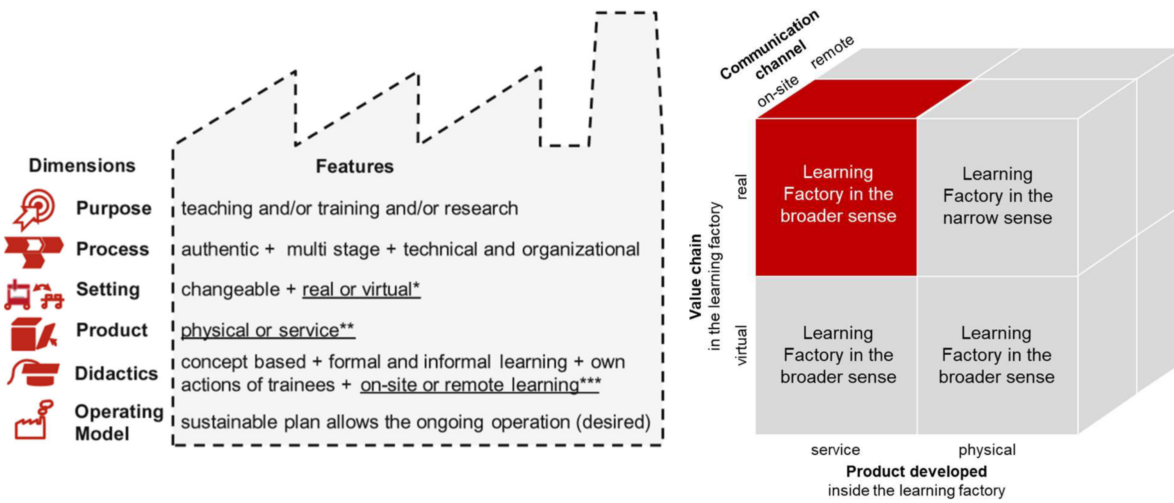

Figure 12: The Core Characteristics of Learning Factories in a more Narrow and Wider Sense [105]

3.2.1. Purpose of the Learning Factory

The primary purpose of learning factories is learning, training and research. In other words, learning happens in the form of competency development, for education and training, or innovation, for research. [106] Furthermore, the goal is to develop the participant's ability to handle complex and unknown situations (including motivational and emotional aspects). The enabling of the participants to work freely within the facility opens up possibilities to further innovate the factory and even processes and/or products.

Learning factories can address different target groups by changing setups. This can be used for different parameters (e.g., prior knowledge, the hierarchical level, the company affiliation, or the role in the company).[107]And the concept in its uniqueness

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[105] Tisch, Hertle, Abele, Metternich, & Tenberg, 2015, pp. 1-21
[106] Abele E. , et al., 2015, p. 2
[107] Abele, Metternich, & Tisch, Learning Factories, 2019, p. 106

can be used in various branches of the industry, which offers opportunities to target different potentials in multiple sectors.

The teaching objectives, on the other hand, vary from factory to factory and depend on the topics in which the learning factory focuses its attention. The same applies to different fields of research in learning factories, while a difference can be drawn as to whether the learning factory serves as a research object or research enabler in the sense of a laboratory.[108]

2.1	**main purpose**	education	vocational training		research
2.2	**secondary purpose**	test environment / pilot environment	industrial production	innovation transfer	public image

Figure 13: Purpose of a Learning Factory[109]

Figure 13 gives an overview of the main and secondary purposes of the learning factory. In the scope of this thesis, the designed concept has the main purpose to educate in the perspective of the customers and additionally provides research possibilities for the company to further innovate and improve internally.

3.2.2. Process of the Learning Factory

To display the specific process, that depends on the unique objectives of each learning factory; the process boundaries have to be defined.[110] Next, the system needs to be broken down into sub-steps. The process which will be experienced in the factory is prepared as a process including all other necessary processes involved to depict the main process.[111]

3.2.3. Setting of the Learning Factory

The setting is used to describe the characteristics of the learning environment and the environment itself. As mentioned above, learning factories can be physical (in the narrow sense) or virtual (in the broader sense). Figure 14 lists and gives a short description of the aspects of the learning factory environment.

[108] Abele, Metternich, & Tisch, Learning Factories, 2019, p. 107
[109] Tisch, Hertle, Abele, Metternich, & Tenberg, 2015, pp. 1-21
[110] Bauernhansl, et al., 2014, pp. 776-779
[111] Abele, Metternich, & Tisch, 2019, pp. 108-109

Aspects of methodical modelling	Learning factory as a learning system
Contextualisation, situated context	Partial model of real factory provides a rich learning context
Activation of learner	Generation and application of knowledge in the learning factory
Problem solving	Solving of real problem situations in the learning factory
Motivation	Motivation by the reality character and the possibility to act hands-on immediatly
Collectivization	Self-organized learning in groups is a suitable model in learning factories
Self-regulation and self-direction	External as well as self-controlled learning processes are enabled – depending on the prerequisites

Figure 14: Aspects of Methodical Modelling of Learning Factories [112]

The equipment used to furnish the factory can vary from life-size products to scaled models with all necessary features.[113] According to the definition of learning factories, concepts cover everything from cells to entire factories and factory networks. In other words, a learning factory can vary by the size displayed as long as it includes more than a single workplace.[114] Another unique feature of learning factories is the changeability and flexibility of the environment.[115] A changeable factory environment means the ability to adapt to the factory environment to various unpredictable changes or ideas of learners, while flexibility refers to a transition of the factory environment for better customization of the training.[116] But being changeable and flexible needs special characteristics referred to as change enablers. This is mobility, modularity, compatibility, scalability, and universality.[117]

3.2.4. Product of the Learning Factory

An essential dimension of the learning factory concept is the characteristics of the product represented within the learning factory environment. The features and variants of the product must be adapted to the overall concept of the learning factory. The product used in a learning factory pictures the demonstration of the learning objectives. Therefore, the choice and complexity of the product also influences the training. Following criteria have to be kept in mind:

[112] Tisch & Metternich, 2017, p. 91
[113] Abele, E., Tenberg, R.,Wennemer, J., & Cachay, J., 2010
[114] Abele, Metternich, & Tisch, Learning Factories, 2019
[115] Nyhuis, P., Reinhart, G., & Abele, E. (Eds.), 2008
[116] Tisch, Modellbasierte Methodik zur kompetenzorientierten Gestaltung von Lernfabriken für die schlanke Produktion, 2018, pp. 14-15
[117] Morales, 2003

- The degree of complexity of the product and the duration needed by the learners to understand the processes presented must be low, to not distract the participant from the teaching objectives. The product has a significant influence on the learning outcome. [118]

- The material and personnel needed for the operation and maintenance of the products must be low to avoid costs. In other words, resetting the learning environment to its initial condition should not take much time and effort. [119]

The products used for the learning factory are either already on the market existing products or particular design for the factory. The functionality of a product can range from fully functional to no functions at all.[120]

In general, physical products are an additional motivational factor for participants since they visualize the outcome of their doing.

3.2.5. Didactics in the Learning Factory

According to the philosopher Johann Amos Comenius, didactics is the art of teaching. Learning factories use non-classical teaching. Like the classical teaching approach learning factories involve the trainees/participants/students and the trainers/facilitators/educators. The trainers passively support the participants in the learning environment. The trainees take on the active role. In the learning factory environment, the concepts of the practical session are applied methodically. As mentioned in chapter 3 the learning factory used a student-centered teaching approach, where the students or trainees empirically transfer the knowledge gained from the theory to the new environment. [121]

The experimental learning happens based on the “trial and error” approach. That is given when students can try different solutions and methods, compare them and evaluate the outcomes without pressure.[122]

Questions to be answered when preparing the didactics of a learning factory are:[123]

- What are the learning objectives, what has to be learned? Which competencies do I want to teach?

- How can be learned? What is the scenario? How much autonomy has the learner? How are the modules structured? What is the trainer’s role?

- Where does learning happen? What are the communication channels?

- How to evaluate the outcome?

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[118] Tisch, Modellbasierte Methodik zur kompetenzorientierten Gestaltung von Lernfabriken für die schlanke Produktion, 2018, p. 87
[119] Abele, 2016, pp. 1-5
[120] Metternich, Abele, & Tisch, 2013, pp. 94–107
[121] Brown, K. L., 2003
[122] Nöhring, F., Rieger, M., Erohin, O., Deuse, J., Kuhlenkötter, B., 2015, pp. 109-114
[123] Abele, Metternich, & Tisch, 2019, pp. 116-117

3.2.6. Operation Model of the Learning Factory

The operation model is the business plan of a learning factory. Before operating a learning factory, the operation model for the factory needs to be considered and planned. The operating model of a learning factory has the intention to create a sustainable operation within the factory and thus to achieve continuous competence development across all hierarchical levels, as well as technological and organizational innovations.[124] Figure 15 pictures the three levels of sustainability, that help to operate a learning factory concept successfully. These are:

- Economic sustainability
- Personal sustainability
- Contentual sustainability

Figure 15: Three Sustainability Dimensions of Learning Factories[125]

Economic sustainability is all about the financing of learning factories. The financial plan considers all costs, e.g., the costs for implementation, the costs of maintenance and the possible revenue streams.

[124] Tisch, Modellbasierte Methodik zur kompetenzorientierten Gestaltung von Lernfabriken für die schlanke Produktion, 2018, p. 70

[125] Abele, Metternich, & Tisch, 2019, p. 102

Personal sustainability is probably the most important of the three levels. The right personnel have to be acquired and trained. Didactic skills for moderation and coaching skills are crucial for high-quality training.

Contentual sustainability ensures that the teaching content is relevant and exciting for the participants. Furthermore, the material must be prepared in an understanding way and must be improved and renewed frequently.

3.3. Benefits and Potentials of Learning Factories

The learning factory as a competence development method is target-oriented, effective, and efficient training.[126] The training and education in production systems have shown that learning factories contribute significantly to building intellectual capital. Additionally, learning factories have a significant contribution in other fields such as research and business creation.[127]

Generally seen, the concept of learning factories provides a variety of benefits that are hardly topped by any other education approach. The following advantages arise among others:

- Improvement of the quality of education and training in general,[128]
- A better understanding of the handling and motivation for learning,[129]
- The increased connection between industry and education, as well as education and research,[130]
- Creating opportunities for knowledge transfer in the field of research, innovation and technology.[131]
- Training of soft skills and interdisciplinary competences,[132]
- Driving force for business creation.[133]

The high learning effect of the learning factory concept is connected to the manipulation of all three domains (cognitive, affective and psychomotor) simultaneously. Therefore, it provides a great platform to address complex content and to link teaching objectives with practical problems.

[126] Adolph, Tisch, & Metternich, 2014, pp. 1001-103
[127] Abele, Metternich, & Tisch, 2019, p. 77
[128] Jäger, A.,Mayrhofer,W., Kuhlang, P.,Matyas, K., & Sihn,W., 2012
[129] Bauernhansl, et al., 2014
[130] Jorgensen, J. E., Lamancusa, J. S., Zayas-Castro, J. L., & Ratner, J. , 1995
[131] Rentzos, L., Doukas, M., Mavrikios, D., Mourtzis, D., & Chryssolouris, G., 2014
[132] Kreimeier, D., Morlock, F., Prinz, C., Krückhans, B., Bakir, D. C., & Meier, H., 2014
[133] Dorer, 2018

3.4. Morphology of Learning Factories

A broad range of configurations for the learning factory can be derived from the definition above. To master the mass of information all description models use the heuristic procedure of morphologic analysis for a clear representation of learning factory models. The morphologic analysis as a tool offers a significant advantage to simplify the outline of a complex system, including all relevant features and characteristics and potential attributes in one overview.[134] The holistic and generic picture of learning factories enables a more simplified illustration of the connections between all existing options for conceptualizing a learning factory and the specific design of the actual learning factory to be analyzed.

The continuous development of learning factories, initiated by new findings from educational research, has the consequence that description models must be continuously adapted and expanded. Therefore, a multidimensional description model was developed and validated by the CIRP Collaborative Working Group and the Consortium Project Network of Innovative Learning Factories (NIL). Figure 16 shows an excerpt of the morphological box for learning factories.

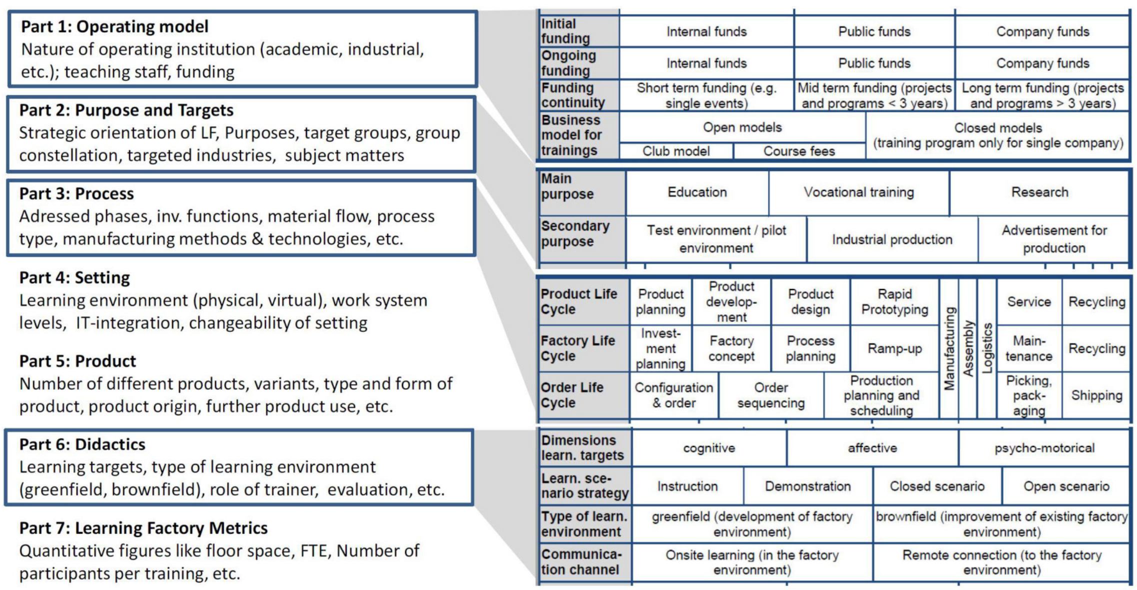

Figure 16: Selection of Specific Learning Factory Features of the Seven Parts of the Morphology[135]

3.5. The Darmstadt Approach to Competency-Oriented Development of Learning Factories

The Darmstadt approach for the planning of the learning factory was generated to solve design related problems of previous approaches.[136] The identified issues which are answered within the Darmstadt approach are:[137]

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[134] Metternich, Abele, & Tisch, 2013, pp. 94–99
[135] Abele E. , et al., 2015, p. 3
[136] Enke, Tisch, & Metternich, 2016, p. 1
[137] Tisch, Hertle, Cachay, Abele, & Metternich, 2013, pp. 580–585

a. The design for competence transfer of the learning factory is executed by technical experts, and therefore, didactic principles are not considered.

b. The focus on the defined objectives is not given or to little implemented in the learning modules.

c. The missing systematic approach results in an inefficient factory design process, which sometimes requires massive and unnecessary redesign of the factory.

d. The transfer of the gained knowledge into real factory environments is made more difficult by a lack of user or target group orientation.

The competency-oriented approach splits the development into three design levels: macro level, meso level, and micro level. (See Figure 17) The different levels are a clear guideline for better development of the complex learning factory system. The macro level focuses on the infrastructural design of the learning factory, including the socio-technical infrastructure such as process, product, participants. The meso level defines the basis of the didactical plan by designing the teaching modules. It includes the formulation of partial competences and the planning of particular teaching processes. Finally, at the micro level, the exact scenarios (workplace descriptions) and the necessary teaching equipment (presentations, technical support material, theoretical input, etc.) are prepared.

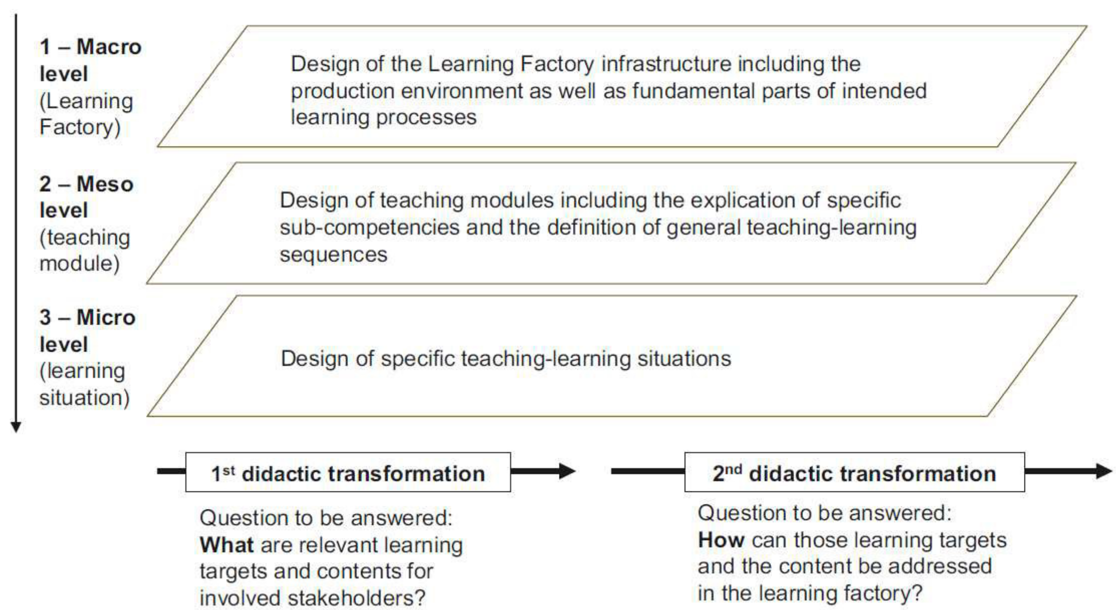


Figure 17: Levels of the Learning Factory Design according the Darmstadt Approach[138]

A more detailed explanations of the design level can be found in the following sub-chapters.

[138] Tisch, Hertle, Abele, Metternich, & Tenberg, 2015, pp. 1-21

3.5.1. Marco Level

The identification and creation of the socio-technical and didactical infrastructure happens on the macro level (see Figure 18). This level defines the general targets and the framework for the learning factory.

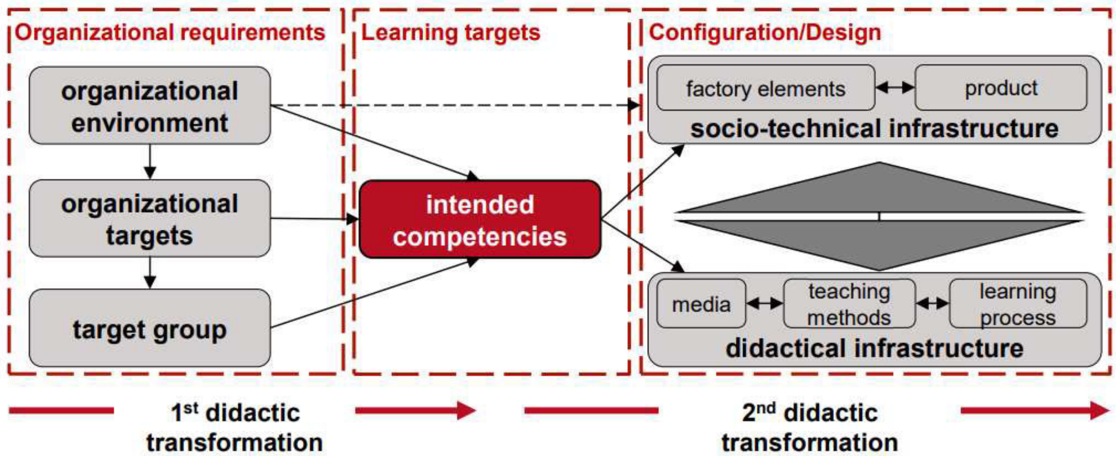


Figure 18: Elements and Relations on the Macro Level[139]

To do so the learning targets are derived after the first and before the second didactic transformation. The first didactical transformation happens by defining organizational requirements. These organizational targets build the foundation for the learning targets. The target group is specified after the organizational targets are set. The intended competencies are derived by including the organizational environment, organizational target, and the target group.[140] The organizational targets will strongly depend on the challenges inside and outside the company and need to be clearly stated before target groups, and learning targets are defined.[141]

Target groups, on the other hand, are dependent on the intentions the organization has for the learning factory. There are no limitations on who to target. Therefore, possible target groups, amongst others, can be students, employees of various hierarchy levels, consultants, customers and many more.[142]

The socio-technical infrastructure includes the planning of the factory and its elements. Furthermore, this also includes the design of workplaces, work cells, process sections, etc., while considering the organizational environment (the industry that the learning factory should address). A further aspect of the socio-technical infrastructure is the selection of a suitable product that meets both didactic and economic requirements and furthermore is authentic.[143]

[139] Tisch, Hertle, Cachay, Abele, & Metternich, 2013, p. 582
[140] Abele E. , et al., 2015, p. 3
[141] Enke, Tisch, & Metternich, 2016, p. 5
[142] Enke, Tisch, & Metternich, 2016, p. 5
[143] Abele E. , et al., 2015, p. 3

The socio-technical infrastructure is linked to the didactical infrastructure, which leads to restrictions between the two. The design is challenged to find a compromise between an authentic and universal factory.[144]

In the didactic infrastructure, the teaching methods and support systems will be used to develop the desired competencies. Criteria for the teaching methods are, for example, the role of the teacher, the type of learning process, material resources, etc. The teaching methods are determined in the didactic infrastructure. Also, the didactic infrastructure describes the theory- and practice-oriented learning processes. Theory-oriented learning processes serve to systematically structure and transfer knowledge while practice-oriented learning processes create a stimulating learning environment in which it is possible to test, explore and gather experience.[145, 146] Figure 19 is based on the dissertation of Tisch and shows a more detailed view of the macro level.

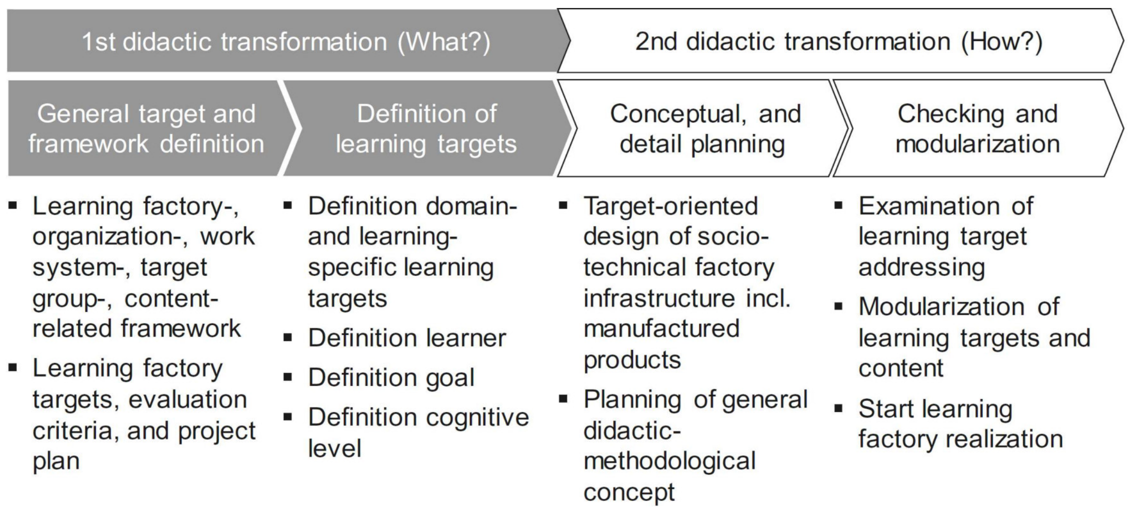


Figure 19: Macro Level Design Process of a Learning Factory[147]

3.5.2. Meso Level

The meso level consists of two parts: Creating operations for the learning target and defining requirements and a framework for the learning modules. (see Figure 20) Each module has to undergo the procedure.

[144] Tisch, Hertle, Abele, Metternich, & Tenberg, 2015, pp. 582-584
[145] Deci, Vallerand, Pelletier, & Ryan, 1991, pp. 328-331
[146] Tisch, Hertle, Cachay, Abele, & Metternich, 2013, p. 582
[147] Abele, Metternich, & Tisch, 2019, p. 135 based on Tisch, Modellbasierte Methodik zur kompetenzorientierten Gestaltung von Lernfabriken für die schlanke Produktion, 2018

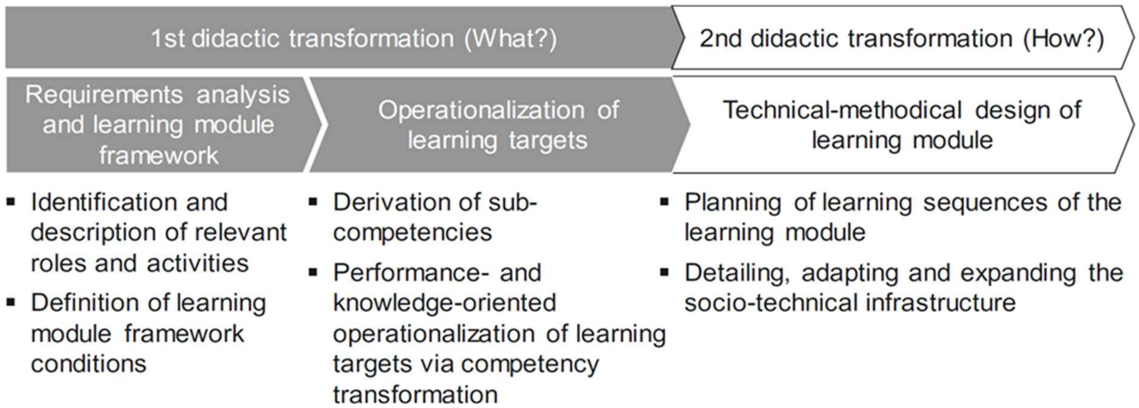


Figure 20: Meso Level Design Process of the Learning Factory[148]

In the first step, the framework conditions and requirements of the learning modules are defined and made interdependent and followed by the identification and description of the necessary roles. The role description depends on the content to be transported. To help design the learning modules, Tisch has created a checklist with questions, which are:[149]

- What is the title of the planned learning module?
- What is the content of the learning module?
- Who are the planned trainers of the module?
- How many coaches are available?
- Who is the target group of the learning module?
- Is this target group homogeneous or heterogeneous? About which features?
- For how many participants should the training be designed?
- What is the duration of the learning module?
- The list is extended with bullet points of special features (for the learning environment, setting, etc.) which must be specified after defining the framework conditions at the macro level.

Based on the requirements of the previous step, competencies are set into operation by using the transformation table, shown in Table 2.

[148] Abele, Metternich, & Tisch, 2019, p. 139 based on Tisch, Modellbasierte Methodik zur kompetenzorientierten Gestaltung von Lernfabriken für die schlanke Produktion, 2018

[149] Tisch, Modellbasierte Methodik zur kompetenzorientierten Gestaltung von Lernfabriken für die schlanke Produktion, 2018, p. 137

Competency 1	Sub-competency 1.1	Corresponding performance / action	Knowledge elements (Professional and conceptional knowledge)
	Sub-competency 1.2	Corresponding performance / action	Knowledge elements
	Sub-competency 1.3	Corresponding performance / action	Knowledge elements
⋮	…	…	…
	…	…	…

Table 2: Structure of the Competency Transformation for the Design[150]

The learning target or competency is divided into smaller sub-competencies. Individual action is elaborated which reflects the content of each sub-competence.

This learning activity is split into its knowledge elements. The knowledge elements consist of two types - professional knowledge and conceptual knowledge. Professional Knowledge asks the "how" and "what" questions, conceptual knowledge is responsible for the "why”.[151]

The essential element is the comparison between the CURRENT situation and the changed implementation (TARGET situation). In the final wrap-up session, this is reviewed and discussed

Most factories use the exploration-based or the testing-based strategy. The exploration-based strategy has more the try and error character, followed by the systematization in form of theory lessons. The testing-based strategy first gives the theoretical input and after the participants use this for the experiment.[152] Figure 21 shows the sequencing of the exercises within a learning factory.

[150] Abele, Metternich, & Tisch, 2019, p. 141
[151] Abele, Metternich, & Tisch, 2019, p. 140
[152] Abele, Metternich, & Tisch, 2019, pp. 142-143

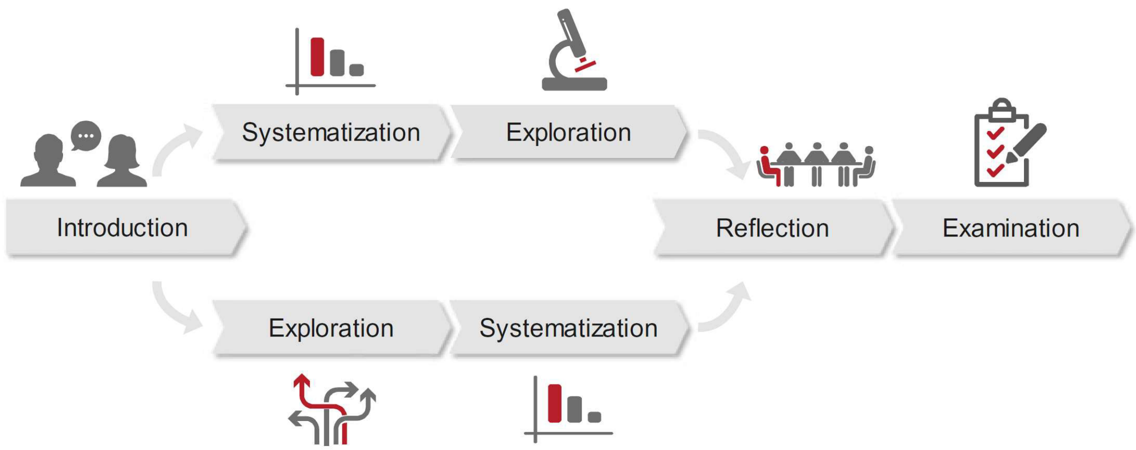


Figure 21: Sequencing the Activities in the Learning Factory[153]

Figure 22 give the exact sequence steps of the two variants. The application of the methods depends on the content, learning factory targets, the time availability, knowledge of the participants and if the participants have recognized urgency of the taught topic.[154]

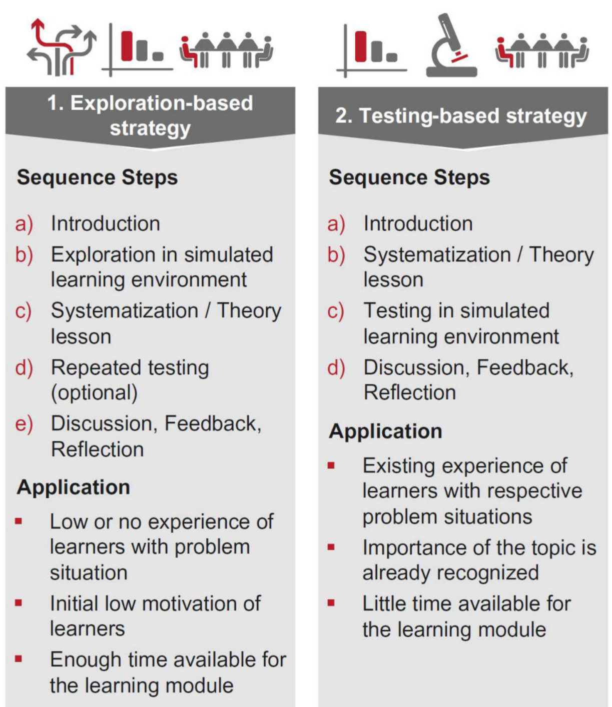


Figure 22: Sequence Steps of the 2 Most Used Sequencing Activities with a Learning Factory[155]

[153] Abele, Metternich, & Tisch, 2019, p. 143
[154] Tisch, Modellbasierte Methodik zur kompetenzorientierten Gestaltung von Lernfabriken für die schlanke Produktion, 2018, p. 153
[155] Abele, Metternich, & Tisch, 2019, p. 144

3.5.3. Micro Level

By the transformation chart from the meso level, the collected learning activities are described in detail. Therefore, scenarios are designed which require the execution of these actions. The participants have to solve the problem, related in the scenarios, in the learning factory to reach the intended competencies.

Figure 23 gives an overview of the last detail level of the designing process, which includes the framework and target definition, and the design of the learning situation.

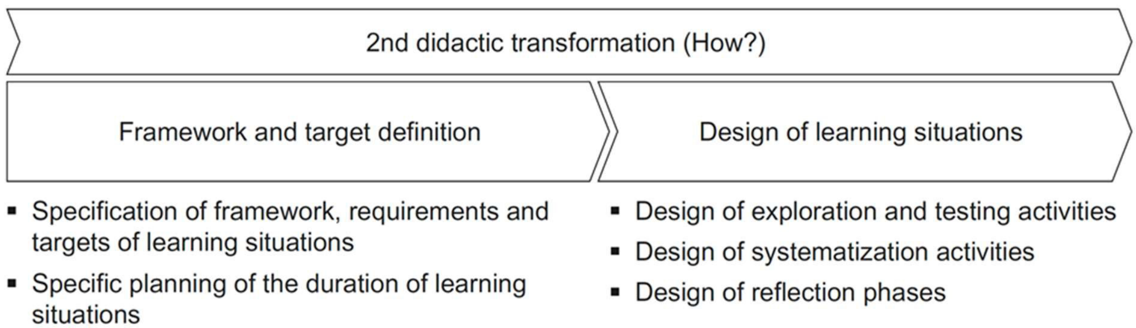


Figure 23: Micro Level Design Process of the Learning Factory[156]

Most parts of the framework definition have already been completed, the only parts missing, are the distribution of the time for the individual scenarios of the learning situation and the detailed scenario description. The descriptions are created by the following rules:[157]

- Output orientation instead of input orientation: The learning situations are tailored to the specific learning objectives. It is necessary to answer how learning situations have to be designed to achieve the desired learning outcomes (output orientation). It is not important which teaching content is integrated (input orientation).
- Practical orientation instead of theoretical orientation: In general, theoretical units should be planned as compact as possible but as long as necessary. Theoretical parts have to contain all relevant knowledge and avoid redundancy. The major time should be spent on experimenting, developing, and reflecting on the activities.

The design of the individual learning situation is divided into three blocks: exploration, development or systematization activities and reflection. [158]

In this level, the content-related or methodical elaboration, also called second didactical transformation is designed. Therefore, design elements are chosen and coordinated:[159]

[156] Abele, Metternich, & Tisch, Learning Factories, 2019, p. 146 based on Tisch, Modellbasierte Methodik zur kompetenzorientierten Gestaltung von Lernfabriken für die schlanke Produktion, 2018
[157] Abele E. , et al., 2015, pp. 1 – 6
[158] Abele, Metternich, & Tisch, 2019, p. 146
[159] Abele E. , et al., 2015, pp. 1 – 6

- Media is used to support teaching and learning. Here presentations, production facilities, components, models, drawings, etc. should be named as examples.
- Methodical designs visualize the learning process. It contains different teaching and learning methods with design tasks. Examples are sketches, notes, inscribed flip charts, full worksheets, and answers sheets.
- Interaction planning describes how the participants, the trainer, the used materials and equipment work with each other — e.g., teamwork, single work, computer exercises, etc.
- Learning material includes all necessary equipment, like worksheets, lecture notes, templates, etc.

4 Concept Design Approach

The last part of this thesis describes the concept design process of the learning factory for awareness development of service products. The order of events during the practical concept development is pictured in Figure 24.

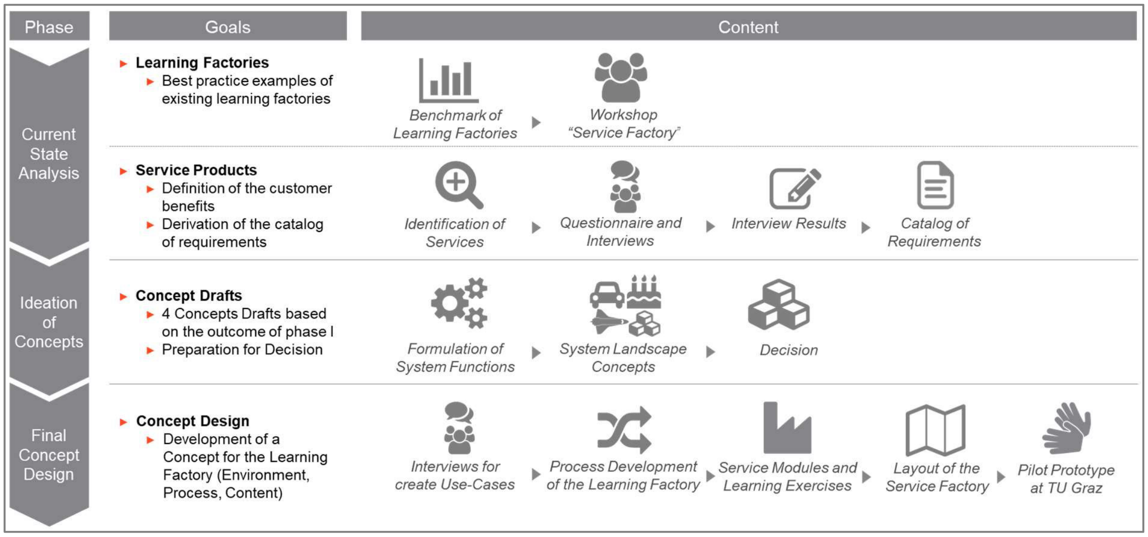


Figure 24: Oder of Events during the Concept Design Development

Phase I

In phase I, the entire warehouse process is to be investigated and depicted. Based on the overall process, points of intersection and associated services are to be identified. A thorough, current state analysis will be used to determine which services intervene in which process steps. These results are used for the evaluation and subsequent creation of a requirements catalog for the project's development.

The starting point for this current state analysis is the data provided primarily by KNAPP, such as information from technical experts. Next interviews with the employee will give further and deeper insights.

Simultaneously, a benchmark and on-site visits of learning factories provide further input for the idea generation.

Phase II

Phase II starts with the idea generation using a morphological box for various system scenarios. Four of the ideas are drafted into concepts. A basic implementation of the system landscapes is described to illustrate the possible learning factory environment and draw the parallels between the original warehouse system and the new environment.

The goal of phase 2 is the final decision on a solution variant which will be detailed later.

Phase III

Phase III contains a detailing of the selected concept about concrete exercises. The goal is to detail the concept to a level that a prototype of the learning factory infrastructure can be implemented and as a next step the developing of detailed training documents based on these elaborations.

The learning factory infrastructure is represented in three levels. Figure 25 displays the levels and content elaborated. According to the research in the chapters above, this design concept is based on the Darmstadt Approach. In Phase III the concept for awareness development for service products will be designed in the macro and meso level.

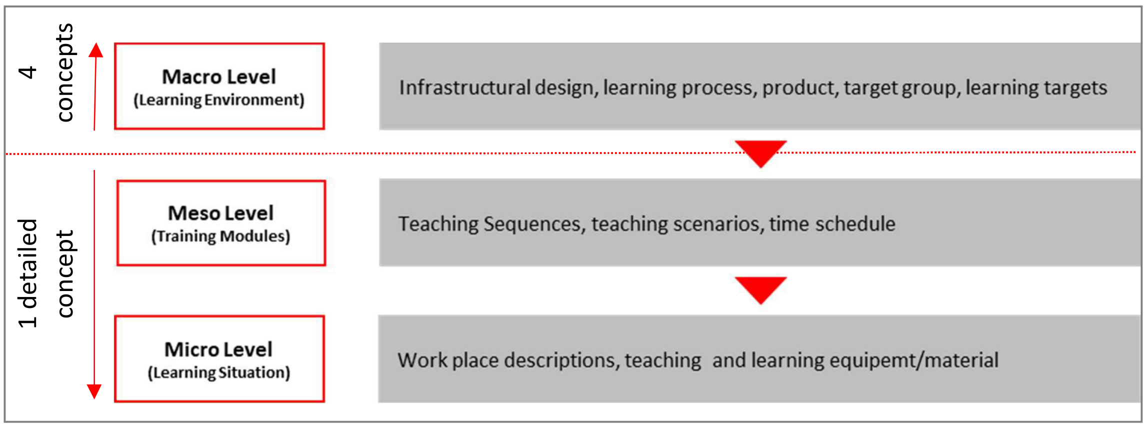


Figure 25: Procedure for the Design of Training Concepts[160]

[160] Based on Abele, Metternich, & Tisch, 2019, p. 133

5 Phase I – Current State Analysis

Phase I focuses on collecting and evaluating of the contents delivered by KNAPP with the intention of creating a requirement catalog for the training concept as well as the identification of the customer benefits of KNAPP services. Therefore, several employees of the company have been interviewed and data from several booklets, presentations and service descriptions have been collected and analyzed. After identifying each Service and defining the customer benefits of each, a requirements catalog is developed. The knowledge gained from the theoretical analysis has been widened by a Benchmark on ten successful learning factories in Europe, by the visit of the DCC Venice learning factory, and by the training with company employees of KNAPP at the LEAD Lab in Graz. Figure 26 provides an overview of the various activities of the project phase I.

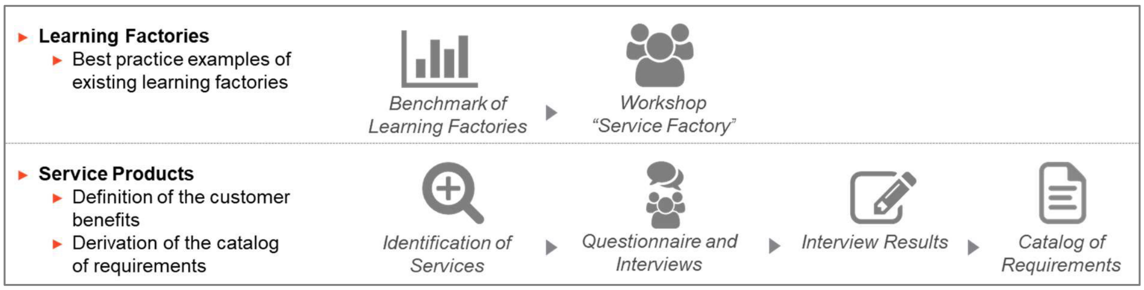


Figure 26: Overview Phase I

5.1. Benchmark on Learning Factories

Ten learning factories located in Europe (out of these three in Austria) were selected for the benchmark. To understand what makes these successful learning environments unique and well working, the focus of the benchmark was on three core areas:

- The product created (What are the participants working on?)
- Size of the learning factory (How much space is needed?)
- Duration of the training (How long is the minimum time to transfer content successfully)

The core areas were chosen to help the company as a first guidance and as a first approximation on

- how many people can be engaged in a learning factory,
- if the necessary space could be found within their facilities and with how much space they can plan,
- how much time does the customer have to offer for a successful training.

An overview of the benchmark is shown in Table 2.

Pos.	Organisation	Schwerpunkt	Inhalt	Gerätschaften	Produkt	Dauer	Größe	Preise	Teiln.
1	TU Darmstadt	Lean Production, Industrie 4.0, Energy Efficience	Lean Basics, Lean Material Flow, Lean Machining, Lean Quality, (5S, Kaizen, Wertstr.) Workplace design, setup time optimization	Mechanical processing, manual assembly, quality assurance, production logistics	Pneumatic cylinder or electric motor	2 days or on request	500 m²	100 Euros per course	8 to 20 Persons
2	RWTH Aachen	Lean Management	Lean Innovation, Lean Administration Lean Production und Lean Maintenance	Learning factory for production (older large machines, see also Toolmaking ACADEMY)	electric car	1 to 5 Days	estimated 150m²	585 to 3500 Euros	
3	Karlsruhe	Global Production	Lean and Industry 4.0 , Six Sigma, Sourcing, Scalable Automation, Production Network Planning	Learning factory with metal-cutting prefabrication and assembly, 14 stations, 2 seminar rooms	Electric motor and transmission	on request	n.A.	on request	n.A.
4	IFA Stuttgart	Advanced Industrial Engineering	Versatile work systems, factory and product data management, factory analysis, strategic enterprise management, Versatile enterprise structures	physical model factory with the iTRAME system is directly linked to the digital learning battery	desk set	11 Days	estimated 150m²	on request	n.A
5	TU München	Lean Produktion	Energy value stream analysis and design Energy productivity, resource management	cutting processes, assembly processes, transport processes, cleaning processes and thermal processes	industriell gefertigten Planetengetrieben	1 to 3 Days		on request	max. 12 Participants
6	McKinsey - DCC Venice	Industrie 4.0	Digital Manufacturing, Lean Manufacturin,g Service Operations, Quality Product Development, Warehousing	3D Verfahren, manuelle Montage,	compressor	2 to 12 Days	estimated 250m²	950 to 4980 Euros	12 to 18 Persons
7	McKinsey - Model factory in a Box	Industrie 4.0	5S, workload balancing, asset integrity reviews	3D process, manual assembly	limonade	2 to 12 Days	estimated 250m²	950 to 4980 Euros	12 to 18 Persons
8	TU Graz	Lean Management, Energy Efficiency, Agility, Digitalization	Teambuilding (Lean basics, teamwork) Lean Basics (Lean Basics, 5S, SOPs, Quality, Create your own Future State) Lean Advanced (Lean Basics, additionally Value Stream Mapping and Best Practice Future State) Lean Expert (Lean Advanced, additionally Kanban and Shopfloor Management Boards) eambuilding (Lean basics, teamwork) Lean Basics (Lean Basics, 5S, SOPs, Quality, Create your own Future State) Lean Advanced (Lean Basics, additionally Value Stream Mapping and Best Practice Future State) Lean Expert (Lean Advanced, additionally Kanban and Shopfloor Management Boards)	3D process, manual assembly	scooter	1 to 3 Days	60 m²	on request	12 to 18 Persons
9	TU Wien	Lean Management	Lean Innovation, Lean Production Lean Assembly	Assembly workstations, turning, milling, drilling machines, saws, vices, rapid prototyping	Slotcar	10 units a 8 hours	60 m² + 250 m²	n.A.	mainly students
10	FH Kufstein	Lean Management	Value Stream Mapping , Toyota KATA, Lean Quality, eKANBAN, Lean Six Sigma, Lean Management	Workplaces with mechanical processing as well as assembly workstations ERP system		1 bis 3 Tage	60 m²	auf Anfrage	k.A

Table 3: Benchmark of Selected Learning Factories in German-speaking Countries[161]

[161] http://www.eta-fabrik.de/, http://www.wzl.rwth-aachen.de/, http://industrie40.tugraz.at/, http://ialf-online.net/index.php/mitglieder/47-learning-factory-global-production.html, http://lf.iff.uni-stuttgart.de/, https://www.iwb.mw.tum.de/forschung-und-industrie/lernfabriken/, https://capability-center.mckinsey.com/locations/dcc-venice, https://capability-center.mckinsey.com/model-factory-in-a-box, https://www.imw.tuwien.ac.at/bt/lehrangebot/zusatzangebot/lernfabrik/, https://www.fh-kufstein.ac.at/Studieren/Master/ERP-Systeme-Geschaeftsprozessmanagement-BB/LEAN-Lab

From the benchmark list mentioned above, two learning factories (DCC Karlsruhe, DCC Venice, both McKinsey) were of interested and were research more thoroughly. The summary is pictured in Figure 27.

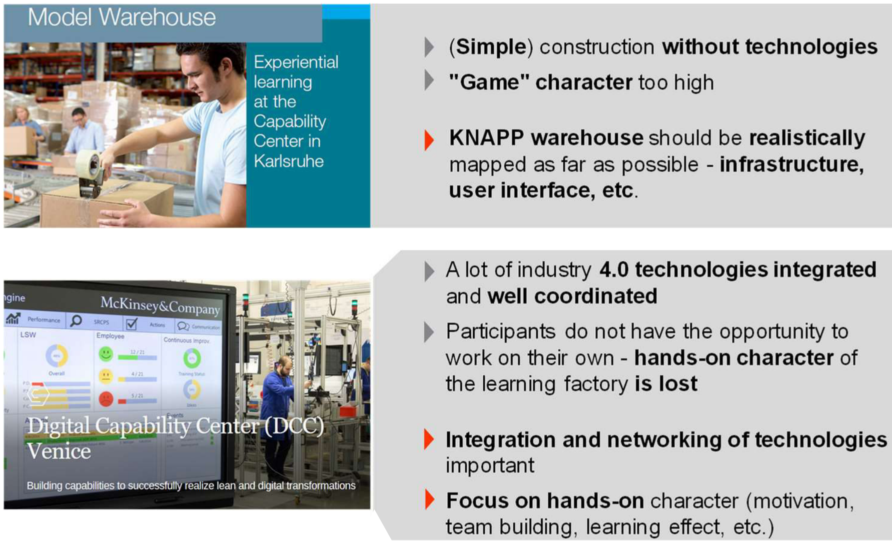


Figure 27: Benchmark of Two Interesting Learning Factories

After evaluating the benchmark outcome with the requirement catalog two learning factories were chosen for an on-site visit – LEAD Factory TU Graz and DCC Venice.

5.1.1. On-site visit of the McKinsey's DCC Venice learning factory

The vision of the learning factory is "Continuous Improvement" of the storage processes. The training usually runs for three days but can last from half a day to ten days on customer's request, depending on the content. The customers are mainly local companies or McKinsey customers and students.

The learning factory is designed for a minimum of 5 people and can be expanded to 30 people. The participants are only integrated into the process as observers. The individual workstations are operated by in-house operators.

After consultation with the companies, the participants receive business cases, which they have to solve in the team. The exercises are structured in modules. There is a total of nine modules that can be combined. Each training session is tailored to the customers by clarifying in advance where the difficulties lie to align the training accordingly.

The training sessions are structured in four stages:

- Current State (before implementing lean)
- Future State (after implementing lean)
- Digital State 1
- Digital State 2

The changes in the KPIs of the various stages are recorded digitally, and the improvements are presented to the participants at the end (diagrams, graphs, etc.).

Following KPIs are measured during the process and compared after the training:

- Productivity
- WIP (Work in Progress)
- Lead Time
- Area Occupied
- Value Added Activity
- Economic Impact (EBITDA %)

5.1.2. LEAD Factory Training of KNAPP Employees

The training of the KNAPP employees took place in the LEAD Factory of the Institute of Innovation and Industrial Management. Seventeen participants experienced the processes and carried out the work steps in the learning factory. The following contents were identified in the wrap-up for a “KNAPP Service Factory”:

- A hands-on learning environment for the service area is desirable.
- A real product as the outcome must be given.
- Decoupling solutions for KNAPP systems should at least be considered.

The following advantages of a learning factory for the service sector intersect with the result desired by KNAPP:

- Improved customer relationship
- Teamwork during training
- Transfer of know-how

5.2. Learnings

Comparing the results from the benchmark and the workshop findings to the theoretical research, the expectations on the learning factory are:

- Experimental environment with a realistic environment
- High teamwork experience
- If possible a transportable version
- Operation of the learning factory by the participants

The first steps before starting with the ideation and development of a learning factory, is the capture of the current state within the service product portfolio. Therefore, the service products need to be identified and an understanding of how they work in the warehouse facilities built.

5.3. Identification of Services

The core business of KNAPP AG are the sale of warehouses and warehouse machines and the sale of services, which are important for the successful operation of the plants. Therefore, the company has two sales departments. One covers the warehousing and the services. Service products generate around 25 percent of the overall revenue. The material used to explain the services and bring these to the customers happens via presentation of the service sales department. Other material are the service contract and a description of the services.

For a better understand of the services and identification of each service product, the mentioned materials were compiled, and the goal was to understand the services and their application in the warehouse. In the following sub-chapter, a short description of each service and their benefit for the customer is provided.

5.3.1. Escrow

As part of the escrow service, the source code, as well as the technical documentation (intellectual property of KNAPP) of the computer programs, can be deposited at an escrow partner (escrow agent) specified by KNAPP. If particular circumstances arise, the stored and confidential data will be released to the customer.

The service provides two core benefits for the customer, risk minimization by depositing the source code and fulfillment of company's internal standards as well as company specifications. (certain businesses have legal obligations)

5.3.2. e-insight

E-insight is a platform for information access. It provides a transparent mapping of key service issues, including equipment and installed components as well as support status (roadmap) of the customer's products (lifecycle management), documents, incidents, reports, etc., of the customer's logistics system. E-insight is intended to be a holistic and central point of contact for a facility. It offers the customer access to the ticketing system and RFCs (Request for Comments), it serves as a database for documents (maintenance and repair) and assists in identifying spare parts and ordering them.

5.3.3. Spare Part Management

The proper operation of a logistics system requires that the right spare parts are available at the right time and in the right quantity. The customer should, therefore, keep a number and selection of spare parts recommended by KNAPP in stock on-site.

Spare parts management plays a significant role for the customer, depending on the strictness of the delivery deadlines.

Therefore, the main benefit of the plant is to minimize the risk of unplanned shutdowns and the rapid delivery of spare parts when needed. However, this service also depends on the knowledge and experience of the personnel. Well-trained employees are necessary for the smooth operation of the work steps.

5.3.4. Hotline

A service with the task of restoring the operational readiness of the system by telephone and remote maintenance, or personnel. The service includes all mechanical and electrical KNAPP components as well as KNAPP software and IT infrastructure components.

Trained employees or a resident engineer can only make an error notification to the hotline, well-trained employees are therefore necessary. The main benefit of the hotline is the quickest possible restoration of operational readiness of the system.

5.3.5. IT-Services

The IT services offer coordinated solutions for the KNAPP software products and their IT infrastructure which contribute to an optimal availability of the system in the long term and facilitate the daily handling of the system for the customer as far as possible. The IT services comprise a broad portfolio of various services with the aim of ensuring high availability of the IT system. These services are:

- *System monitoring and capacity management:* The system monitoring includes an automatic, proactive, round-the-clock monitoring of the IT infrastructure using a fully automated monitoring software. The monitoring software evaluates errors and assigns them to a technician in the hotline depending on the component and criticality. It triggers the hotline incident process. Preventive measures are taken in the incident process to avoid effects on availability as far as possible.
- *Monitoring Appliance*: The Monitoring Appliance is an independent system (server hardware or virtual machine on customer or KNAPP infrastructure) for the module System Monitoring & Capacity Management including visualization from an IT point of view and/or for storing and managing backups of all KNAPP server systems.
- *Backup System Check*: The existing backup solution for the IT components supplied by KNAPP will be reviewed and analyzed to ensure that the recovery of the regulated operation can run smoothly if required. If critical IT components are used without a backup system, KNAPP develops measures to minimize risk. Otherwise, KNAPP concentrates on actions for rapid recovery.

- *Update Service*: Necessary updates and patches of the firmware, the operating systems and, if necessary, resulting updates and patches of the database applications are tested and installed once a year after consultation with the customer. Hotfixes can also be supplied outside the annual patch cycle if required.

It offers a massive reduction of downtimes through a tested and correctly functioning system. Downtimes are reduced by preventive maintenance of the systems, and thus plant availability is increased.

5.3.6. Multi Stage Deployment

Multi-Stage Deployment is a preventive service. The most significant benefit is risk minimization in the change process by testing the system in advance in the testing environment. (Early error detection without impact on the live system.)

5.3.7. Ramp Up Services

KNAPP provides a technician for mechanical and electrical issues during the first months of set-up. The KNAPP technician supports the customer in all matters during the ramp-up phase concerning settings, maintenance, problem management, and spare parts management.

By making use of the Ramp Up Services, the customer saves time and money by correctly ramping up the plant and learns the correct handling of the plant at an early stage.

5.3.8. Resident Engineering

Resident Engineers are trained software (IT Resident Engineer) or hardware (Technical Resident Engineer) technicians for support directly at the facility. The Resident Engineer serves as the central point of contact for the customer for all software/hardware as well as logistical issues. In the event of occurring disturbances in the system, which are reported by the customer, the engineer carries out measures for possible remedy or initiates these in close contact with the KNAPP hotline. The customer is also supported in the development of improvements and changes as well as in their installation and/or setup.

The Resident Engineer is a direct KNAPP contact person on-site at the customer. The customer saves time and searches for the recruiting and training process for employees.

5.3.9. Service Level Agreement for Technical Plant Availability

As part of the Service Level Agreement for Technical Plant Availability (SLA), KNAPP collects and evaluates the data for the verification of the currently achieved Key

Performance Indicators (KPIs). For this purpose, KNAPP must meet the requirements specified by the customer. The most significant benefit for a customer is the prioritization of his errors.

5.3.10. Service Level Agreement for Hotline

Within the scope of the Service Level Agreement for Services (SLA), KNAPP records and evaluates the data for the verification of the currently achieved service levels. The evaluation is carried out with the help of a customer-specific scorecard. For this purpose, KNAPP must meet the customer's requirements.

The Service Level Agreement refers to the Hotline Service. In this context, defined service levels (e.g., reaction and solution times) are guaranteed and penalized in the form of service credits if they are not fulfilled. KNAPP ensures the correct recording of incident data (start and end of troubleshooting, etc.).

The greatest benefit for a customer is the prioritization of his errors.

5.3.11. SMART Services

Smart services intelligently connect digital and physical systems and services. Information from all relevant systems of the facilities is collected, evaluated, enriched and made available to customers with added value to optimize their logistics processes. Customers can also keep control across several plants and can exploit new potentials by gaining more valuable insights into their processes.

SMART Services are preventive measures and monitoring of the plant, as well as an emancipation instrument to enable interpretations of the system by the customers itself.

5.3.12. Technical Service

Technical Services are designed to maintain system reliability and functionality over time through proactive and professional support from KNAPP in the maintenance of the customer's equipment. The aim is to determine and assess the actual condition or minimize wear and tear.

The technical service increases the reliability of the plant against failure, as well as prolongs its service life.

5.3.13. KNAPP Academy

The high complexity of modern plants requires well-trained employees.

The KNAPP Academy training increases the competence and expertise of the customer's employees for safe operation, efficient troubleshooting and proper maintenance of the system.

High knowledge results in higher plant availability and less downtime. Many failures are caused by the lack of knowledge of employees, which can be prevented by training. Also, this acquired knowledge leads to increased independence in handling the system.

5.3.14. Warehouse Operation Support

KNAPP experts advise customers on operational and strategic warehouse logistics (existing processes are optimized, and new logistics processes are developed and adapted to customer needs). The team has many years of experience in operative warehouse management. The WOS experts carry out goods flow analyses, ABC analyses, and storage bin definitions, etc. In addition, they support the customer in the creation of key performance indicators (KPIs) and help to introduce quality standards or increase quality. All types of data are collected and visualized so that relevant information is readable, immediately available and can be easily monitored.

Warehouse Operation Support not only provides data on technical availability, but it also goes one step further: it integrates warehouse management data from the customer's system. This data is displayed in easy-to-read diagrams and various graphs and simultaneously visualizes the target and actual status in real time. The graphs, diagrams, and data are tailored to the needs of the customer business.

Warehouse Operation Support offers customers an external, objective evaluation of their plant. The transparent representation of the processes helps to identify errors and thus to increase performance, as well as to save costs and improve quality.

5.4. Interviews Results

To provide more detailed information on the various services as well as a general assessment of each service from the KNAPP employees, questionnaires were created. It was divided into two parts, a general part, and a service-specific part. The results of the interviews are summarized below.

5.4.1. General Questionnaire

For the general part, a total of 16 people was interviewed who also maintain direct customer contact.

The general part of the questionnaire includes two parts:

- Importance of service consulting
- Influence of the services on the customer and his plant

5.4.1.1. Importance of Service Consulting

81 percent of the respondents rated good service advice as very important (see Figure 28). The reasons can be summarized in the following four points:

- The comprehensibility and usefulness of the service must be understandable.
- The customer relationship is strengthened by better communication.
- The customer satisfaction can be increased.
- Furthermore, good customer service helps the company improve as well.

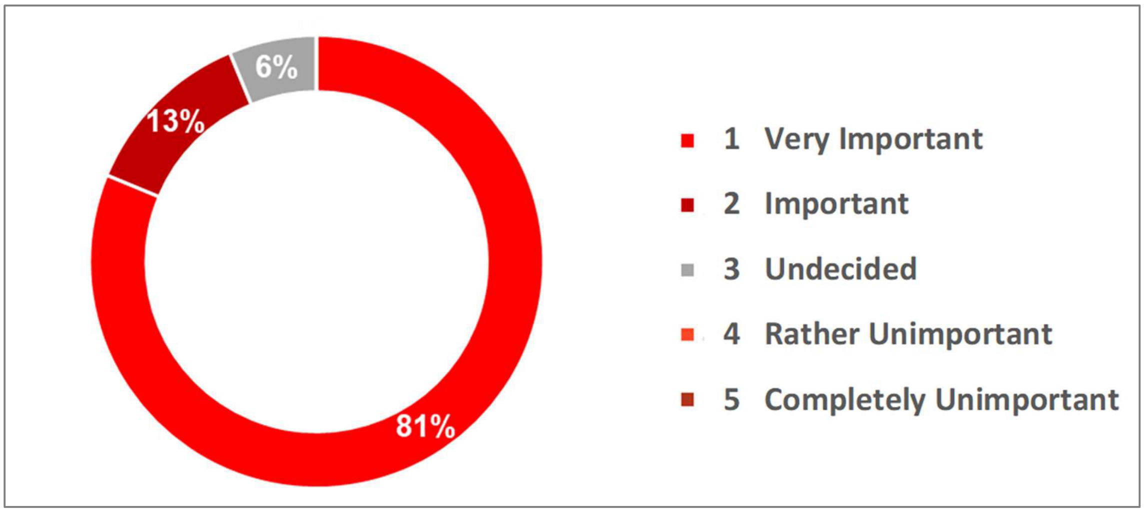


Figure 28: Importance of Service Consulting

5.4.1.1. Influence of the services on the customer and his plant

To foresee the impact of the services on the customer from the participants' point of view, the participants had to evaluate all 1 to 5 (1 - large influence; 5 - no influence). In the next section, three services had to be named that have the most significant impact on system availability.

Figure 29 depicts the ranking. The "Hotline" service is ranked first in both categories. The "Resident Engineering" service has a significant influence on the customer's system as well. These two questions were asked to understand what the participants think is important and what the customer thinks is.

Which service has the largest benefits for the customer?

	Service	mean
1	Hotline	1,20
2	Resident Engineer	1,57
3	SLA for system availability	1,80
4	Warehouse Operation Support	1,85
5	Technical Service	1,93
6	Spare Parts Management	1,93
7	Ram-UP Service	2,00

What contributes most to high system availability?

	Service	
1	Hotline	14
2	Spare Parts Management	8
3	Resident Engineer	7
4	IT-Services	5
5	Training	3
6	Technical Service	3
7	Warehouse Operation Support	2

Figure 29: Ranking of the Influence of Services on Customer Benefit and Plant Availability

5.4.1. Service-specific Part of the Questionnaire

For the service-specific part, an employee with in-depth knowledge and experience of the respective topic is interviewed.

This part of the interview should, on the one hand, provide further knowledge about each service and on the other hand, bring out concrete use cases.

The information generated from this is then used to derive the requirement catalog.

Due to the complexity of the services and partial linkage with other services, it was necessary to rethink the approach as the Use Cases delivered from the interviews had insufficient informative value.

In the next chapter, the strategy will be remodeled to derive a requirement catalog.

5.5. Deriving a Catalogue of Requirements

To present the situation as accurately as possible and to obtain a target-oriented catalog of requirements, all contents supplied by KNAPP are prepared, and descriptions of the specific scenario are created of how the warehousing system would behave with and without service. These are extended with the core statements from the interviews. By taking this as a base, the knowledge of each service that needs to be transferred and the requirements for the training concept is derived.

Figure 30 shows the procedure for developing the requirements on the example of the service “Spare Parts Management”.

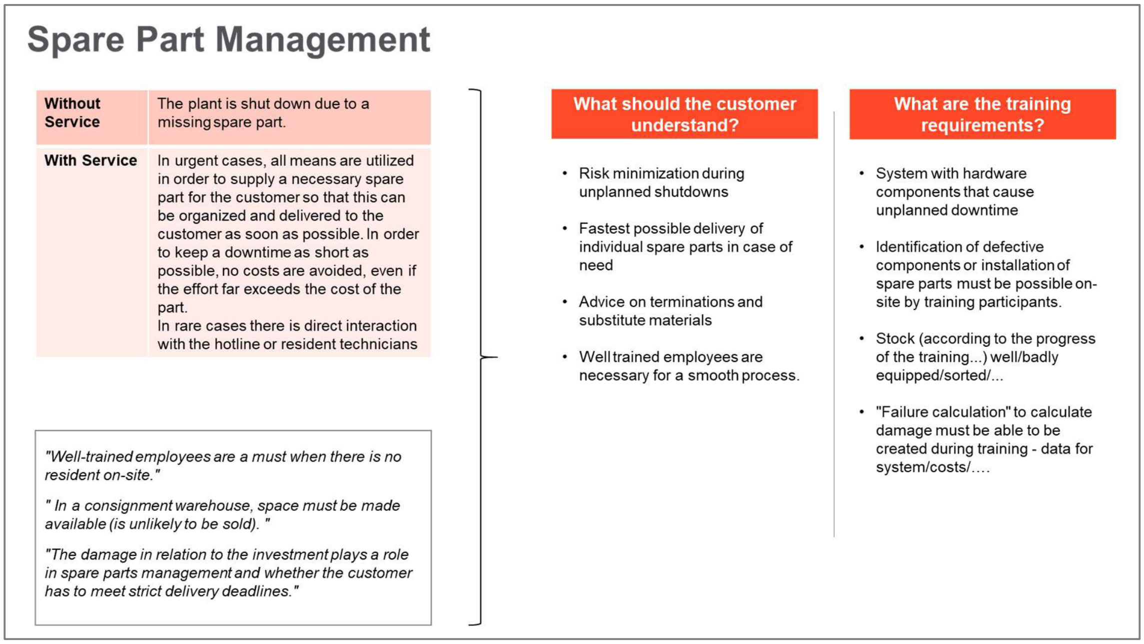


Figure 30: Procedure for Deriving the Requirements for the Training Concept

The following the resulting requirements of each service are summarized:

Escrow

- An application with corresponding software control is necessary.
- A scenario with need for modification of the software control must be simulated.
- A detailed description of the source code must be available (Showcase).

e-insight

- A system which produces various data and interactions (maintenance, inquiries, spare parts, ...).
- A platform for system data with already available information at hand.
- Use cases are created for the active use of the platform to illustrate the advantages.
- There must be the possibility of active "communication" with KNAPP employees via this platform (e.g.: status change RFC).

Spare Part Management

- The system must be equipped with hardware components which cause "unplanned" shutdowns.
- The identification of defective components or the installation of a spare part must be possible locally by the training participants.
- The inventory (based on the progress of the training...) must be well/badly equipped/sorted. (before/after comparison)

- It should be possible to draw up a "failure calculation" during training to clarify the consequences. This requires data from the system (costs, etc.).

Hotline

- The system must be equipped with hardware components which cause "unplanned" shutdowns.
- The simulation of the service “hotline” is either simulated by chat, a voice recording connected to a software, or a real one.
- The error is eliminated by a certain order of sequences.

IT-Service

- The system must be equipped with hardware components which cause "unplanned" downtimes accordingly.
- Exchangeable IT components are installed. (Bay in Raid system, plug-in board etc.)
- The system is linked with a simulation software to simulate IT errors.
- The system is equipped with sensors that deliver live data.

Multi Stage Deployment

- The system must be equipped with hardware components which cause "unplanned" downtimes accordingly.
- A testing environment of the training system is required.

Ramp Up Services

- The system is equipped with hardware components which cause an operational disturbance.
- The user must be able to identify these errors independently and draw up a solution plan.
- An external person, provided by KNAPP, who guides through the optimal process sequences of the plant ,is on-site.

Resident Engineering

- The system must be equipped with hardware components which cause "unplanned" downtimes accordingly.
- A task (e.g. exchange of a defective part, etc.) must be performed by both a trained and an untrained participant.

Service Level Agreement for Technical Plant Availability

- The system must be equipped with hardware components which cause "unplanned" downtimes accordingly.
- The error is eliminated by a certain sequence plus better ranking with estimated resolution times.

Service Level Agreement for Hotline

- The system must be equipped with hardware components which cause "unplanned" downtimes accordingly.
- The error is eliminated by a certain sequence plus better ranking with estimated resolution times.

SMART Services

- The system must be equipped with hardware components which cause "unplanned" downtimes accordingly.
- A link with simulation software to simulate early warnings/anomalies is required.
- The system is equipped with sensors that provide live data.
- Old data for capacity calculations etc. must be available.

Technical Service

- The system must be equipped with hardware components which cause "unplanned" downtimes accordingly.
- The removal and installation of parts must be easily and quickly possible on-site by training participants.

KNAPP Academy

- The system must be equipped with hardware components which cause "unplanned" downtimes accordingly.
- A task (e.g.: exchange of a defective part, etc.) must be carried out by a trained as well as an untrained participant.

Warehouse Operation Support

- The system must be equipped with hardware components which cause "unplanned" downtimes accordingly.
- The training participant must identify problems independently and develop a solution plan.
- An external person, provided by KNAPP, is on-site and guides through the optimal process sequences of the plants.

5.6. Summary of the Requirements on the Concept Designs

The requirements mentioned above are summarized in Table 4 and divided into three categories (hardware, software and learning environment).

Hardware	Software	Learning Environment
► A sensor-equipped system that delivers live data. ► Identification of defective components and their removal and installation must be easily possible on-site by training participants. ► Hardware should be designed in such a way that the customer can "work" independently. ► Inventory for exchange parts should be taken into account. ► Learning environment must promote interaction between the participants and trainer.	► Simulation of the system needs to be possible (software error, test environment for multi-stage deployment) ► Platform providing data of the monitored system with as much information as possible (similar to e-insight) ► Applications with software control ► Possibility of active interaction with "Hotline" (Chat Assistant, e-insight, etc.) ► Software to process live data of the system	► System that produces/requires various data and interactions. ► Use cases to make the service experienceable in the sense of "from bad to good logic". ► Simulated standstills, which can be cancelled by a certain (action) sequence. ► Fun factor and identification with the "product" of the system must be given. ► "external" consultant, Resident Engineer with "Best Practice Know-How". ► Duration of training: 4-6 hours ► Min. number of participants: ~6

Table 4: Requirements on the Concept Design

6 Phase II – Ideation of Concepts

Phase II starts with the generation of ideas to represent the service contents in a suitable scenario. To develop a suitable environment for this, functions are derived from the requirements catalog created in phase I. The aim is to use a morphological box to develop ideas for possible implementations in various scenarios.

The next step is to select four scenarios for representation in a learning factory environment. For these scenarios, rough concepts are developed which are presented to a selected group. Then a decision is made as to which of the concepts will be further developed in the next level of detail I.

Figure 31 provides a summary of the steps taken in Phase II.

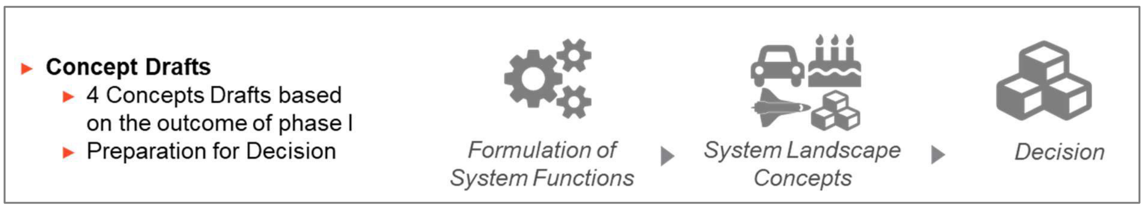


Figure 31: Overview Phase II

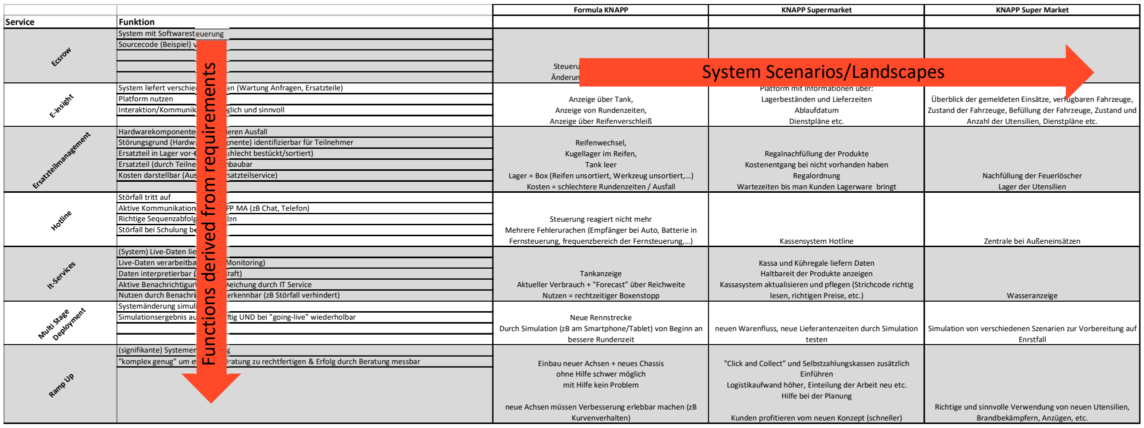
6.1. Formulation of System Functions and Development of System Scenarios/Landscapes

The morphological box is chosen as a suitable method for generating ideas. This method is particularly suitable for processing the mass of information in a structured and systematic way. Therefore, this method provides a good overview of the variety of variants. For many problems, there is a large number of solutions, but finding the useful ones is a challenge. The process simplifies them by systematically organizing and grouping appropriate aspects of the situation to identify new and appropriate combinations. The aim is to decompose this topic into its essential parameters or dimensions and to put it into a multidimensional matrix.[162]

Table 5 shows an excerpt of the morphological box to demonstrate the structure. In the first step, ideas for possible scenarios, also called system landscapes, are generated. For these, functions that fulfill requirements from Phase I will be developed.

In the next step, the table is filled with implementation solutions. The complete table can be found in the Appendix A.

[162] Zwicky, 1989



Service	Funktion	Formula KNAPP	KNAPP Supermarket	KNAPP Super Market
Ecsrow	System mit Softwaresteuerung Sourcecode (Beispiel) v	Steueru Änderun		
E-insight	System liefert verschie… …en (Wartung Anfragen, Ersatzteile) Platform nutzen Interaktion/Kommunik… …glich und sinnvoll	Anzeige über Tank, Anzeige von Rundenzeiten, Anzeige über Reifenverschleiß	Platform mit Informationen über: Lagerbeständen und Lieferzeiten Ablaufdatum Dienstpläne etc.	Überblick der gemeldeten Einsätze, verfügbaren Fahrzeuge, Zustand der Fahrzeuge, Befüllung der Fahrzeuge, Zustand und Anzahl der Utensilien, Dienstpläne etc.
Ersatzteilmanagement	Hardwarekomponente… …ieren Ausfall Störungsgrund (Hardw… …onente) identifizierbar für Teilnehmer Ersatzteil in Lager vor-… …chlecht bestückt/sortiert) Ersatzteil (durch Teilne… …nbaubar Kosten darstellbar (Aus… …satzteilservice)	Reifenwechsel, Kugellager im Reifen, Tank leer Lager = Box (Reifen unsortiert, Werkzeug unsortiert,…) Kosten = schlechtere Rundenzeiten / Ausfall	Regalnachfüllung der Produkte Kostenentgang bei nicht vorhanden haben Regalordnung Wartezeiten bis man Kunden Lagerware bringt	Nachfüllung der Feuerlöscher Lager der Utensilien
Hotline	Störfall tritt auf Aktive Kommunikation… …PP MA (zB Chat, Telefon) Richtige Sequenzabfolg… …len Störfall bei Schulung be…	Steuerung reagiert nicht mehr Mehrere Fehlerurachen (Empfänger bei Auto, Batterie in Fernsteuerung, frequenzbereich der Fernsteuerung,…)	Kassensystem Hotline	Zentrale bei Außeneinsätzen
It-Services	(System) Live-Daten lie… Live-Daten verarbeitba… …Monitoring) Daten interpretierbar (… …kraft) Aktive Benachrichtigun… …weichung durch IT Service Nutzen durch Benachri… …erkennbar (zB Störfall verhindert)	Tankanzeige Aktueller Verbrauch + "Forecast" über Reichweite Nutzen = rechtzeitiger Boxenstopp	Kassa und Kühregale liefern Daten Haltbareit der Produkte anzeigen Kassasystem aktualisieren und pflegen (Strichcode richtig lesen, richtigen Preise, etc.)	Wasseranzeige
Multi Stage Deployment	Systemänderung simul… Simulationsergebnis au… …ftig UND bei "going-live" wiederholbar	Neue Rennstrecke Durch Simulation (zB am Smartphone/Tablet) von Beginn an bessere Rundenzeit	neuen Warenfluss, neue Lieferantenzeiten durch Simulation testen	Simulation von verschiedenen Szenarien zur Vorbereitung auf Enrstfall
Ramp Up	(signifikante) Systemer… …g "komplex genug" um e… …eratung zu rechtfertigen & Erfolg durch Beratung messbar	Einbau neuer Achsen + neues Chassis ohne Hilfe schwer möglich mit Hilfe kein Problem neue Achsen müssen Verbesserung erlebbar machen (zB Kurvenverhalten)	"Click and Collect" und Selbstzahlungskassen zusätzlich Einführen Logistikaufwand höher, Einteilung der Arbeit neu etc. Hilfe bei der Planung Kunden profitieren vom neuen Konzept (schneller)	Richtige und sinnvolle Verwendung von neuen Utensilien, Brandbekämpfern, Anzügen, etc.

Table 5: Excerpt of the Morphological Box

6.2. First Concept Draft of four System Landscape Concepts

After an evaluation of the possibilities by KNAPP, the following ideas were selected for further conception:

- Formula KNAPP
- KNAPP Bakery
- KNAPP Rocket Launch
- KNAPP Mini Warehouse

These ideas need to be abstracted so that a learning environment can be developed. In the next step, the parallels between the system landscape and a KNAPP system are drawn. Based on this, initial ideas are recorded on how the different services can be placed in the new environment. The results including a chosen service are briefly described in the next subchapters. The same procedure was used to develop each service in the new environment. The full drafts are in the Appendix B.

6.2.1. "Formula KNAPP" Concept

The original idea lies in Formula 1. Figure 32 shows the abstraction of the system from Formula 1 to go-kart racing, right down to the smallest form the model car race. The abstracted system consists of model cars, their remote control, spare parts and tools for the pit stop, as well as petrol, a touch screen, and two computers.

The system landscape is managed by the team manager, who makes strategic decisions for the pilot with the help of his crew. The pilot has the remote control and is responsible for maneuvering the vehicle.

Figure 32: Formula 1 System Abstraction

The necessary system elements for the abstraction are shown in Figure 33. The overview provides further the information delivered by the various subareas.

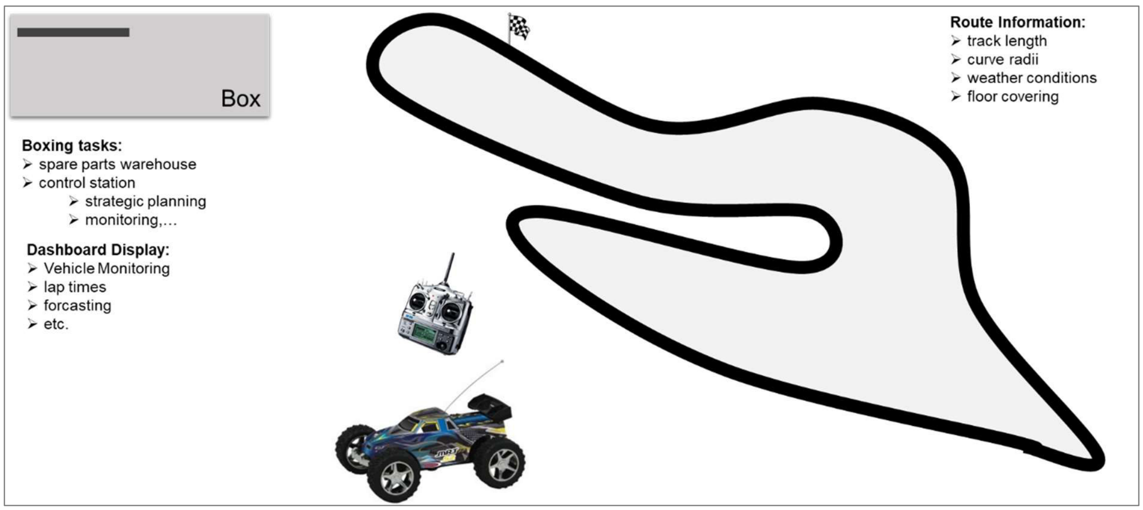


Figure 33: Overview of the “Formula KNAPP” System Elements

In the next Figure 34 the parallels between a real plant and Formula 1 are displayed.

Team Structur Warehouse:	**Team Structur Formula 1:**
- Manager	- 1 Team boss
- Warehouse manager	- 1 Technical manager
- Warehouse employee	- 1 Pilot
Services in the warehouse environment:	**Service in the alternative environment:**
Multi Stage Deployment	Route simulation by app
Ramp-Up	Curve behaviour with correct application
E-Insight	Dashboard with up-to-date data
IT-Services	Monitoring of the vehicle
SMART Services	Forecasting and strategic planning
Technical Service	Tyre change, refuelling, etc.
Warehouse Operation Support	Driving behaviour analysis, strategy
Resident Engineer	Pirelli external engineers or AVL engineers
Hotline	Radio communication
Spare Parts Management	Engines (combustion units, MGUH, MGUK etc.), tyres, petrol
Escrow	Small programming task
Training	Faster lap time with each repetition

Figure 34: Parallels between KNAPP Warehouse and Formula 1

A possible implementation in the new system is explained by the technical service. As shown in Figure 35, the technical service is comparable to the Formula 1 pit stop. This can be both a proactive exchange of wear components (e.g., tires) and the exchange/repair of a damaged vehicle part (e.g., due to a collision).

Figure 35: Pit Stop in Formula 1

6.2.2. "KNAPP Bakery" Concept

Starting from an industrial bakery, Figure 36 shows the abstraction of a manufacturer of baked goods and finally of a small bakery. The smallest system includes a baking device, a cooling device, the storage and a mixing machine.

Figure 36: Bakery System Abstraction

The overview for the small bakery is sketched in Figure 37. It includes the minimum necessary stations to create an authentic process for the essential information.

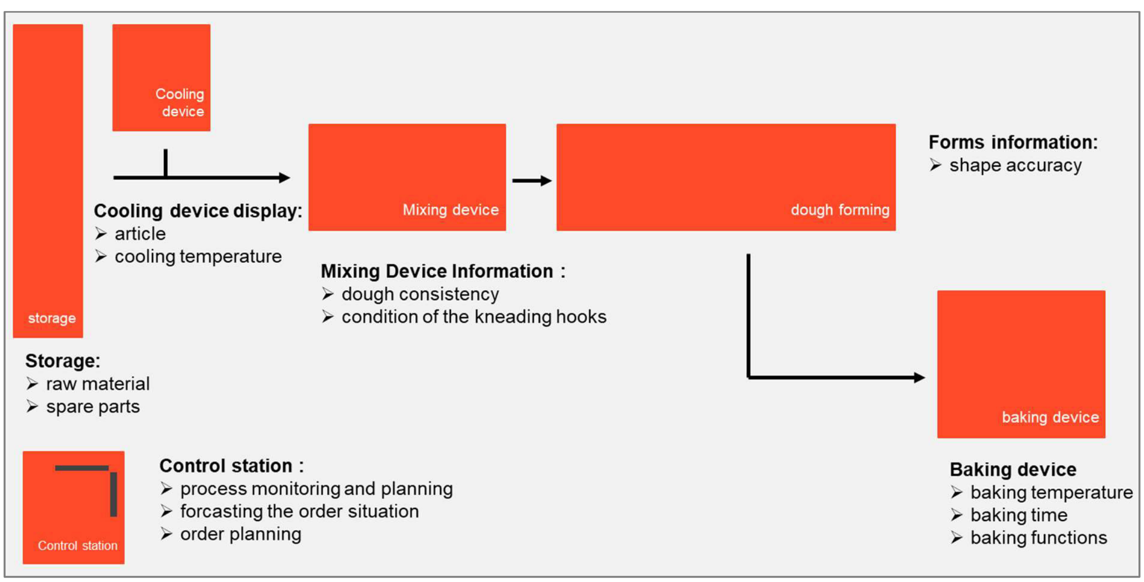


Figure 37: Overview of a "KNAPP Bakery" Draft

In the first step, the required ingredients are collected and checked for quality. The ingredients are then mixed according to the recipe and prepared for oven baking. The last step is the adjustment of the right settings for baking the goods. In the system environment, the master confectioner leads the process and gives instructions to the bakers and apprentices. The orders are transmitted on a screen. Figure 38 shows a comparison between the bakery and the logistics system.

Team Structur Warehouse:	**Team Structur KNAPP Bakery:**
- Manager	- Bakery Manager
- Operational manager	- Baker
- Technical manager	- Baking apprentice
Services in the warehouse environment:	**Service in the alternative environment:**
Multi Stage Deployment	Bakery König
SMART Services	Forcasting variety and baking characteristics
E-Insight	Duty rosters, machine descriptions
Spare Part Management	Necessary baking components (ingredients)
scrow	Secret recipe
Ramp-Up	Kitchen explanation and optimal use
Warehouse Operation Support	Layout and process optimization
Resident Engineer	Trained kitchen assistant (trainer role)
Hotline	Technical hotline or others
Training	Learning a Skillset
IT-Services	Monitoring, capacity management
Technical Service	Replacement/repair of baking tools

Figure 38: Parallels between KNAPP Warehouse and a Bakery

Since the system is very simplified, the hardware components also loose complexity. The following options, therefore, exist for displaying the technical service in the bakery system landscape:

- Replacement and repair of hardware components (e.g., oven, mixer, etc.)
- Breakage/ bending of the sheet metal guide
- Wear and tear of whisks, silicone parts, etc.

6.2.3. “KNAPP Rocket Launch” Concept

The start of abstraction is a real space rocket. The reduction is shown in Figure 39. (Space rocket - facility from an amusement park – simulation capsule with the necessary hardware and software functions) The system includes a simulation capsule and a control station. The control station is equipped with screens and computers.

Figure 39: Rocket Launch System Abstraction

Figure 40 shows an overview of the rocket launch. It should be noted that the control room and the space capsule are physically separated - even only by a visual block.

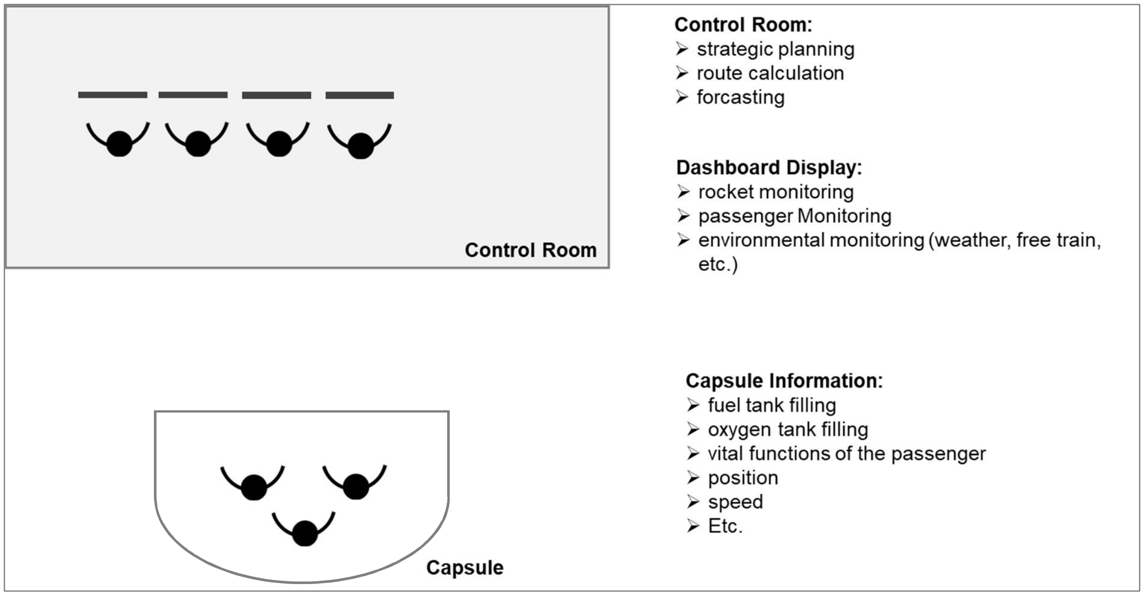


Figure 40: Overview of the "KNAPP Rocket Launch" Draft

The mission control uses the control station to guide the crew, which executes its instructions and maintains radio contact with the simulation capsule. The mission crew is responsible for checking the outside and inside of the capsule and can carry out repairs if necessary. The simulation capsule contains the astronauts. The capsule is equipped with a touch screen. The astronauts take the steps required for the launch by using the touch screen. The possible implementations of the service products in the new environment are shown in Figure 41.

Team structur Warehouse:	**Team structur Rocket Launch:**
- Manager	- 1 Mission director
- Operational manager	- 1 Crew captain
- Technical manager	- 2-3 Astronaut
- Technician	- 3+ Mission crew
Services in the warehouse environment:	**Services in the alternative environment:**
Multi Stage Deployment	Start simulation via App
Ramp-Up	Control-Station expert
E-Insight	Dashboard with various data
IT-Services	Monitoring of the vehicle
SMART Services	Forecast of virtual functions, glight data
Technical Service	Check of space suit, outer and inner parts
Warehouse Operation Support	Control-Station experten
Resident Engineer	Experienced astronaut
Hotline	Radio communication to Control Station
Spare Parts Management	Exchange of inner and outer parts
Escrow	Small programming task
Training	KNAPP Rocket Launch example

Figure 41: Parallels between KNAPP Warehouse and Rocket Launch

The representation of the technical service in the system landscape can be experienced by testing and replacing worn or damaged parts of the space suit, or by servicing the outside or inside parts of the space capsule (see Figure 42). Some parallels to the original logistics system can be identified.

Figure 42: Repair and Maintenance of a Space Capsule

6.2.4. “KNAPP Mini Warehouse” Concept

The mini-warehouse consists of the essential workstations of a real warehouse, including virtually represented components.

In Figure 43, an automated logistics system is reduced to a small manual system and in the last figure further abstracted to only its essential functions.

Figure 43: Logistics Warehouse System Abstraction

The processes in the smallest possible version remain identical to those of the large system. A rough layout was created as shown in Figure 44. The stations were compressed to such an extent that all necessary processes can still be displayed without restrictions.

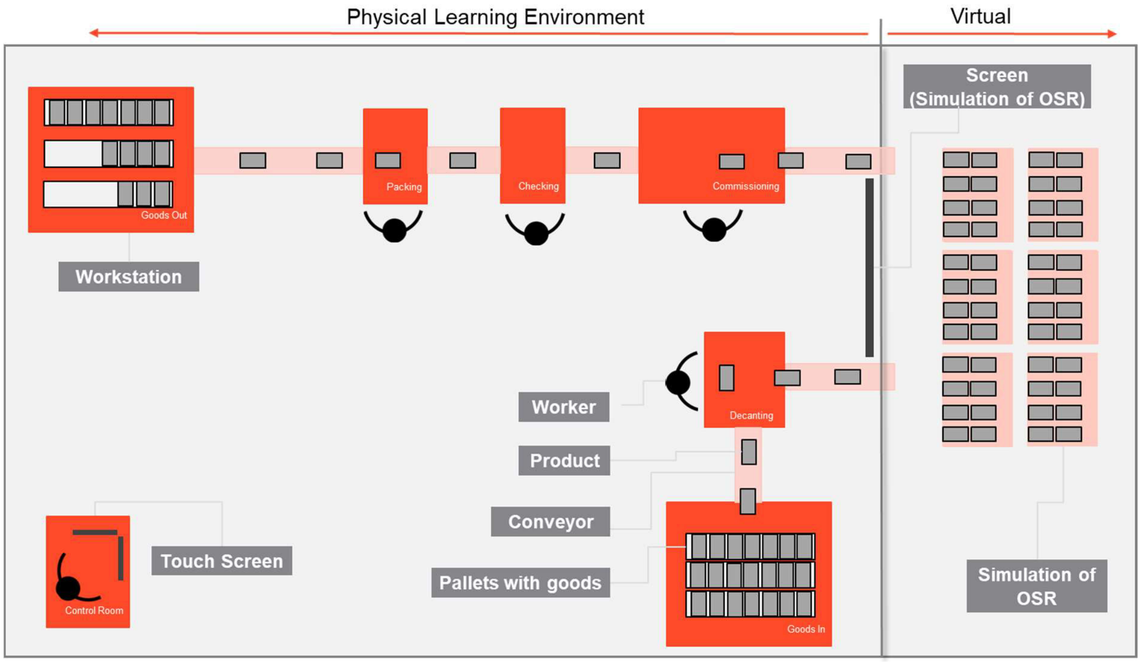


Figure 44: Overview of the "KNAPP Mini Warehouse" Layout

Initially, the workstations are planned by the participants to a certain extent. The technicians then set them up and configure them.

After completion of the first warehouse system check, the warehouse is filled for the first time with products. Before the goods can be stored, they must first be checked at the check station (automatically or by a warehouse worker).

The goods are then virtually stored on a conveyor system in the high-bay warehouse (OSR). From this point on, customer orders can be processed on a picking station and transported on to dispatch, where they are again subjected to a quantity and quality check.

Finally, these are grouped into batches and transferred to the outgoing shipping department.

6.3. Decision

The following questions are used as guidance for the decision process:

- Is the system environment (the processes) known to the customer?
- Does the system landscape provide an emotion/fun factor?
- Is teambuilding/teamwork possible within the groups?
- How does the idea appeal to the customers?
- Is the effort regarding transport to the customer and setup high?
- Is the number of participants scalable?
- Is the system expandable for new services?
- What image does KNAPP give the customer?

It is necessary to recognize the unconventional ideas and their parallels to the KNAPP services, as well as to ensure for the "Mini Warehouse" that no negative connection to KNAPP products arises.

Considering the criteria and an additional input session with selected KNAPP service employees, the "KNAPP Mini Warehouse" was chosen for the next development step.

7 Phase III – Final Concept Design

In the last project phase, a detailed conceptual design of the "KNAPP Mini Warehouse" will be developed, continued with the new title "KNAPP Service Factory." In the following pages the learning environment, the layout, as well as the procedure and the contents of the training are described. Figure 45 provides an overview of the activities of Phase III.

Figure 45: Overview Phase III

7.1. Interview Round 2 for the development of Use Cases (Macro Level)

For the second interview round, an excel sheet was created on the bases of the current state analysis. This document was previously evaluated and reviewed by the project management and forwarded to selected KNAPP employees for revision.

Table 6 shows an excerpt of the revised excel file. The individual services are listed in the columns. The rows are structured into the following categories:

- Service description
- Customer benefit
- KNAPP deliverables
- Customer view (purchase motivation)
- Use Cases
- Plant behavior without service
- Plant behavior with service

The original file can be found in the Appendix C.

Description	Customer Benefits	KNAPP Service	Buyer motivation
SMART SERVICES link digital and physical systems, and Services in an intelligent way. Information of all relevant systems of plants are managed together, and enriched with added value to optimize their customers' business. logistics processes. Customers can also keep a grip on their plants group-wide or across several plants and can exploit new potentials by gaining more valuable insights into their processes.	Maximum Optimization & Transparency	- provides a quick overview - independent interpretation (also possible without KNAPP) - Empowerment tools with early warning system - intuitive and easy to use elements - Preventive and monitoring tools - Mobile assistance systems and availability of all relevant key figures worldwide and without having to be in the KNAPP network. - Monitor all systems against customer or KNAPP thresholds, enabling immediate response or proactive solutions to an emerging problem.	Empowerment Tools mit Frühwarnsystem State of the Art Technologien die in anderen Bereichen genutzt werden auch im Arbeitsumfeld nutzen Selbst Informationen/ Entscheidungsgrundlagen herbeiführen und nicht wegen allem bei KNAPP nachfrage Optimierung der Anlage & der logistischen Prozesse Erhöhung der Verfügbarkeit, die richtige Information zum richtigen Zeitpunkt an die richtige Person, erhöhte Transparenz
Technical Services are designed to maintain system reliability and functionality over time through proactive and professional support from KNAPP in the maintenance of the customer's equipment. Objective: Determination and assessment of the actual condition or minimization of wear and tear	long lasting system reliability	a. Maintenance b. Inspection c. On-site technicians d. Add-Ons Professional maintenance and servicing increase the reliability of the system Well-maintained investments retain their value for longer. "Zero Defect" systems also need maintenance to extend their service life.	Maximize service life and avoid system failures
The proper operation of a logistics system requires that the right spare parts are available at the right time and in the right quantity. The customer should therefore keep a number and selection of spare parts recommended by KNAPP in stock at the plant location	Rapid availability of a spare part	A. Spare parts consulting B. Spare parts procurement C. Online platform for spare parts Expert advice on tailor-made spare parts packages Fastest possible delivery of individual spare parts in case of need Online request for spare parts (e-insight) Ongoing data collection and analysis for optimal life cycle planning	Transparenz und VertrauenTransparency and trust

Table 6: Excerpt of Use Cases and Customer Benefits File

The new information is used to define the customer benefits of each service more precisely.

The exercises described below are developed by the customer benefit in a brainstorming unit in the project team and finalized step by step.

7.2. Storyboard of the Training

The training in the KNAPP Service Factory is divided into three phases:

- Set-up Phase
- Go-Live Phase
- Warehousing Phase

The use cases collected from the interviews are used to create the training exercises. In the interviews, the services and the matching use cases were additionally allocated to the phases in which they have the most significant impact based on the assessment of the employees. For each phase the exercises are pictured in the next chapters.

7.2.1. Training Content of the Set-up Phase

The first phase serves to develop an understanding of warehouse processes and the various warehouse components. The participants familiarize themselves with the new environment. The structure of the training module is as shown in Figure 46. Each exercise has the task of teaching specific content (customer benefits), which is summarized in the boxes on the right of the figure below.

The following services are displayed in the set-up phase:

- e-insight
- Resident Engineering
- IT Resident Engineering
- Spare Part Management

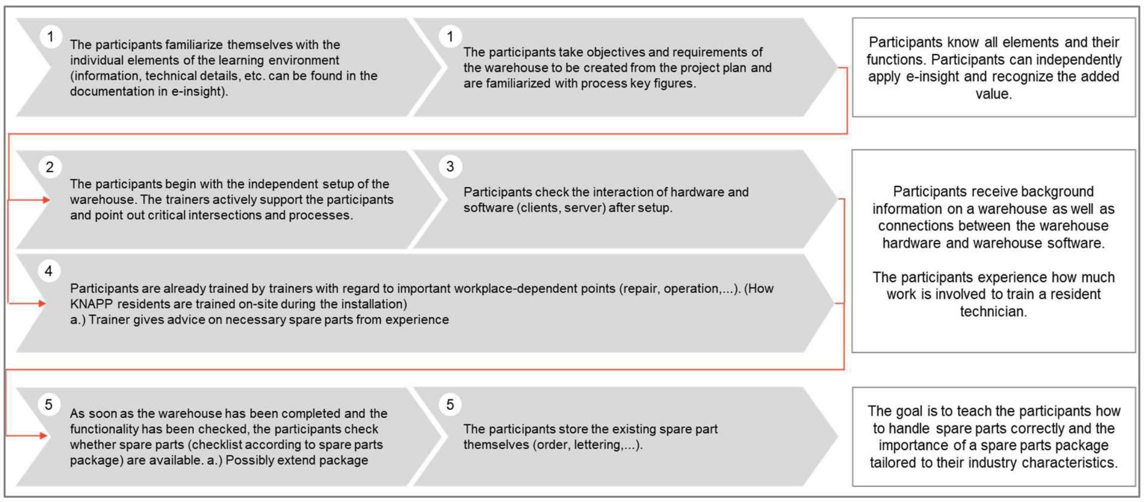


Figure 46: Training Content of the Set-up Phase

The first module consists of five exercises. Figure 47 shows two of these exercises.

Sequence	Exercise Description	Modus	Knowledge to be Communicated:
1 Introduction	▪ Presentation of the "KNAPP Mini Warehouse" idea and intention (e.g. via video to enable a better linking to the real situation) ▪ Introduction to a KNAPP warehouse and the logistic processes as a presentation ▪ Overview of – Objectives and requirements of the KNAPP Mini Warehouse: What must the warehouse fulfil? What is the warehouse designed for? (Specification of the warehouse) ▪ ▪ If necessary, clarify open questions	Theory	➢ Participants are familiar with ➢ The workstations ➢ The process ➢ The procedure. ➢ The participants have gained sufficient knowledge for the next tasks. ➢ They have become familiar with the e-insight and the content it contains.
2 Exercise 1 Setup of the Workstations	▪ Each participant will be equipped with a tablet. In a short video or presentation, the e-insight is explained over the tablet to give an overview of the functions and possible contents.	Theory	
	▪ The participants use the documentation and information in the e-insights to build the learning environment: – Description of the individual workstations and layout is used to arrange the workstations according to the plan. – The information is taken from the assembly plans of the plants in order to realise the mechanical connection of the partial elements with the conveyor technology. – etc.	Practice	
3 Exercise 2 Resident Engineer	▪ At the same time as the workstations are set up, the participants are divided into groups, which take over the configuration of 2-3 workstations. ▪ The trainer team provides additional information to the groups on the different workstations for the exact construction of the subcomponents, potential sources of error and the correct use of the equipment..	Practice	➢ Participants will experience the effort for training a Resident Engineer and the educational advantages this brings with it. ➢ Developing an understanding of the IT hardware and its communication with the main system.
4 Exercise 3 Setup IT-Infrastruktur	▪ The IT-infrastructure (software and hardware) of the warehouse is explained to the participants. Hardware/Software interactions: What information is transferred from the IT hardware components and the workstation to the service station? ▪ Server training: The difference between virtual and physical servers and how they work will be explained to the participants.	Theory	
	▪ The next step is to connect the servers to the workstations. The server is positioned in a glass rack to give the participants a better view inside. ▪ Then the complete system is connected to the network, started and tested. In the control station the system is recognized and displayed. (Visu) ▪ If a connection is interrupted, it will be marked in the Visu and must be checked. The IP addresses are checked and the missing ones are assigned so that a connection can be established.	Practice	
4 Exercise 4 IT- Resident Engineer	▪ At the same time as the server is being set up, the trainer also trains the participants. ▪ Training on the servers and the maintenance of the IT infrastructure are shown at the facilities.	Theory	➢ The participants learn how the IT infrastructure is maintained and the influence on the availability of the plant.
5 Exercise 5 Spare Parts Management	▪ After testing the warehouse, the customer selects a spare parts package. ▪ (The spare parts package will be calculated through a simplified risk management analysis to select the appropriate package for the model Warehouse business case). ▪ It will be checked if the correct spare parts are in stock. ▪ In the next step, the participants must find a suitable location for those and store the spare parts. ▪ It is important to note that the participants label the spare parts and store them in such a way that they can be accessed quickly if necessary.	Practice	➢ The correct handling of the spare parts and the influence of spare parts adjusted to his critical business hours is explained to the participant.

Figure 47: Exercises in the Set-up Phase

7.2.2. Training Content of the Go-Live Phase

The second phase begins with the first storage of the goods and taking the first orders. The phase starts with the first commissioning and lasts until the ramp-up of the warehouse. Figure 48 describes the module of the Go-Live Phase and the lessons learned during the training.

The following services are being covered in the Go-Live phase:

- Ramp up Service
- Escrow
- Multi Stage Deployment
- Hotline
- Smart Services

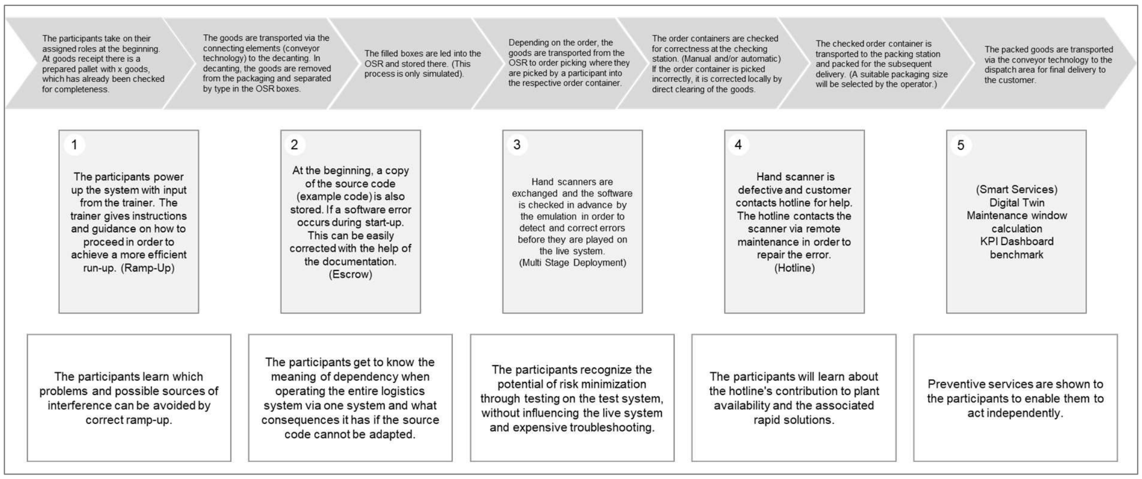


Figure 48: Training Content of the Go-Live Phase

The exercises planned for the Go-Live Phase are described in Figure 49.

Sequence	Exercise Description	Modus	Knowledge to be Communicated :
1 Excrcise 6 Ramp Up	The system is started and already filled. The first orders have already been accepted and processed. ▪ The system cannot fulfill the orders because there is not enough goods in the warehouse and cannot execute dialogues with the software.	Theory	➢ Understanding KPIs and using them to exploit their potential ➢ Error minimization and elimination through support from the trainer
	▪ With the help of the trainer, the participants work out important KPIs for the system (e.g. throughput/h, provision times, picking performance, etc.). ▪ The trainer takes over the management during the start-up of the plant and eliminates any problems that may be caused by the participants..	Practice	
2 Exercise 7 Escrow	▪ A supplier changes the product code from 8 digits to 13 digits. Company Knapp is no longer available to change it for the participants. ▪ A simplified source code with a detailed description is provided to the customer so that the participants can adapt the source code. (e.g. Grasshoper)	Practice	➢ Safety for the system availability in a special case
3 Exercise 8 Multi Stage Deployment	▪ Since a supplier no longer produces the hand-scanners and also stops supplying spare parts for this product, it is necessary to convert to a new one. ▪ The new hand-scanners offer easier/convenient and faster handling for the employees. However, they differ in data processing and forwarding. ▪ In an emulated environment of the KNAPP learning factory, this software is tested and checked in advance before used.	Practice	➢ Risk minimization of shutdowns due to unexpected errors caused by changes.
4 Exercise 9.1 Hotline	▪ When the goods enter the OSR, the height control is moved and no container can enter the high rack anymore. ▪ Participants contact the hotline, which obtains information remotely and finds out that the containers are too fully loaded and have been damaged. ▪ A technician is informed and takes care of the repair.	Practice	➢ Competent technical assistance and thus rapid solutions in the case of incidents.
Exercise 9.2 Hotline	▪ During decanting, the goods are scanned and during this process the hand-scanner fails. The participants are not able to repair the failure and contact the hotline, which is simulated as a chat assistant. ▪ The chat-assistant establishes a connection to the scanner and tries to detect and correct the error. The error can be found in the network configuration and is corrected remotely. ▪ The participant is informed by the chat assistant and can continue working.		
5 Exercise 10 SMART Services	Trends: ▪ The participants analyze the performance of the previous years with the help of the database with previous values and calculate the expected performance for the new year. ▪ In the forecasting calculation, the market growth and the industry-specific benchmark are taken into account and presented in a visually form. Digital Twin: ▪ The participants are given the task of checking whether their stock is ready for the peek of the Christmas season. (Figures are handed over to the participants by the trainer.) ▪ The participants simulate the different ideas (system expectations, etc.) in order to develop the optimal flow of goods.	Practice	➢ Preventive service tools to enable participants to develop solutions independently.

Figure 49: Exercises in the Go-Live Phase

7.2.3. Training Content of the Warehousing Phase

The Warehousing Phase describes the condition of the warehouse in which a plant has been operated at full capacity for a longer period. Figure 50 illustrates the training module of this phase. The errors occur during operation, which causes delays or shutdown of the plant.

The following three services are performed in the warehousing phase:

- Technical Services
- IT- Services
- Warehouse Operation Support

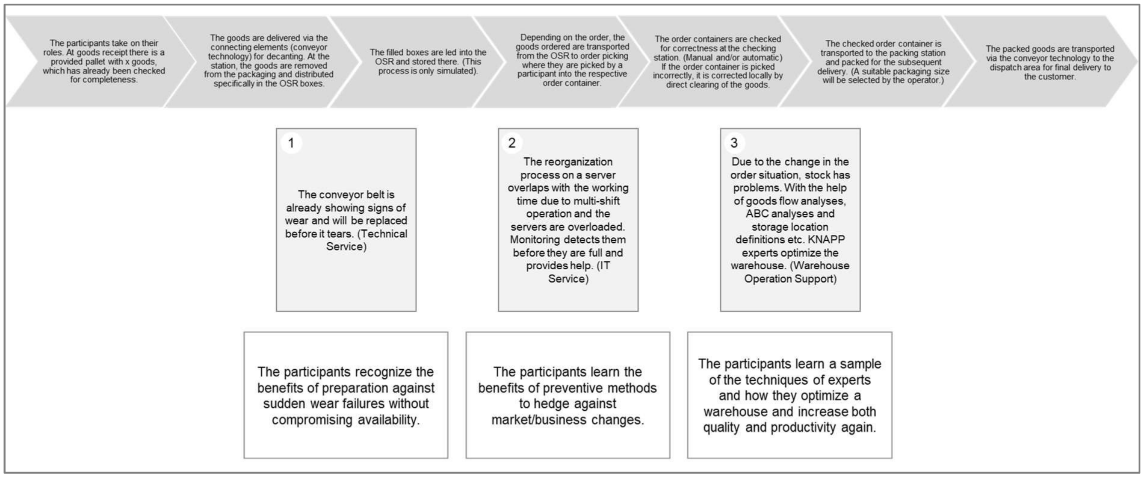


Figure 50: Training Content of the Warehousing Phase

Figure 51 describes two of the three exercises from the last phase of the training.

Sequence	Exercise Description	Modus	Knowledge to be Communicated:
❶ Exercise 11 Technical Service	▪ The participants are divided into groups and instructed by the trainer team how maintenance is carried out. ▪ At the work stations, the groups learn which components need special attention and where wear and tear can already be seen (e.g. conveyor belt has initial tears). ▪ The trainer works out a repair plan together with the participants.	Practice	➢ Elimination of possible failures and thus risk minimization through unforeseen failures of wear parts.
❷ Exercise 12 IT-Services	IT-Service - Monitoring: ▪ The warehouse has to change its working hours from 2 shifts to 3 shifts during the Christmas season. ▪ Due to the reorganization, which is now taking place at the same time as the new 3rd shift, the database of the server is in danger of running full. ▪ Through the IT monitoring the hotline is informed before the problem occurs and deletes old "logfiles" in order to create storage space and subsequently to investigate the cause (in this case: simultaneous reorganization and warehouse operation).	Practice	➢ A change in market-specific requirements has an impact on business activities, providing protection against unscheduled failures.
❸ Exercuse 13 Warehouse Operation Support	▪ Due to a new market situation, the order volume of the warehouse is changing. The warehouse cannot react to this change and no longer works in a way that conserves resources. ▪ The trainer instructs the participants in various valuation methods (goods flow analyses, ABC analyses and storage location definitions, etc.).	Theory	➢ A comprehensive and accurate improvement requires a lot of knowledge and experience to optimize a warehouse.
	▪ The participants create a requirement catalog which describes the new situation. ▪ By applying the learned methods, the participants optimize/expand the warehouse based on the requirements to be fulfilled.	Practice	

Figure 51: Exercises in the Warehousing Phase

7.3. Freeze of concept

Based on the evaluation of the created exercise, the following next step are derived:

- The separation into phases didn't help the objective of creating more impact on the understating of the participants, therefore the differentiation in different phases will be eliminated.
- The first use-case descriptions need further adjustments.
- A final layout including all elements has to be designed.

7.4. Designing of the KNAPP Service Factory Layouts

Simultaneous to the creation of the use cases and exercises, the necessary system components are filtered out, which must be included in the learning factory. In several iteration steps, two layouts are developed based on the sketch from the rough concept using the additional information for the Service Factory. The first layout meets the specification: transportable in a sea container. (Figure 52) However, the second layout is planned as a non-transportable system with more scope for expansion. (Figure 53)

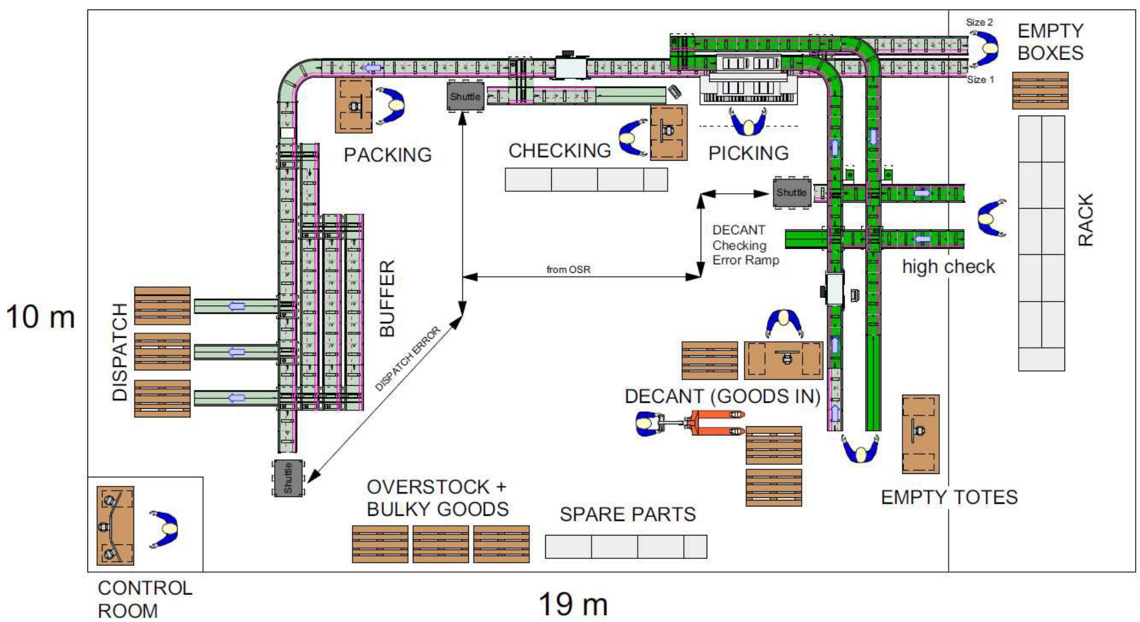


Figure 52: Transportable Layout of the Service Factory

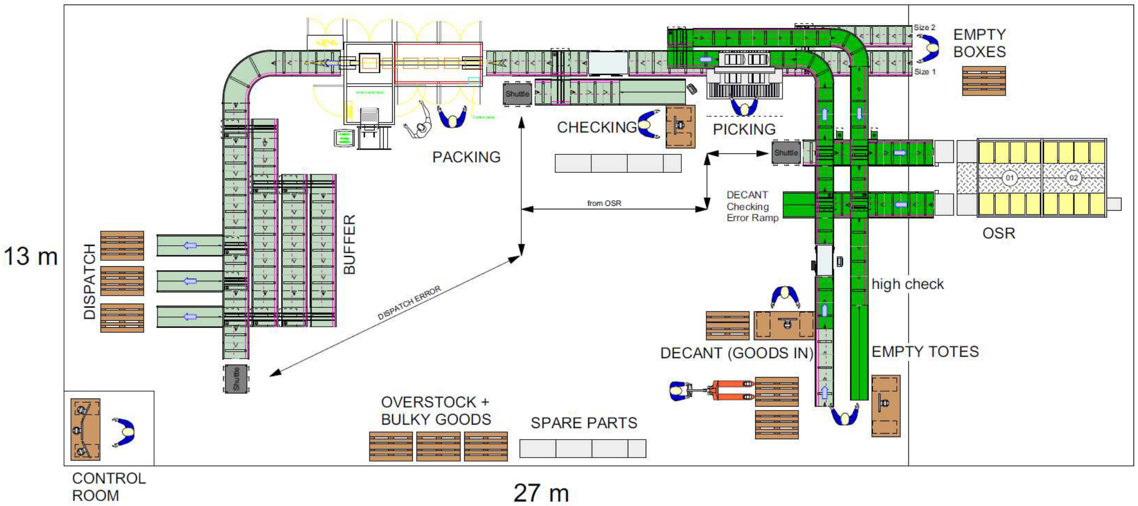


Figure 53: Non-transportable Layout of the Service Factory

7.5. Development of service packages

The interconnection of certain service products makes it impossible to separate them into phases. Therefore, the services are combined into packages that deliver the desired synergies for and meet different plant needs. These service packages will be used to develop training packages.

7.5.1. Overview of the Service Packages

Figure 54 provides an overview of the result on the bundled service packages. Each package builds on the previous one. This means that the services contained in the "Basic" package remain in use when upgrading to the next "Classic" package level.

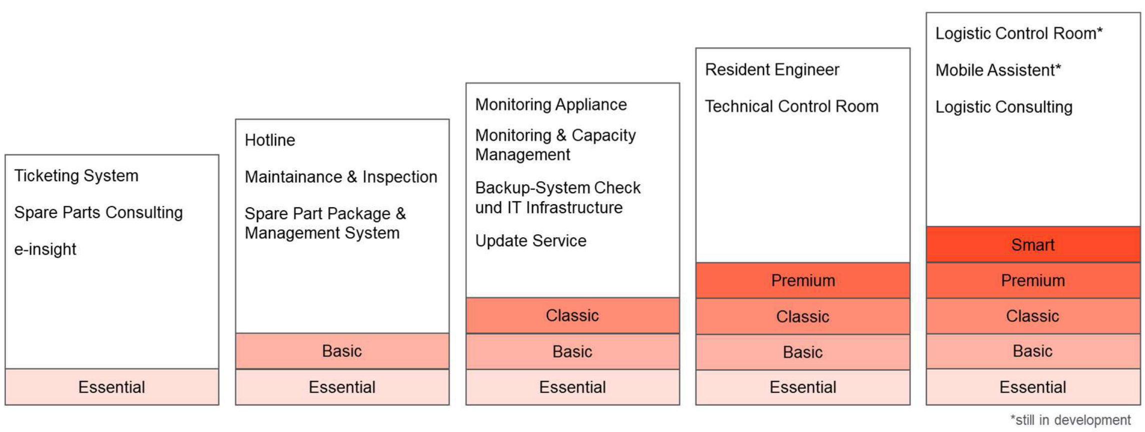


Figure 54: Service Packages

A training schedule for customers is planned by using the service packages.

7.5.2. Training Schedule

As shown in Figure 55, the training plan consists of three parts - the intro, the service package training and the final outro.

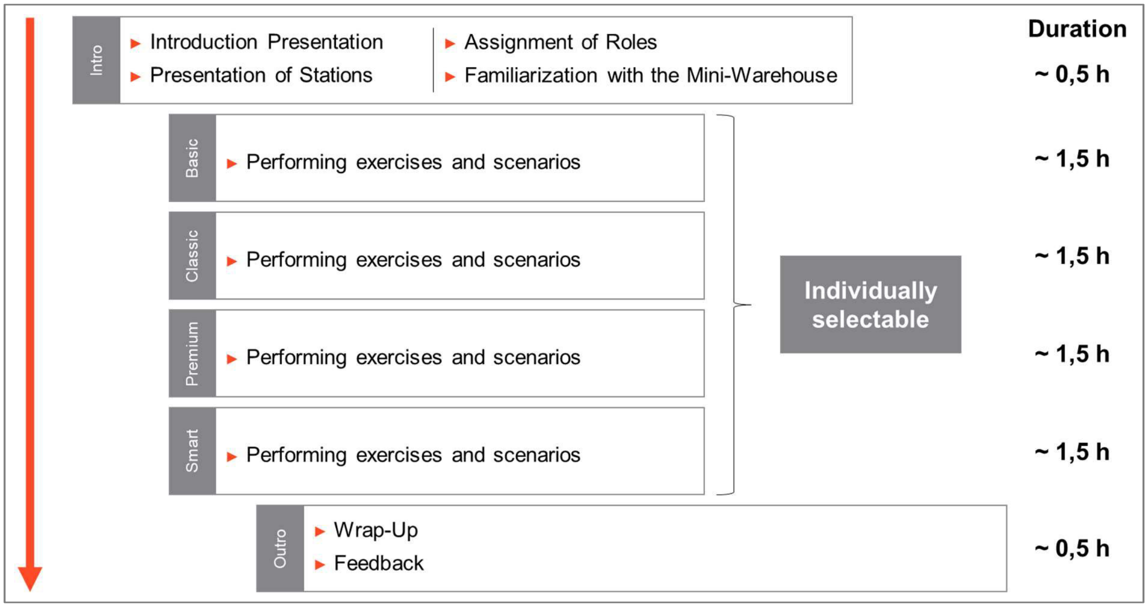


Figure 55: Training Schedule of the Service Factory

7.5.2.1. Intro

The intro begins with an introductory presentation to familiarize the participant with the environment. Next, the individual stations, the layout, the process flow, and the necessary tools are explained. This is followed by the assignment of the roles in the Service Factory. The participants take their positions and test the system for three orders. As a closing of the Introduction, open questions will be clarified.

The aim of the introduction is to give all participants a basic understanding of logistics, process flows and working methods in the learning environment.

The participants are later able to carry out more advanced exercises safely.

7.5.2.2. Service Package Training

As mentioned before the service packages build up on each other and are designed to be held individually or altogether. In other words, if the customer is already using the "Classic" package services and his plant can prevent breakdowns with the "Premium" package services. A "Premium" package training is held with the customer. As an introduction, the status quo is played through with the "Classic" packages to experience the change of the before and after the implementation of the new services intensively.

Each service is divided into three sections and described:

- Scenario: The Scenario describes the situation in which the incident happens.
- Solution: In the solution, a sequence of steps is given to eliminate or prevent the incident described in the scenario.
- Benefits: In the last section it is stated what the participant should learn during the exercise. The aim of each exercise is to communicate the benefits to the customer.

In the next chapters, one service is described for each service package to illustrate the approach. The complete training schedules can be reviewed in the Appendix D.

7.5.2.2.1. Service Package "Basic"

The Package "Basic" consists of the standard services, which should prevent major downtimes or fix them quickly. The package "Basic" is described by the service "Hotline".

As described in Figure 56, the system cannot be started, and a group leader has to take care of the problem. In training, participants can experience the difference between a helpdesk and a hotline. The damage/loss can further be calculated from the downtime.

Scenario	(1) The system fails to start because the server does not boot. (Reason: Nightly power outage caused) (2) Group leader must contact Helpdesk. (3) Since the incident occurs out of KNAPP business hours, the Helpdesk is available in 2 hours. (4) The system is shut down for production.
Solution	(1) Hotline is notified immediately and checks for malfunctions. (2) After some time the problem can be identified and solved. (3) Work can start as planned in the morning.
Benefits	(1) Fast and competent help (2) Availability during the entire production period

Figure 56: Training Schedule of the Service "Hotline"

7.5.2.2.2. Service Package "Classic"

With the "Classic" package, the system is additionally equipped with IT services.

Many of the exercises build-up on each other, to experience the differences and performance contrast of the services. The process created makes it more understandable and comprehensible for the training participants. For example, the same scenario was selected for the "Monitoring Appliance" service as in the “Basic” package for Hotline. The intention is to show the effects of a higher service package on the system. In this case (see Figure 57), the end customer would have little or no downtime due to the early warning from the new IT appliance.

Scenario	(1) A power outage at night causes a corrupt database (2) The system would not start before the start of production because the server does not boot. (analog to HOTLINE)
Solution	(1) Monitoring Appliance has already detected the problem and informed the hotline via e-mail. (2) The hotline has already solved the problem using remote access. (3) The customer receives an e-mail with information about the problem solved. (4) The system can start as usual in the morning.
Benefits	(1) Reduction of downtime (2) Cost saving (3) Time saving during troubleshooting

Figure 57: Training Schedule of the Service “Monitoring Appliance”

7.5.2.2.3. Service Package “Premium”

The "Premium" package offers customers additional safeguards and live monitoring of their plant. By introducing a control room, the participants will be introduced with a new tool.

Figure 58 shows a view of the "Premium" package using the "Technical Control Station" service.

The learning factory has no monitoring or a point of contact until now — only some cameras. No information is transmitted. To improve the situation, a technical control station equipped with the visualization software KiSoft SCADA is introduced. The participants experience in the KNAPP Service Factory how the new system enables better control and better monitoring of the plant.

Scenario	(1) The control station is a simple desk with screens in its initial state. (2) Live camera images of the warehouse can be seen on the screens. (3) No further information is transmitted. (4) As part of the premium service package, the participants are provided a fully equipped technical control station.
Solution	(1) The technical control station uses KiSoft SCADA for visualization. The system provides real-time information. (2) The operational readiness of the technical systems such as conveyor technology or servers can be checked at any time.
Benefits	(1) Visualization of the plant status (2) Control system of the warehouse

Figure 58: Training Schedule of the Service “Technical Control Station”

7.5.2.2.4. Service Package “Smart”

The last package not only provides information but also prepares it specifically for the plant. The "Smart" package should enable the customer to work independently with the system and to prepare the system data such that the data can be easily interpreted by the operates without help.

The "logistics control station" was selected for the presentation of the package, as it builds upon the technical control station. Figure 59 displays the exercise structure. With the logistics control station, the contents are custom-tailored, which give the participants the freedom to decide which KPIs fit their system best. The overview is more intelligent and provides predefined KPIs. Further features are the capacity utilization calculation for better planning of the maintenance plans.

Scenario	(1) The technical control station only provides information about the technical systems. (2) Process monitoring is not possible. (3) As part of the Smart Service package, participants are provided a logistics control station.
Solution	(1) The logistics control station supplements the technical control station with the Smart Services dashboard. (2) It delivers KPIs with a detail level of 5 minutes. (3) Customized key figures can also be recorded and analyzed (4) Capacity utilization calculations enable more efficient maintenance plans
Benefits	(1) Intelligent overview (2) Tailor-made contents (3) Increased efficiency (4) Empowerment

Figure 59: Training Schedule of the Service “Logistics Control Station”

7.5.2.3. Outro

The end of the training is formed by the Outro. The outro is one of the core elements of the learning factory. In this step, the overall impression and the learned contents are summarized and evaluated. A before-and-after comparison is repeated by the participants, to rethink the experience.

The aim is to analyze disturbances in the customer's plant, to interpret them about the experienced contents and to establish a connection to the real system. The outro should provide an impulse to develop ideas for one's facility.

As the last point, feedback of the experienced is collected and discussed.

7.6. Detailed Descriptions of the Training Schedule Process (Meso Level)

The next step in the concept creation is the detailed description of the training schedule processes. For two of the service packages (“Basic” and “Smart”), a detailed process description has been created within the scope of the thesis.

First, the different roles within the warehouse have been described. Taking the roles into account, process descriptions for the “Basic” and “Smart” Package have been developed and will be presented in the following chapters. Only an excerpt of the scheduling process is presented. The complete documentation of the “Basic” and “Smart” Package training schedule description is provided in the Appendix E.

7.6.1. Roles in the Service Factory

Seven different roles are assigned in the Service Factory. Each part has one work area with activities to cover. The following roles arise:

- Group leader: The group leader takes over the leadership of the group. He gives instructions to the other participants and organizes the group.
- Control station technician: The participant operates the control station, gives instructions and monitors the process. He receives direct instructions from the group leader and provides him with information.
- Technician: The technician is responsible for all repairs, as well as maintenance and inspection of the facility.
- Decanting: The participant is responsible for ensuring that the goods are picked by type for storage. The goods are then transported to the OSR (high-bay warehouse) via a conveyor belt.
- Order picking: Depending on the order, the goods are transported from the high-bay warehouse (OSR) to the picking station, where they are placed in the correct order container by the participant.

- Checking: The order container is checked for correctness (are the correct goods in the container) and completeness (is also the correct quantity in the container) by the participant.
- Packing: The inspected goods are packed by the participant for shipment in a suitable box and labeled with the shipping information.

7.6.2. Detailed Descriptions of the Processes of the Intro

The introduction should not take long and is limited to a duration of 30 minutes. As described in Table 7 after a short briefing on the learning factory and the logistic process, an active familiarization with the work stations by carrying out the tasks of the various stations follows.

Agenda	Content	Modus	Duration (min.)
1. Presentation of the Learning Factory	► The "KNAPP Service Factory" will be presented to the participants. ► Idea and Intention ► Overview of the training contents ► The e-insight is presented in a short video/presentation. ► Short introduction of a KNAPP warehouse and the logistic processes. (e.g. via video to enable a better link to the real situation) ► Assignment of roles	(De-)Briefing	10
2. Familiarization with the workstations	► Getting to know the system and stations: ► The participants go to the work stations and start the warehouse for the first time. ► A standard work scenario is practiced by the participants.	Exercise	20

Table 7: Detailed Descriptions of the Processes of the Intro

As a preparation for the next step, Figure 60 summarizes the necessary documents and materials for the moderator and participants and shows which area is affected during the introduction.

Teaching notes
- Documentation of introductory presentations
- Moderation notes/instructions

Learning notes
- Standard Operating Procedures

Exercice material
- Präsentationsvideo
- Handout e-insight

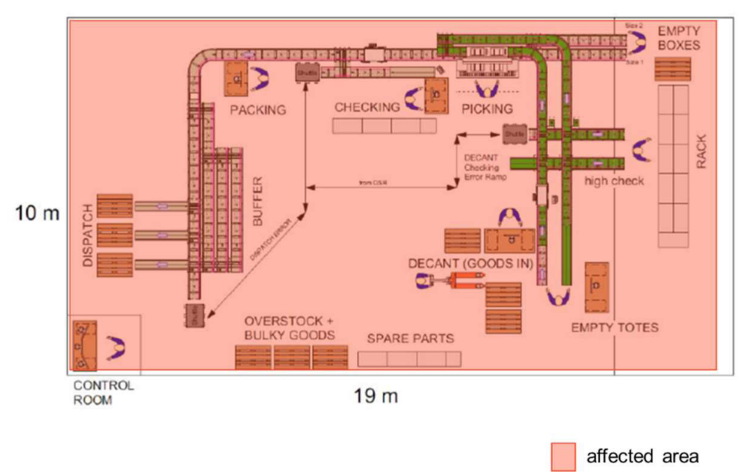


Figure 60: Overview of the Necessary Documents for the Introduction Session

7.6.3. Detailed Descriptions of the Processes of the "Basic" Package

The package "Basic" consists of three different exercises, Hotline, Maintenance and Inspection, as well as Spare Parts package and Spare Parts Management system. For illustration purposes, Table 8 describes the Hotline service procedure.

Agenda	Content	Modus	Duration (min.)

1. Introduction	► Presentation Exercise:
	  ► Starting of the plant in the morning is simulated
	  ► All participants head to their stations
	  ► Preparations are started
	  ► Incident occurs and must be solved
		(De-)Briefing	5

2. Working without Services	► Participants start to power up the plant
	► Error occurs
	  ► Server does not start, system stops running
	  ► Group leader looks in the manual
	  ► Manual recommends to call Helpdesk
	  ► Helpdesk is called
	  ► Automatic answering machine, because outside business hours
	► Problem cannot be solved (until Helpdesk is reachable)
	► Exercise ends after 2-3 minutes
		Exercise	10

3. Debriefing	► Debriefing of the experience
	  ► What problems occurred?
	  ► What would have helped?
	  ► How could the problem have been solved better?
	► Debriefing moderated by trainer
	► Points are recorded on prepared poster
		(De-)Briefing	10

4. Working with Services	► Participants start to power up the plant
	► Error occurs
	  ► Server does not start, system stops running
	  ► Group leader looks in the manual
	  ► Manual recommends to call Hotline
	  ► Hotline is called
	  ► Hotline provides help or solves the problem remotely
	► System can be started normally
	► work could start -> end of exercise
		Exercise	10

5. Wrap-up	► Discussion/preparation of the experience ► Participants reflect the impact of the service	(De-)Briefing	5

Table 8: Detailed Descriptions of the Processes of the "Basic" Package

The materials and documents listed in Figure 61 are necessary for the "Basic" training session. In the Micro level, these materials and equipment have to be developed /designed and procured.

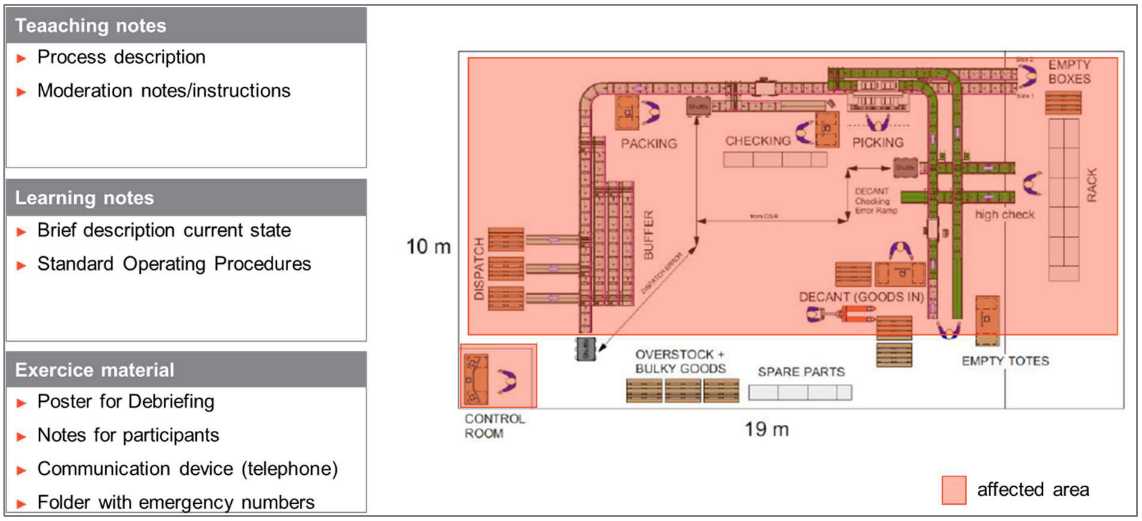


Figure 61: Overview of the Necessary Documents for the Introduction Session “Basic”

7.6.4. Detailed Descriptions of the Processes of the “Smart” Package

The "Smart" service package has a different structure. The services bundled in the "Smart" package are complementary and affect the entire system and not just individual areas. The exercise is designed in the form of a case study and must be studied by the participants. For comparison purposes, the groups are equipped with different tools and technologies. Table 9 explains the procedure for all services in the package.

Agenda	Content	Modus	Duration (min.)
1. Introduction	► Presentation of Exercise: ► Operators (trainer team) operate the system ► KPIs should be recorded in order to solve a case study (e.g. reduce lead time / increase throughput).	(De-)Briefing	10
2. Case Study Preparation	► Participants are divided into 3 groups and solve case study independently of each other. ► Group " Pinboard and stopwatch " ► Group " Logistic Control Centre + Mobile Assistant ". ► Group "Logistics Control Center + Mobile Assistant + Logistics Consulting" ► Case study will be read by the participants, followed by a brief discussion	Exercise	50
3. Group work	► Participants begin to record KPIs: ► Group " Pinboard and stopwatch ". ► Participants record KPIs manually with stopwatch by observing locally ► Group " Logistic Control Centre + Mobile Assistant ". ► Participants are provided with KPIs by the logistics control center ► The mobile assistant also allows the simultaneous inspection of the plant in order to conduct interviews or to inspect the process. ► Group "Logistics Control Center + Mobile Assistant + Logistics Consulting" ► Participants will receive additional support from a logistics expert who will advise them on how to solve the case. ► Participants develop case study solutions ► Exercise ends after 20 minutes	Exercise	20
4. Wrap-up	► Comparing the results of each team ► Evaluation of the results ► Debriefing of the experience ► How difficult was it to collect the KPIs? ► How was the case study perceived? ► What would have helped? ► How could the case study be solved more easily? ► Debriefing moderated by trainer ► Points are recorded on prepared poster OBJECTIVE: Participants recognize the added value of the services "Logistics Control Center", "Mobile Assistant" and "Logistics Consulting". The resulting high availability of KPIs simplifies planning, optimization and adaptation work	(De-)Briefing	20

Table 9: Detailed Descriptions of the Processes of the “Smart” Package

The various materials listed in Figure 62, including the case study, are required to implement the exercise.

Teaching notes
- Process description
- Case study
- Moderation notes/instructions

Learning notes
- Standard Operating Procedures
- Case study & preparatory questions
- Handout on KPIs

Exercice material
- Poster for Debriefing
- Notes for participants
- Pinboard
- Stopwatch
- Tablet

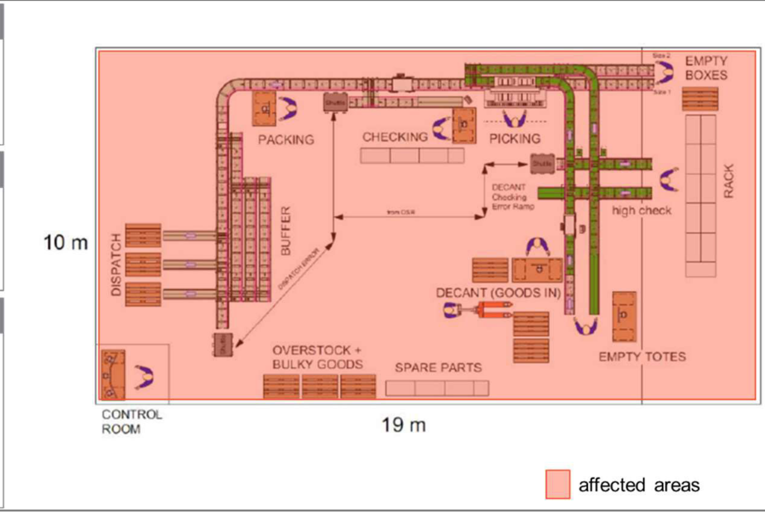


Figure 62: Overview of the Necessary Documents for the Introduction Session "Smart"

7.6.5. Detailed Descriptions of the Processes of the Outro

The Outro closes the training. This is organized as shown in Table 10. The experienced and witnessed contents are summarized and reflected again in the outro. Also, this unit also serves to receive feedback on the KNAPP Service Factory and to use it for internal improvements.

Agenda	Content	Modus	Duration (min.)
1. Wrap-up	► Debriefing of the experience ► Reflection of contents ► Debriefing moderated by trainer ► Points are recorded on a board	(De-)Briefing	10
2. Feedback	► How do you like the content presented? ► What do you think about the methode used? ► What should be done differently/improved?	(De-)Briefing	5
2. Idea generation	► What could the participants get for their camp? ► Where do they see the greatest benefit for their facility? ► Where are the problems in their plant? ► Which services are best suited to solve their issues?	(De-)Briefing	15

Table 10: Detailed Descriptions of the Processes of the Outro

For effective performance, the documents listed in Figure 63 should be prepared and used.

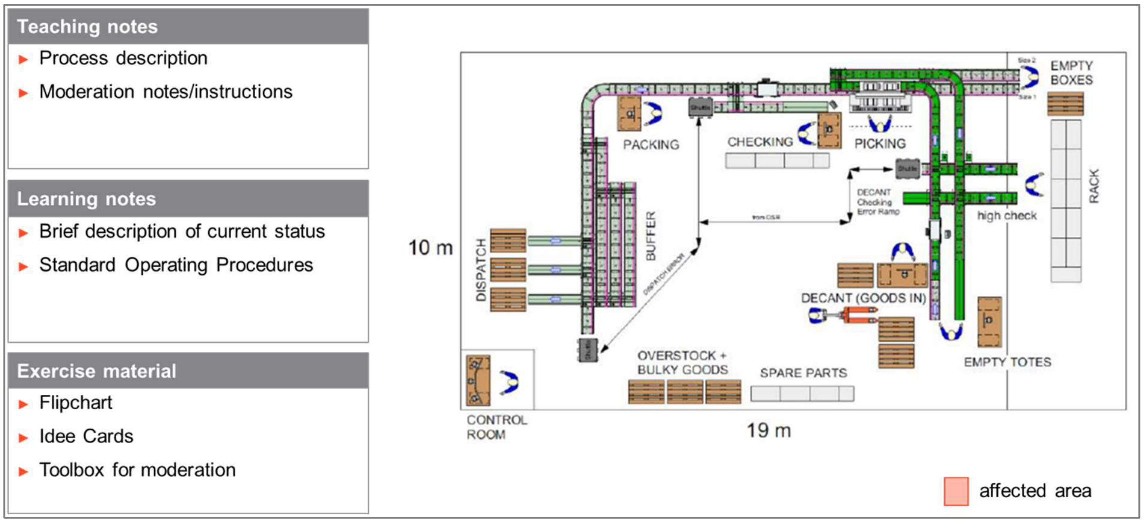


Figure 63: Overview of the Necessary Documents for the Outro Session

7.7. Morphological Analysis of the KNAPP "Service Factory"

For the design of the concept a morphological analysis has been made to keep an overview of the overall targets and settings of each dimension of the learning factory. The morphological box is based on the approach from the Paper "Learning Factory Morphology" by Tisch M. et al. The analysis used was manly design for learning factories focusing in the field of production but with few adaptations could be used as a guidance for the design of the logistics factory displaying logistic service products.

An excerpt of the resulting morphological analysis of the KNAPP "Service Factory" can be seen in Figure 64. The complete morphological analysis of the Service Factory designed for KNAPP is in Appendix F.

2. Purpose and targets	2.1 Main purpose	Education			Vocational training		
	2.2 Secondary purpose	Test environment/pilot environment			Industrial production		
	2.3 Target groups for education and training	Pupils	Students: Bachelor	Students: Master	Students: PhD students	Employees: Apprentices	Employees: Skilled workers / Semi-skill. W. / Un-sl work
	2.4 Group constellation	Homogenous					
	2.5 Targeted industries	Mechanical & plant eng.	Automotive	Logistics	Chemical industry	Electronics	Construction
	2.6 Subject-rel. learning contents	Prod. Mgmt & organization	Resource efficiency	Lean mgmt	Automation	CPPS	
	2.7 Role of LF for research	Research object					
	2.8 Research topics	Production management & organization	Resource efficiency	Lean mgmt	Automation		

Figure 64: Excerpt of the Morphological Analysis of the KNAPP Service Factory[163]

[163] Based on Tisch, Ranz, Abele, Metternich, & V., 2015

8 Pilot Prototype

The last part of the practical development of the Service Factory is the creation, implementation and testing of a pilot prototype to experience the concept. The learning environment setup contains all relevant components for a real warehousing process and further demonstrates the relevant functions of a warehouse.

Among other things, this includes the software used for individual workstations, abstracted technologies from real storage systems (e.g. "Pick to Light") as well as a higher-level control of the entire process. The employees of KNAPP AG were invited to work in the physical test setup and to experience the service products included in the "Essential" and "Basic" packages. Figure 65 shows the Layout that was developed for the pilot Prototype in the LEAD Factory at the TU Graz.

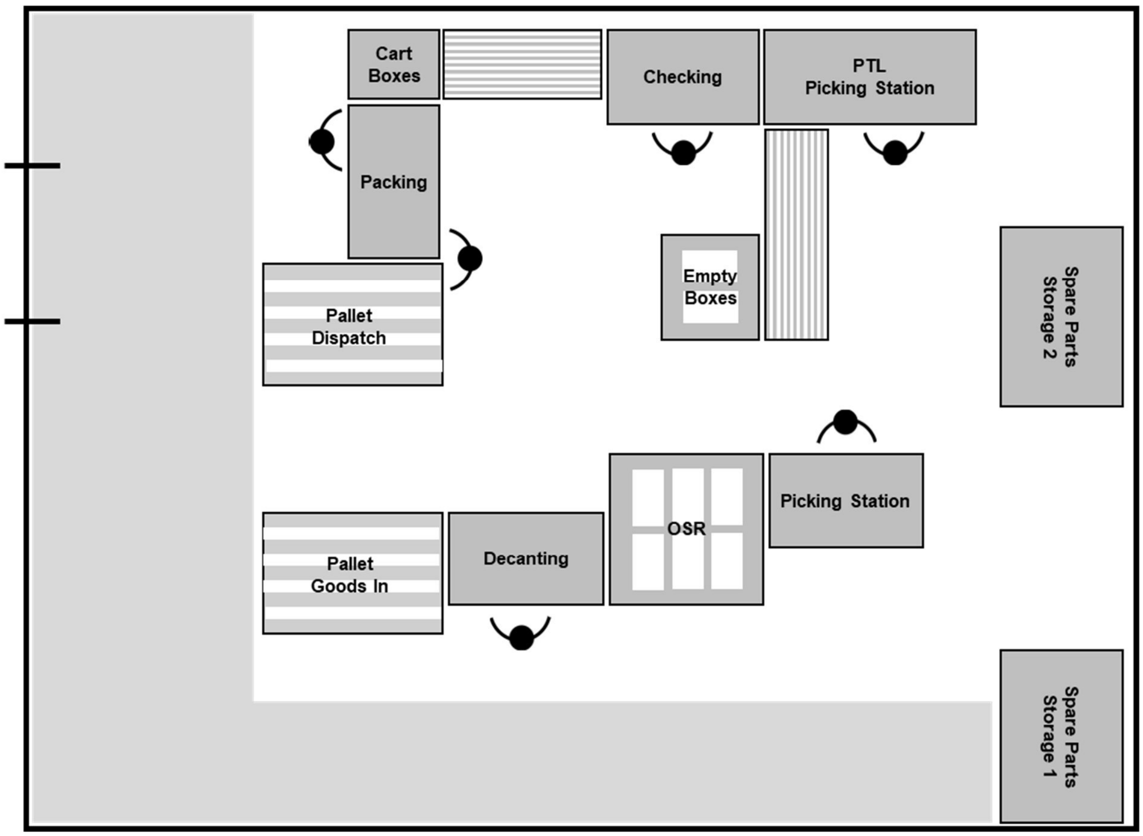


Figure 65: Layout of the Prototype of the Service Factory

The Training starts with an Introduction, followed by the exercises without and next with implemented services. The last part of the training is the Wrap-up and discussion.

Introduction

During the introduction the trainer explains the events and system. He hands out the handbook with the plant description.

Practice

The exercises are first played through without the integration of services and in the next step with implemented services. To trigger failure events, the facilitators use different product barcodes, which they can change during the practice. Three failure scenarios happen in the system to experience the following service products:

- Hotline: The old hand-scanners are changed with new ones. The new hand-scanners offer easier/convenient and faster handling for employees. However, they differ in data processing and forwarding. The participants cannot identify the problem. In the first round the helpdesk and after the hotline is contacted for help to implement this in the new system. The barcodes need to be parametrized.
- Spare parts management: A certain product creates an error in the “Pick-to-Light” station and a defect part needs to be changed. The participants first need to solve the situation by finding the defect part in the spare parts warehouse. Initially there is no sorting and it takes a lot of time to find the part. With the spare parts package the part can be found easy and fast.
- Monitoring: Label printer has a malfunction which cannot be solved by the workers. Monitoring allows a technician to solve the problem remotely.

Wrap-up

The effect of the services on the warehouse is illustrated with a cost analysis. The participants start with a defined capital which they have planned for service products or error elimination.

Based on the outcome of this thesis KNAPP has decided to carry on and build the “Service Factory” to develop awareness within customers.

Figure 66 pictures the final prototype and the used elements for the test setup.

Figure 66: Picture of the Pilot Prototype at the LEAD Factory at TU Graz

9 Outlook: Challenges and Opportunities

Companies nowadays need to offer their customers maximum service, optimized service processes and, finally, a customized service to increase customer satisfaction. The changes in the intralogistics sector have led to a change in the operation of the warehouses. Services have become a crucial aspect to operate the complex facilities successfully. Operators face new and unknown problems which lead to a decrease in satisfaction. Therefore, Intralogistics system providers are looking for innovative ways to help customers.

The learning factory has proven to be a beneficial instrument for teaching the connections and functions of sophisticated knowledge. The direct experimenting and experiencing teaching content make the method unique. Learning factories in the narrow sense, especially in the field of production and manufacturing education, have experienced enormous growth in recent years. They have proven to be a promising learning and innovation platform for various institutions. While physical products and their process are investigated and researched, learning factories in the broader sense, particularly for services/ non-physical products have remained mainly untouched.

Working with non-physical products is a great challenge. Service undergo rapid change, and the pace in which services evolve is significantly higher compared to physical products. This problem occurred and took a lot of time when defining proper use cases for the learning factory concept during this thesis. Many new service technologies and approaches are created within a short period, and progressive digitalization opens up the additional potential for services (Service 4.0). The learning factory concept must keep up with these changes and furthermore, proactively innovative to be attractive.

The learning factory idea allows participants to learn new technologies and services, but they also experience how to select suitable services for their systems and how to implement these approaches in their facilities subsequently. Since the above presented is still in the implementation phase, there is still a need for adaption and improvement on several stages during the prototype trainings.

But using the learning factory for awareness training of customers opens up not only new possibilities to increase customer satisfaction but also to create a stronger connection to the customer's facilities. The resulting high exchange of knowledge helps to understand the needs of plants better and to address these with new products, changes in processes, etc. This opens up great innovation opportunities for the intralogistics system providers, not only in the field of service product but throughout the company.

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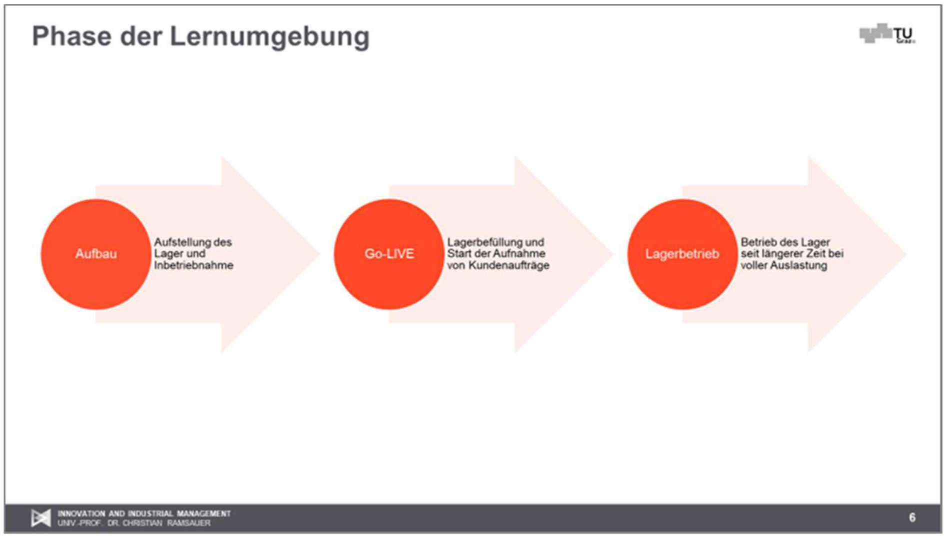
Appendix A

Morphological Box

Service	Funktion	Formula KNAPP	KNAPP Super Market	KNAPP Fire Brigade	KNAPP Rocket Launch	KNAPP Backery
Ecsrow	System mit Softwaresteuerung Sourcecode (Beispiel) vorliegen	Steuerung der Modellautos; Änderung des Setups möglich	Kassen und Buchungssystem ändern und erweitern			Geheim Rezept wird veraendert
E-insight	System liefert verschiedene Daten (Wartung Anfragen, Ersatzteile) Platform nutzen Interaktion/Kommunikation möglich und sinnvoll	Anzeige über Tank, Anzeige von Rundenzeiten, Anzeige über Reifenverschleiß	Platform mit Informationen über: Lagerbeständen und Lieferzeiten Ablaufdatum Dienstpläne etc.	Überblick der gemeldeten Einsätze, verfügbaren Fahrzeuge, Zustand der Fahrzeuge, Befüllung der Fahrzeuge, Zustand und Anzahl der Utensilien, Dienstpläne etc.	Dashboard mit Kraftstoffanzeige, Sauerstoffgehalt, etc.	Technische Dokumentation der Maschinen
Ersatzteilmanagement	Hardwarekomponenten produzieren Ausfall Störungsgrund (Hardwarekomponente) identifizierbar für Teilnehmer Ersatzteil in Lager vor-Ort (gut/schlecht bestückt/sortiert) Ersatzteil (durch Teilnehmer) einbaubar Kosten darstellbar (Ausfall vs. Ersatzteilservice)	Reifenwechsel, Kugellager im Reifen, Tank leer Lager = Box (Reifen unsortiert, Werkzeug unsortiert,...) Kosten = schlechtere Rundenzeiten / Ausfall	Regalnachfüllung der Produkte Kostenentgang bei nicht vorhanden haben Regalordnung Wartezeiten bis man Kunden Lagerware bringt	Nachfüllung der Feuerlöscher Lager der Utensilien	Ersatzteile werden ins Aal geschossen rechtzeitig bzw sind bereits on board dramatisch bei fehlenden Ersatzteilen	Backofenlicht, Temperatursensor,etc
Hotline	Störfall tritt auf Aktive Kommunikation mit KNAPP MA (zB Chat, Telefon) Richtige Sequenzabfolge darstellen Störfall bei Schulung behebar	Steuerung reagiert nicht mehr Mehrere Fehlerurachen (Empfänger bei Auto, Batterie in Fernsteuerung, frequenzbereich der Fernsteuerung,...)	Kassensystem Hotline	Zentrale bei Außeneinsätzen	Erdstationkontakt bei Störungen und Notfällen	technischen Service bei Backröhr Problemen, etc. Teig gelingt nicht Oma und Mama anrufen
It-Services	(System) Live-Daten liefern Live-Daten verarbeitbar (zB für Monitoring) Daten interpretierbar (Aussagekraft) Aktive Benachrichtigung bei Abweichung durch IT Service Nutzen durch Benachrichtigung erkennbar (zB Störfall verhindert)	Tankanzeige Aktueller Verbrauch + "Forecast" über Reichweite Nutzen = rechtzeitiger Boxenstopp	Kassa und Kühregale liefern Daten Haltbareit der Produkte anzeigen Kassasystem aktualisieren und pflegen (Strichcode richtig lesen, richtigen Preise, etc.)	Wasseranzeige	Sensorik liefert Daten IT System Checks zur Überprüfung der Genauigkeit und Funktionalität Überwachung der Subsysteme	Brotsortimentplanung, Überwachung der Backtemperatur
Multi Stage Deploymen t	Systemänderung simulierbar Simulationsergebnis aussagekräftig UND bei "going-live" wiederholbar	Neue Rennstrecke Durch Simulation (zB am Smartphone/Tablet) von Beginn an bessere Rundenzeit	neuen Warenfluss, neue Lieferantenzeiten durch Simulation testen	Simulation von verschiedenen Szenarien zur Vorbereitung auf Enrstfall	Simulation des Starts und der Funktionalität vorab	Simulation des Backprozesse
Ramp Up	(signifikante) Systemerweiterung "komplex genug" um externe Beratung zu rechtfertigen & Erfolg durch Beratung messbar	Einbau neuer Achsen + neues Chassis ohne Hilfe schwer möglich mit Hilfe kein Problem neue Achsen müssen Verbesserung erlebbar machen (zB Kurvenverhalten)	"Click and Collect" und Selbstzahlungskassen zusätzlich Einführen Logistikaufwand höher, Einteilung der Arbeit neu etc. Hilfe bei der Planung Kunden profitieren vom neuen Konzept (schneller)	Richtige und sinnvolle Verwendung von neuen Utensilien, Brandbekämpfern, Anzügen, etc.	Erdstation-Experten bei Problemen geben Hilfe und Leitung zur Optimierung und Beseitigung der Störung	Erklaerung der Kueche und der richtigen Nutzung der Geraete
Resident Engineering	System ausreichend komplex um Vorteil von Experten (use-case) zu erkennen --> messbar	Trainer fähr Bestzeit Trainer gibt Tipps für Boxenstopp (Reifenwechsel etc.)	Filialeleiter?!		Techniker on Board	Gelernte Backkraft ist sofort einsetzbar
Smart Services	System mit Sensoren austattbar (Live-Daten) Erstellung relevanter KPIs mit gelieferten Daten möglich Dashboard für Anzeige "Vorschläge" / "Learnings" aus Daten zeigen Impact	Tankanzeige Aktueller Verbrauch + "Forecast" über Reichweite Nutzen = rechtzeitiger Boxenstopp	Rechtzeitige Information über Regalbefüllung Forecast über Produktbestellungen Abgelaufene Lebensmittel rechtzeitig erkennen Temperatur von Kühlgeräten/Raum regulieren Beschädigte Ware erkennen	Brandmeldung durch Feuermelder mit Temperaturmessung und Sensorik 5-W Fragen zum Abschätzen der Situation Feuerlöscher in Haushalten, Brandschutztüren	Aufwendige mathamatische Berechnung mit Ankunfszeit, Vitalfunktionen der Insassen, Flugbahn und -zeit Sauerstoff- Nahrungspesum Körperliche Belastung durhc schwere Losigkeit etc.	Backsortimentplannung, Wartungsfensterberechnung
Technischer Service	Systemkomponenten mit Verschleiß (Instandhaltung) Austausch von Hardwarekomponenten (Verschleiß) notwendig (Wartung)	Service bei jedem Boxenstopp proaktiver Austausch von Komponenten ist plausibel	abgelaufene Lebensmittel rechtzeitig entsorgen proaktiver Kühlgerätetausch zur Erhaltung der Warenqualität	Fuktion der Feuerlöscher Feueranzugzustand prävventiver Tausch von alten Schläuchen etc	Allanzugzustand Serviceren von außen Teilen etc	Austausch udn reperatur von Hardware Komponenten (Abgenutzte Mixstaebe etc.)
KNAPP Academy	Erfolg während des Trainings (Wiederholungen) für Kunden messbar (erhöht Verständnis für notwendigkeit von Trainings der Mitarbeiter)	Mehr Training = schnellere Rundenzeiten		Traning von jungen Freiwilligen Außeneinsätze nur nach Ausbildung	Monatelanges, hartes Training notwendig um ausreichend vorbereitet zu sein	Traning um richte techniken zu Beherrschen "Strizeln, zoepfe, etc."
Warehouse Opperation Support	Beobachtungen der Trainer während Trainings liefert "Verbesserungsvorschläge" wie Effizienz erhöht werden kann Konkrete Maßnahmen umsetzbar Effizienzsteigerung darstellbar ("Business Case")	Tipps für Fahrverhalten Tipps für "Strategie" Tipps für Setting Darstellung durch schnellere Rundenzeiten	Tipps zur Kommissionierung, Ablauf der Logistik und Personaleinteilung Bessere Arbeitseinteilung, Qualitätssteigerung, richitige Vorbereitung auf Stoßzeiten, etc	Objektive Person zur Planung der Einsätze, Neuaufstelung und Ablauf von Meldung bis zum Aufbruch zur Verkürzung der Reaktionszeitzeit = Retten von Menschenleben	Erdstation-Experten bei Problemen geben Hilfe und Leitung zur optimierung und Beseitigung der Störung	Beratung durch Konditormeister, Verbesserung des Prozesses etc.
Allgemeine	Spaßfaktor für Kunden (zB Wettbewerb) aktive Einbindung "hands-on" Zusatznutzen (zB Teambuilding) vorhanden Aufwand (Transport, Aufbau,...) überschaubar Mit 6 - 12 Teilnehmern durchführbar In 4 Stunden durchführbar (eventuell ausgewählte Module..)	für jeden Verständlich Emotion Aufwand gut Teilnehmerzahl skalierbar Teambuilding vorhanden	einfache Verständlichkeit Themennahe Teilnehmerzahl skalierbar	Emotionale Verbindungung Identifikations Teambuilding	Spannende Thematik Teambuilding Emotion Hoher Aufwand Teilnehmerzahl skalierbar	Teambuilding Emotion Hoher Aufwand Teilnehmerzahl skalierbar

Appendix B


Phase der Lernumgebung
Aufbau
Aufstellung des Lager und Inbetriebnahme
Go-LIVE
Lagerbefüllung und Start der Aufnahme von Kundenaufträge
Lagerbetrieb
Betrieb des Lager seit längerer Zeit bei voller Auslastung
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Formula KNAPP
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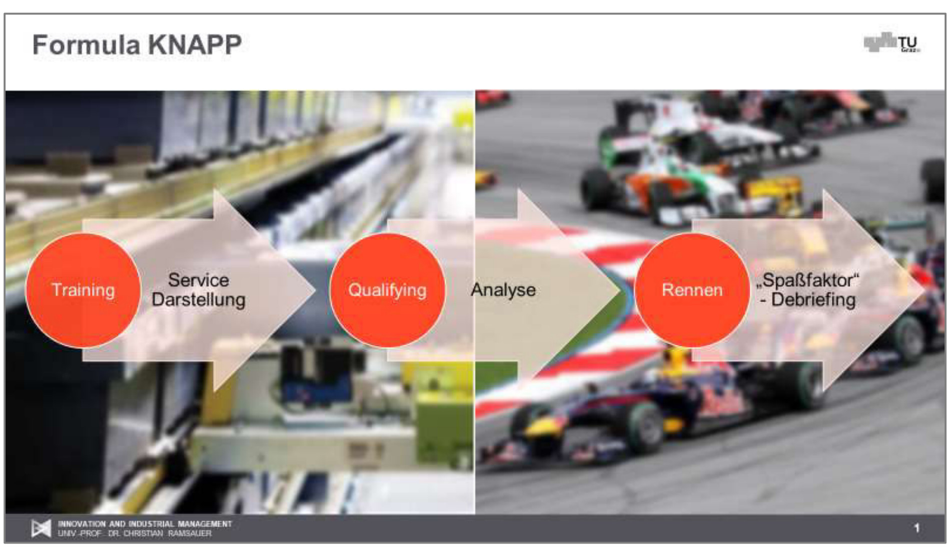
Formula KNAPP
Training
Service Darstellung
Qualifying
Analyse
Rennen
„Spaßfaktor"
- Debriefing
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Systemlandschaft "Formula KNAPP"

Ablauf:
Das System besteht aus Modellautos, dessen Fernsteuerung, Ersatzteilen und Werkzeugen für den Boxenstopp, sowie Benzin, einem Touch Screen Bildschirm und 2 PC. Die Systemlandschaft wird vom Teamchef geleitet, welcher mit Hilfe seiner Crew strategische Entscheidungen für den Piloten trifft. Der Pilot hat die Fernbedienung und ist für das Manövrieren des Fahrzeugs zuständig.

System Abstraktion:

Formel 1 → Go Kart → Modellauto

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Rollen im KNAPP Lager vs. Rollen in der Formula KNAPP

Teamstruktur Lager:
- Manager
- Lagerleiter
- Lagerarbeiter

Services im Lager:
Multi Stage Deployment
Ramp-Up
E-Insight
IT-Services
SMART Services
Technischer Service
Warehouse Operation Support
Resident Engineer
Hotline
Ersatzteilmanagement
Escrow
Training

Teamstruktur Formel 1 Team:
- 1 Teamchef
- 1 Technischer Leiter
- 1 Pilot

Service in der Alternative:
Streckensimulation mittels App
Kurvenverhalten bei richtiger Anwendung
Dashboard mit aktuellen Daten
Monitoring des Fahrzeugs
Forecasting und Strategieplanung
Reifenwechsel, Tanken, etc.
Fahrverhalten Analyse, Strategie
Pirelli externe Ingenieure od AVL Ingenieure
Funk-Kommunikation
Motoren (Verbrennungseinheiten, MGUH, MGUK etc.), Reifen, Sprit
kleine Programmieraufgabe
schnellere Rundenzeit mit jeder Wiederholung

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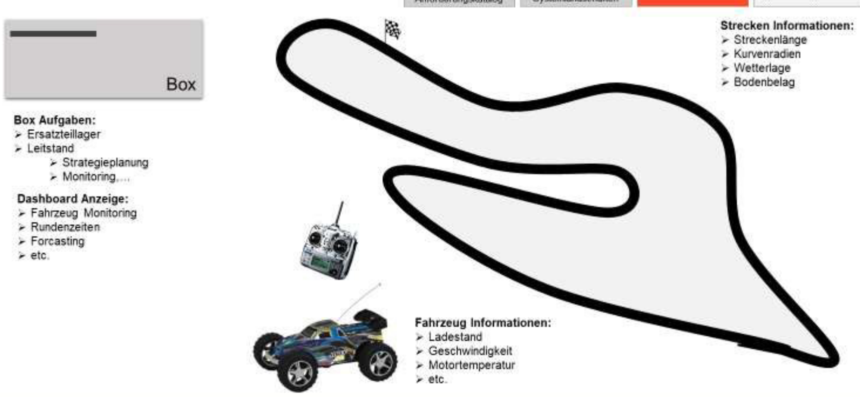
Grobkonzept

Übersicht „Formula KNAPP"

Erstellung von Funktionen aus Anforderungskatalog | Auswahl / Einarbeitung von Systemlandschaften | Aufbereitung von 4 Grobkonzepten | Entscheidung



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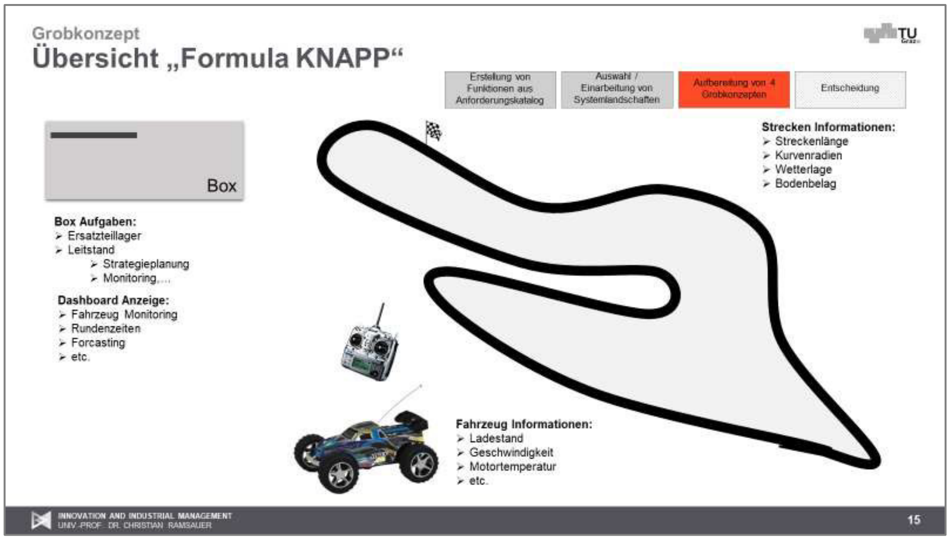

Grobkonzept
Übersicht „Formula KNAPP“
Erstellung von Funktionen aus Anforderungskatalog
Auswahl / Einarbeitung von Systemlandschaften
Aufbereitung von 4 Grobkonzepten
Entscheidung
Box
Box Aufgaben:
➢ Ersatzteillager
➢ Leitstand
➢ Strategieplanung
➢ Monitoring,…
Dashboard Anzeige:
➢ Fahrzeug Monitoring
➢ Rundenzeiten
➢ Forcasting
➢ etc.
Strecken Informationen:
➢ Streckenlänge
➢ Kurvenradien
➢ Wetterlage
➢ Bodenbelag
Fahrzeug Informationen:
➢ Ladestand
➢ Geschwindigkeit
➢ Motortemperatur
➢ etc.
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TRAINING
Multi Stage Deployment
Ramp-Up
e-insight
IT Services
SMART Services
Technischer Service
Warehouse Operation Support
Resident Engineering
Hotline
Ersatzteilmanagement
Escrow
KNAPP Academy
– Neue Rennstrecke testen durch Simulation (z.B.: am Smartphone/Tablet)
– von Beginn an bessere Rundenzeit
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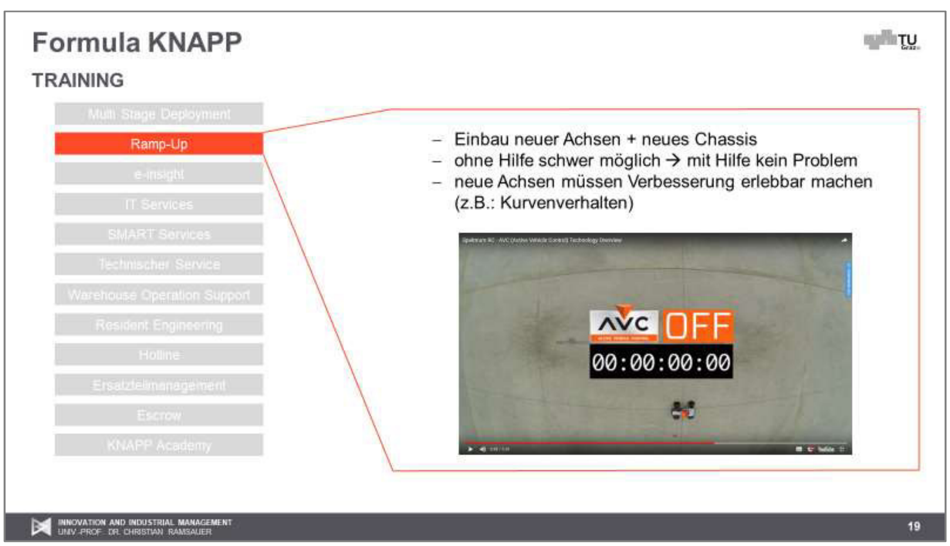

Formula KNAPP
TRAINING
Multi Stage Deployment
Ramp-Up
e-insight
IT Services
SMART Services
Technischer Service
Warehouse Operation Support
Resident Engineering
Hotline
Ersatzteilmanagement
Escrow
KNAPP Academy
– Einbau neuer Achsen + neues Chassis
– ohne Hilfe schwer möglich → mit Hilfe kein Problem
– neue Achsen müssen Verbesserung erlebbar machen (z.B.: Kurvenverhalten)
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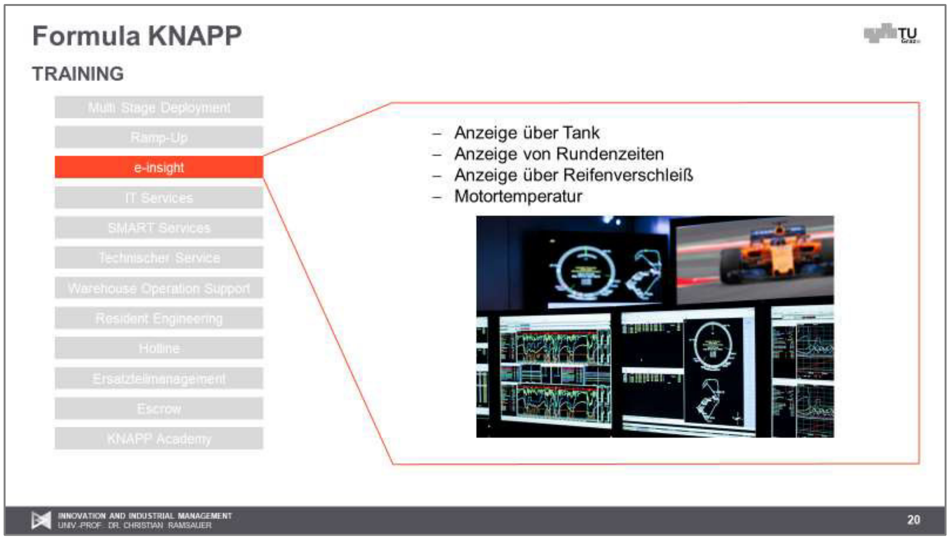
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Multi Stage Deployment
Ramp-Up
e-insight
IT Services
SMART Services
Technischer Service
Warehouse Operation Support
Resident Engineering
Hotline
Ersatzteilmanagement
Escrow
KNAPP Academy
– Anzeige über Tank
– Anzeige von Rundenzeiten
– Anzeige über Reifenverschleiß
– Motortemperatur
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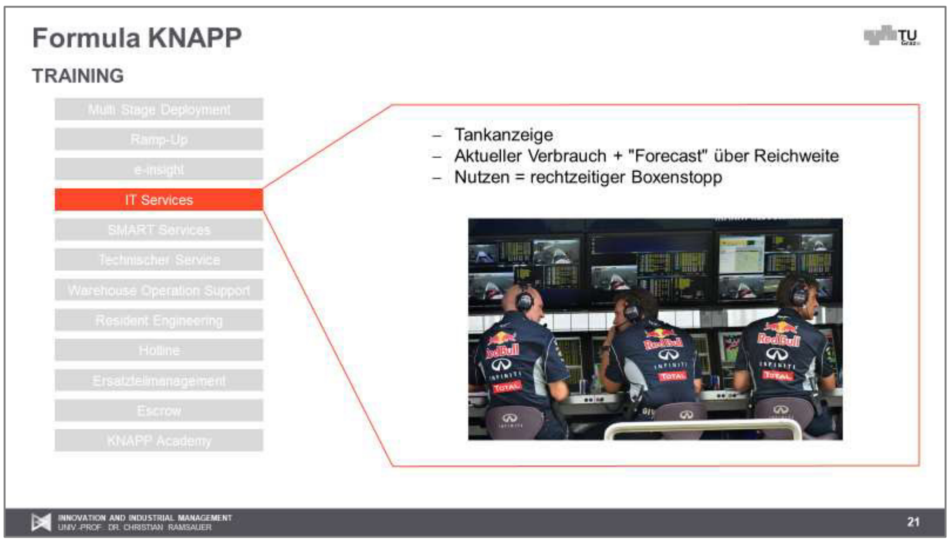
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Multi Stage Deployment
Ramp-Up
e-insight
IT Services
SMART Services
Technischer Service
Warehouse Operation Support
Resident Engineering
Hotline
Ersatzteilmanagement
Escrow
KNAPP Academy
– Tankanzeige
– Aktueller Verbrauch + "Forecast" über Reichweite
– Nutzen = rechtzeitiger Boxenstopp
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IT Services
SMART Services
Technischer Service
Warehouse Operation Support
Resident Engineering
Hotline
Ersatzteilmanagement
Escrow
KNAPP Academy
– Aktueller Verbrauch + "Forecast" über Reichweite
– Optimaler Boxenstopp
– „Wartungsfensterberechnung" = Boxenstoppstrategie
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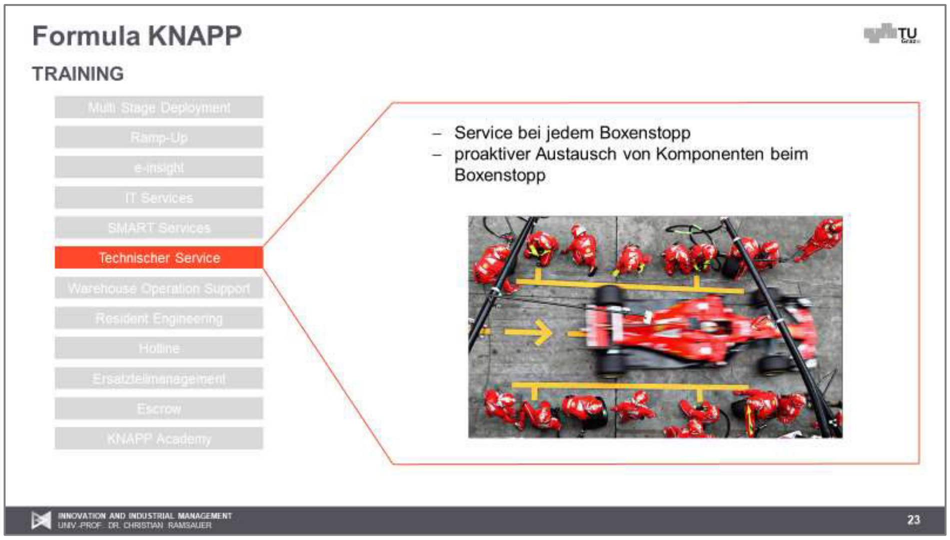
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Multi Stage Deployment
Ramp-Up
e-insight
IT Services
SMART Services
Technischer Service
Warehouse Operation Support
Resident Engineering
Hotline
Ersatzteilmanagement
Escrow
KNAPP Academy
– Service bei jedem Boxenstopp
– proaktiver Austausch von Komponenten beim Boxenstopp
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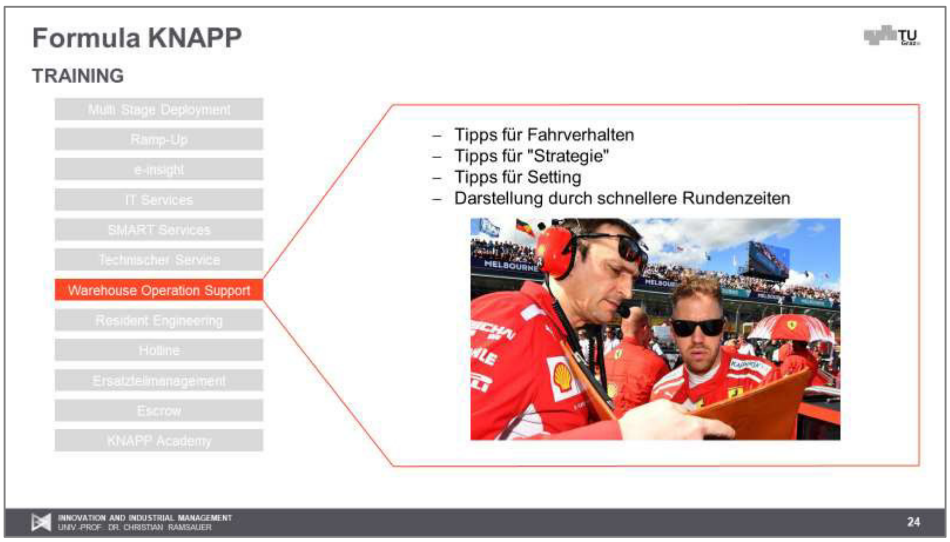
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Multi Stage Deployment
Ramp-Up
e-insight
IT Services
SMART Services
Technischer Service
Warehouse Operation Support
Resident Engineering
Hotline
Ersatzteilmanagement
Escrow
KNAPP Academy
– Tipps für Fahrverhalten
– Tipps für "Strategie"
– Tipps für Setting
– Darstellung durch schnellere Rundenzeiten
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TRAINING
Multi Stage Deployment
Ramp-Up
e-insight
IT Services
SMART Services
Technischer Service
Warehouse Operation Support
Resident Engineering
Hotline
Ersatzteilmanagement
Escrow
KNAPP Academy
– Trainer fährt Bestzeit
– Trainer gibt Tipps für Boxenstopp (Reifenwechsel etc.)
– Externe Ingenieure (AVL, Pirelli, etc.)
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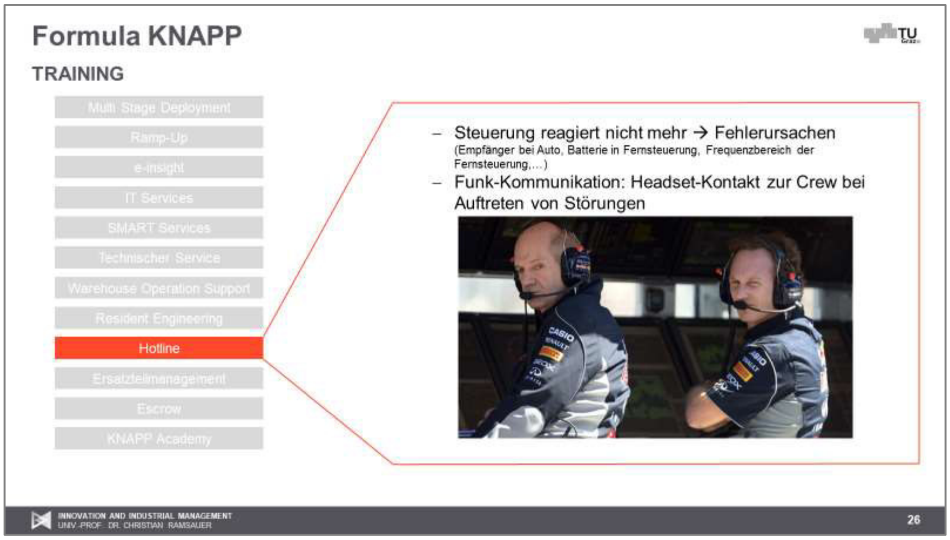
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TRAINING
Multi Stage Deployment
Ramp-Up
e-insight
IT Services
SMART Services
Technischer Service
Warehouse Operation Support
Resident Engineering
Hotline
Ersatzteilmanagement
Escrow
KNAPP Academy
– Steuerung reagiert nicht mehr → Fehlerursachen
(Empfänger bei Auto, Batterie in Fernsteuerung, Frequenzbereich der Fernsteuerung,…)
– Funk-Kommunikation: Headset-Kontakt zur Crew bei Auftreten von Störungen
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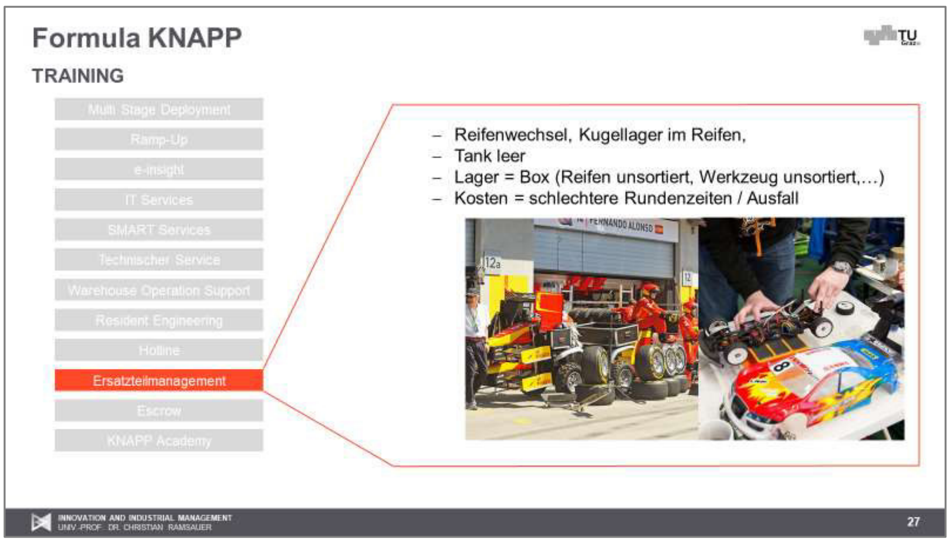
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TRAINING
Multi Stage Deployment
Ramp-Up
e-insight
IT Services
SMART Services
Technischer Service
Warehouse Operation Support
Resident Engineering
Hotline
Ersatzteilmanagement
Escrow
KNAPP Academy
– Reifenwechsel, Kugellager im Reifen,
– Tank leer
– Lager = Box (Reifen unsortiert, Werkzeug unsortiert,…)
– Kosten = schlechtere Rundenzeiten / Ausfall
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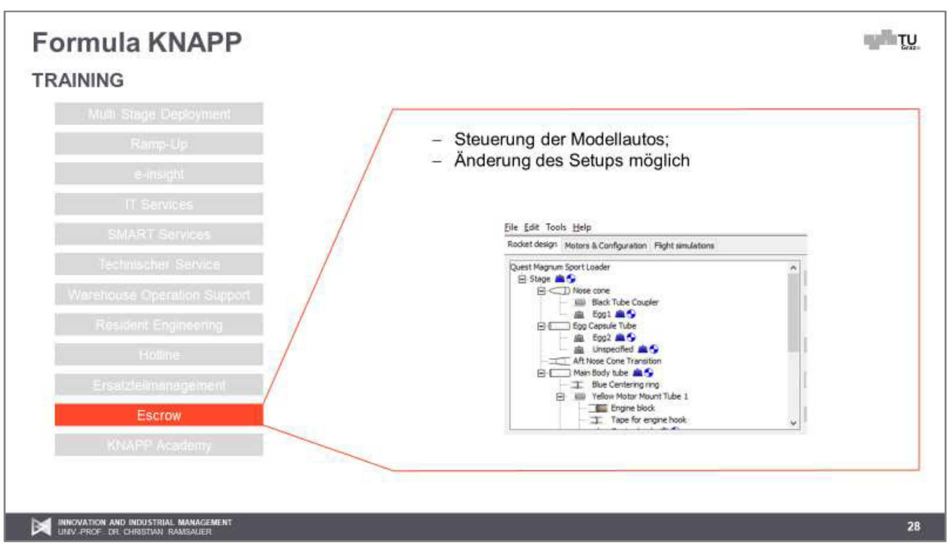
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TRAINING
Multi Stage Deployment
Ramp-Up
e-insight
IT Services
SMART Services
Technischer Service
Warehouse Operation Support
Resident Engineering
Hotline
Ersatzteilmanagement
Escrow
KNAPP Academy
– Steuerung der Modellautos;
– Änderung des Setups möglich
File Edit Tools Help
Rocket design
Motors & Configuration
Flight simulations
Quest Magnum Sport Loader
Stage
Nose cone
Black Tube Coupler
Egg1
Egg Capsule Tube
Egg2
Unspecified
Aft Nose Cone Transition
Main Body tube
Blue Centering ring
Yellow Motor Mount Tube 1
Engine block
Tape for engine hook
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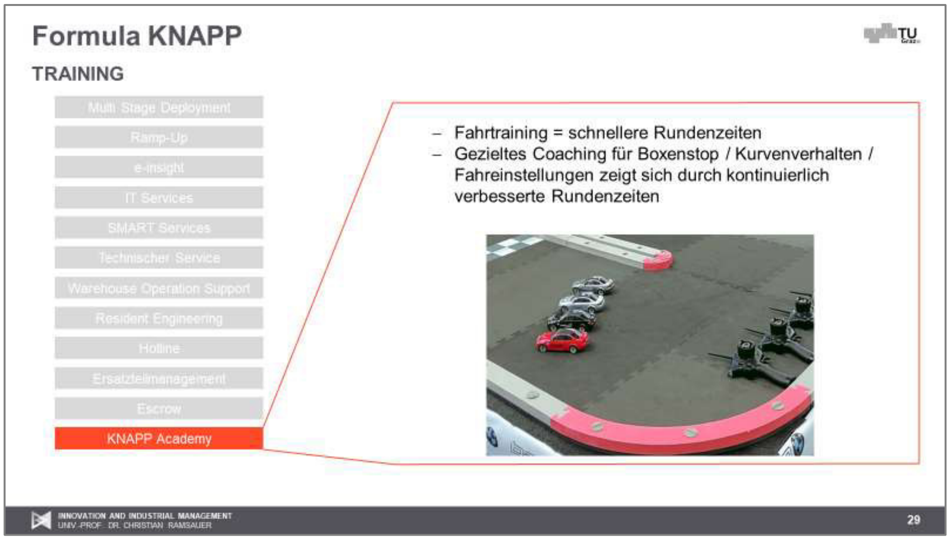
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TRAINING
Multi Stage Deployment
Ramp-Up
e-insight
IT Services
SMART Services
Technischer Service
Warehouse Operation Support
Resident Engineering
Hotline
Ersatzteilmanagement
Escrow
KNAPP Academy
– Fahrtraining = schnellere Rundenzeiten
– Gezieltes Coaching für Boxenstop / Kurvenverhalten / Fahreinstellungen zeigt sich durch kontinuierlich verbesserte Rundenzeiten
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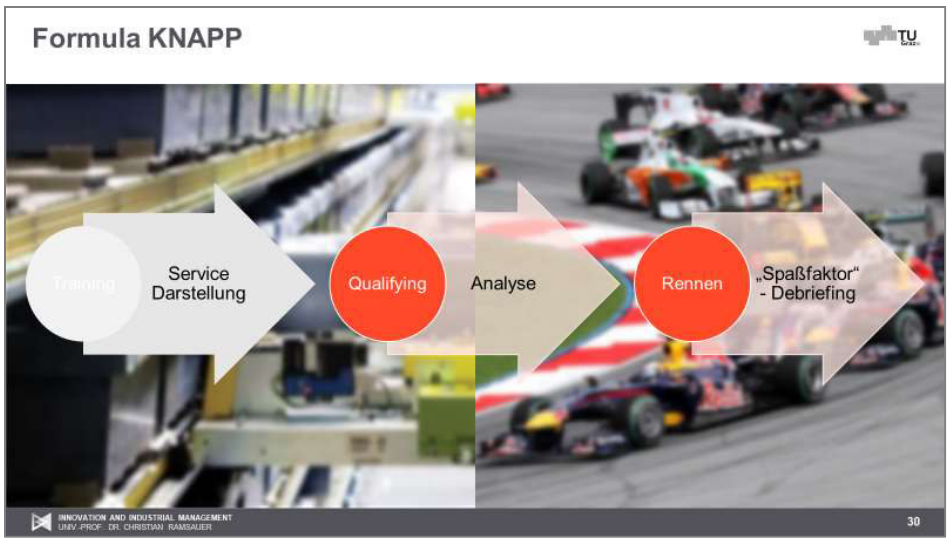
Formula KNAPP
Training
Service Darstellung
Qualifying
Analyse
Rennen
„Spaßfaktor“ - Debriefing
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KNAPP Rocket Launch

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KNAPP Rocket Launch

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Systemlandschaft “KNAPP Rocket Launch”

Ablauf:
Das System umfasst eine Simulationskapsel und eine Control Station. Die Control Station ist mit Bildschirmen und Computern ausgestattet. Von dort aus leitet der Mission Control die Crew, welche seine Anweisungen ausführt und den Funkkontakt zur Simulationskapsel hält. Die Mission Crew ist zuständig für den außen und innen Check der Kapsel und können bei Bedarf Reparaturen vornehmen.
In der Simulationskapsel befinden sich die Astronauten. Diese ist mit einem Touch Screen ausgestattet. Über den Touch Screen werden die notwendigen Schritte für den Start ausgeführt von den Astronauten.

System Abstraktion:

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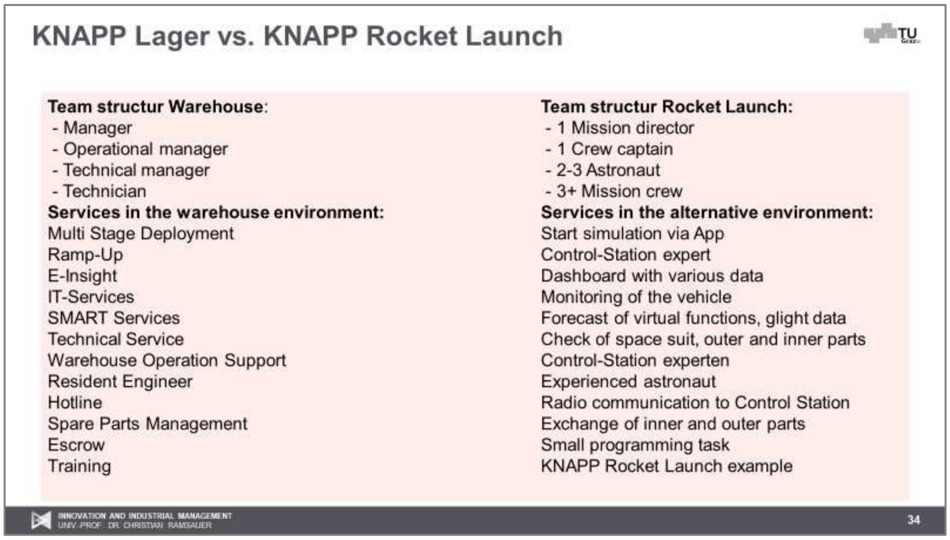
KNAPP Lager vs. KNAPP Rocket Launch
Team structur Warehouse:
- Manager
- Operational manager
- Technical manager
- Technician
Services in the warehouse environment:
Multi Stage Deployment
Ramp-Up
E-Insight
IT-Services
SMART Services
Technical Service
Warehouse Operation Support
Resident Engineer
Hotline
Spare Parts Management
Escrow
Training
Team structur Rocket Launch:
- 1 Mission director
- 1 Crew captain
- 2-3 Astronaut
- 3+ Mission crew
Services in the alternative environment:
Start simulation via App
Control-Station expert
Dashboard with various data
Monitoring of the vehicle
Forecast of virtual functions, glight data
Check of space suit, outer and inner parts
Control-Station experten
Experienced astronaut
Radio communication to Control Station
Exchange of inner and outer parts
Small programming task
KNAPP Rocket Launch example
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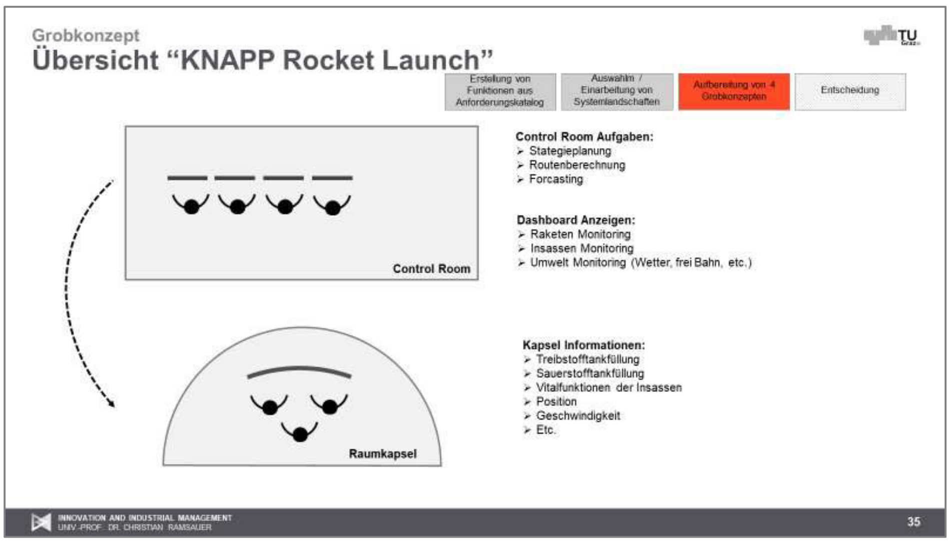
Grobkonzept
Übersicht "KNAPP Rocket Launch"
Erstellung von Funktionen aus Anforderungskatalog
Auswahlm / Einarbeitung von Systemlandschaften
Aufbereitung von 4 Grobkonzepten
Entscheidung
Control Room
Raumkapsel
Control Room Aufgaben:
➢ Stategieplanung
➢ Routenberechnung
➢ Forcasting
Dashboard Anzeigen:
➢ Raketen Monitoring
➢ Insassen Monitoring
➢ Umwelt Monitoring (Wetter, frei Bahn, etc.)
Kapsel Informationen:
➢ Treibstofftankfüllung
➢ Sauerstofftankfüllung
➢ Vitalfunktionen der Insassen
➢ Position
➢ Geschwindigkeit
➢ Etc.
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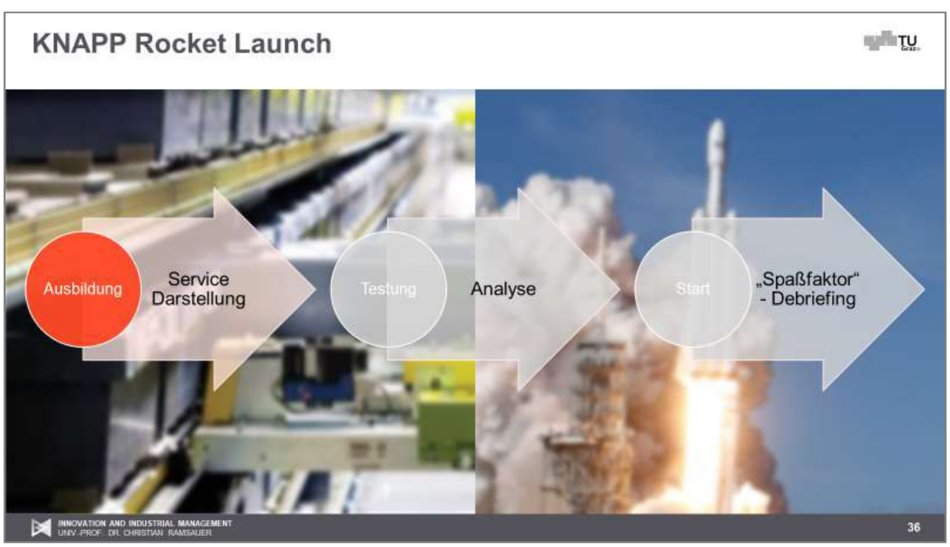
KNAPP Rocket Launch
Ausbildung
Service Darstellung
Testung
Analyse
Start
„Spaßfaktor" - Debriefing
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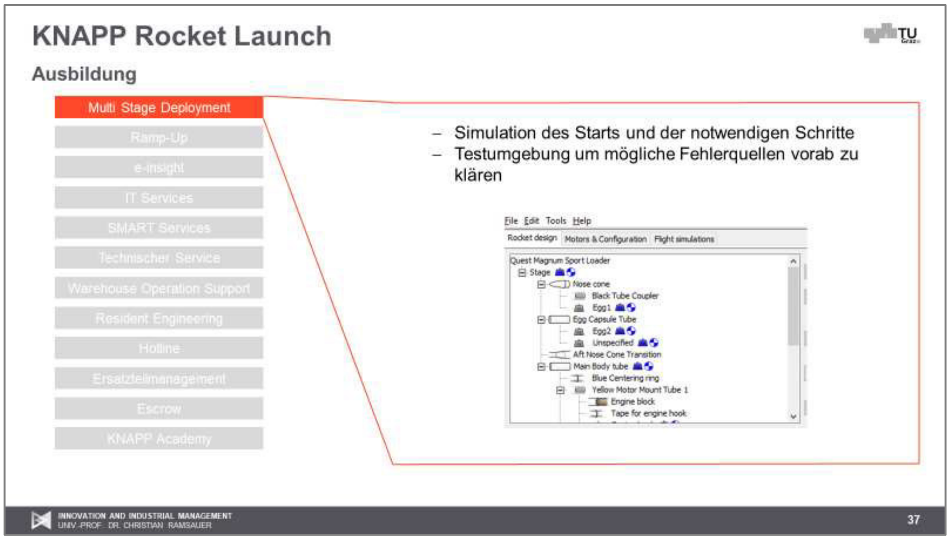
KNAPP Rocket Launch
Ausbildung
Multi Stage Deployment
Ramp-Up
e-insight
IT Services
SMART Services
Technischer Service
Warehouse Operation Support
Resident Engineering
Hotline
Ersatzteilmanagement
Escrow
KNAPP Academy
– Simulation des Starts und der notwendigen Schritte
– Testumgebung um mögliche Fehlerquellen vorab zu klären
File Edit Tools Help
Rocket design Motors & Configuration Flight simulations
Quest Magnum Sport Loader
Stage
Nose cone
Black Tube Coupler
Egg1
Egg Capsule Tube
Egg2
Unspecified
Aft Nose Cone Transition
Main Body tube
Blue Centering ring
Yellow Motor Mount Tube 1
Engine block
Tape for engine hook
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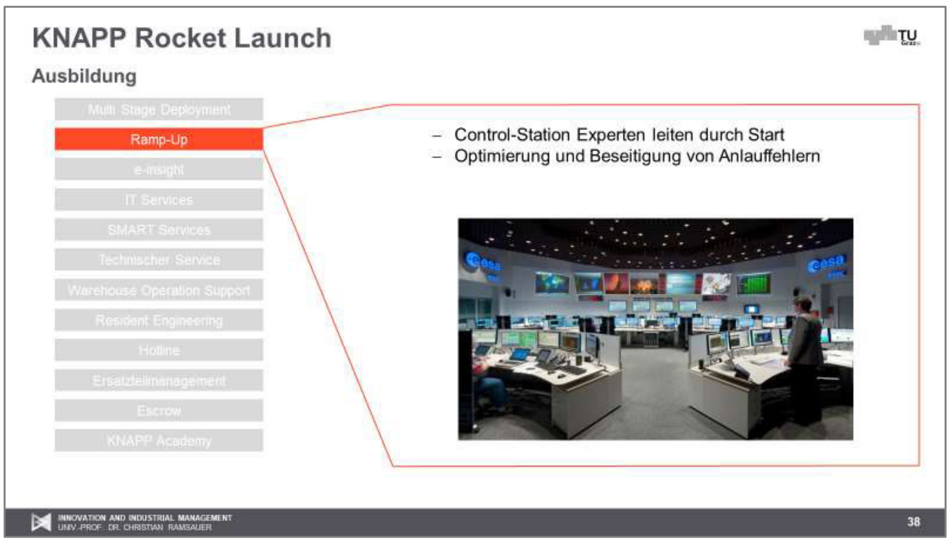
KNAPP Rocket Launch
Ausbildung
Multi Stage Deployment
Ramp-Up
e-insight
IT Services
SMART Services
Technischer Service
Warehouse Operation Support
Resident Engineering
Hotline
Ersatzteilmanagement
Escrow
KNAPP Academy
– Control-Station Experten leiten durch Start
– Optimierung und Beseitigung von Anlauffehlern
esa
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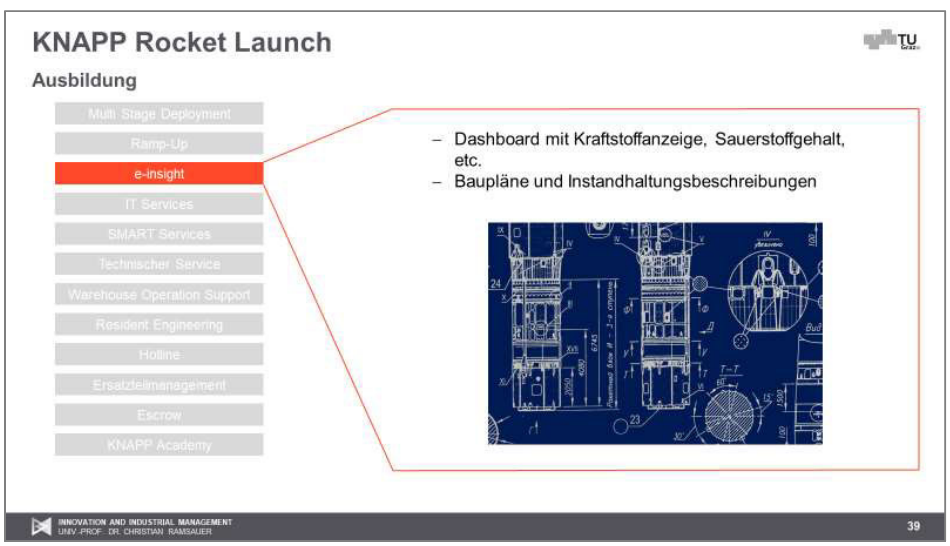
KNAPP Rocket Launch
Ausbildung
Multi Stage Deployment
Ramp-Up
e-insight
IT Services
SMART Services
Technischer Service
Warehouse Operation Support
Resident Engineering
Hotline
Ersatzteilmanagement
Escrow
KNAPP Academy
– Dashboard mit Kraftstoffanzeige, Sauerstoffgehalt, etc.
– Baupläne und Instandhaltungsbeschreibungen
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KNAPP Rocket Launch

Ausbildung

- Multi Stage Deployment
- Ramp-Up
- e-insight
- **IT Services**
- SMART Services
- Technischer Service
- Warehouse Operation Support
- Resident Engineering
- Hotline
- Ersatzteilmanagement
- Escrow
- KNAPP Academy

- Sensorik liefert Daten
- IT System Checks zur Überprüfung der Genauigkeit und Funktionalität
- Überwachung der Subsysteme

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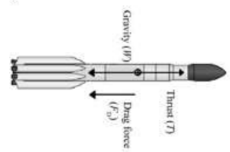
KNAPP Rocket Launch

Ausbildung

- Multi Stage Deployment
- Ramp-Up
- e-insight
- IT Services
- **SMART Services**
- Technischer Service
- Warehouse Operation Support
- Resident Engineering
- Hotline
- Ersatzteilmanagement
- Escrow
- KNAPP Academy

- Aufwendige mathematische Berechnung aus gesammelten vergangenheitsbezogenen Daten der Ankunftszeit und der Flugbahn
- Wetterlage, Abschusszeitpunkt festlegen = Wartungsfensterberechnung
- Benchmarkauswertung aus früheren Starts
- Vitalfunktionen der Insassen, Körperliche Belastung, Sauerstoffgehalt etc. Toleranz



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KNAPP Rocket Launch

Ausbildung

- Multi Stage Deployment
- Ramp-Up
- e-insight
- IT Services
- SMART Services
- **Technischer Service**
- Warehouse Operation Support
- Resident Engineering
- Hotline
- Ersatzteilmanagement
- Escrow
- KNAPP Academy

- Weltraumanzug Zustand
- Service von außen oder innen Teilen etc.

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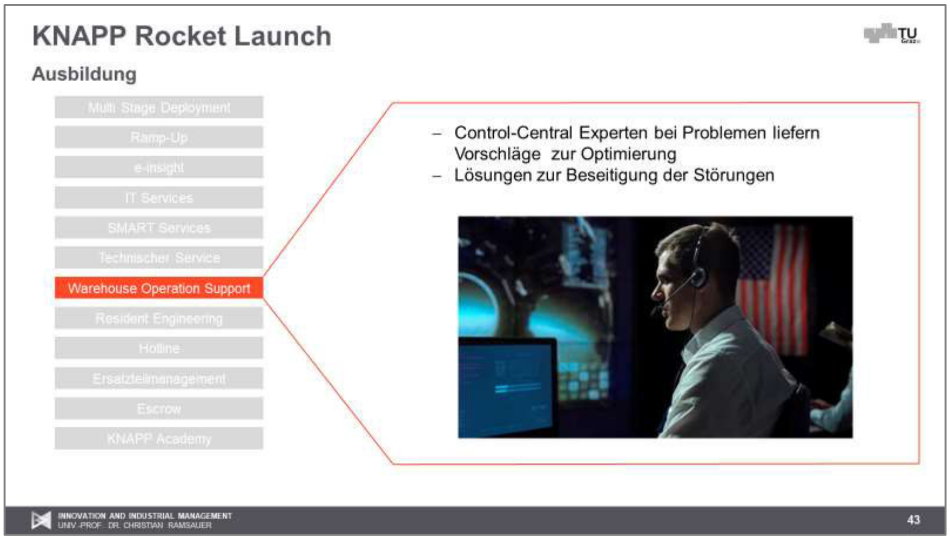
KNAPP Rocket Launch
Ausbildung
Multi Stage Deployment
Ramp-Up
e-insight
IT Services
SMART Services
Technischer Service
Warehouse Operation Support
Resident Engineering
Hotline
Ersatzteilmanagement
Escrow
KNAPP Academy
– Control-Central Experten bei Problemen liefern Vorschläge zur Optimierung
– Lösungen zur Beseitigung der Störungen
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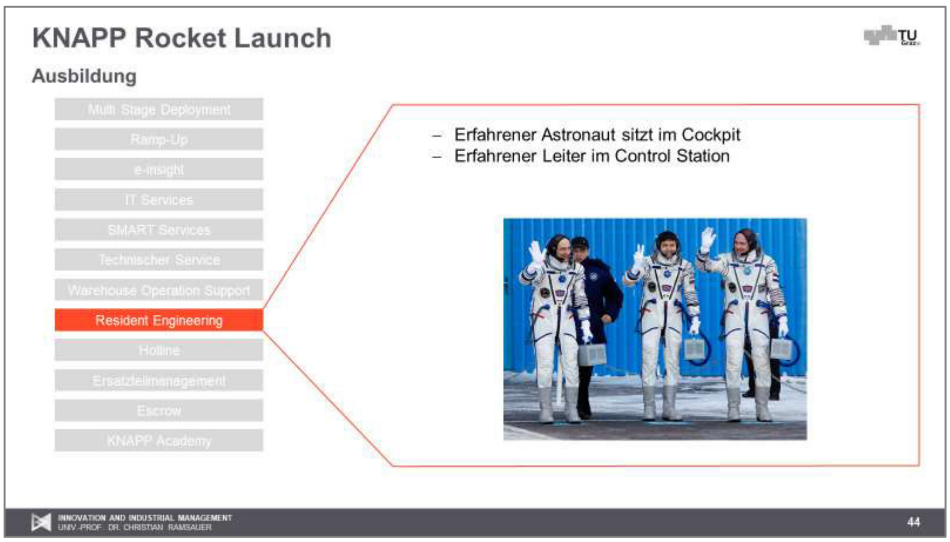
KNAPP Rocket Launch
Ausbildung
Multi Stage Deployment
Ramp-Up
e-insight
IT Services
SMART Services
Technischer Service
Warehouse Operation Support
Resident Engineering
Hotline
Ersatzteilmanagement
Escrow
KNAPP Academy
– Erfahrener Astronaut sitzt im Cockpit
– Erfahrener Leiter im Control Station
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KNAPP Rocket Launch
Ausbildung
Multi Stage Deployment
Ramp-Up
e-insight
IT Services
SMART Services
Technischer Service
Warehouse Operation Support
Resident Engineering
Hotline
Ersatzteilmanagement
Escrow
KNAPP Academy
– Kontrollleuchten blicken auf → Fehlerursachen (niedriger Sauerstoff gehabt, Lecks, etc.)
– Funk-Kommunikation: Kontakt zur Control Station-Crew für Hilfe
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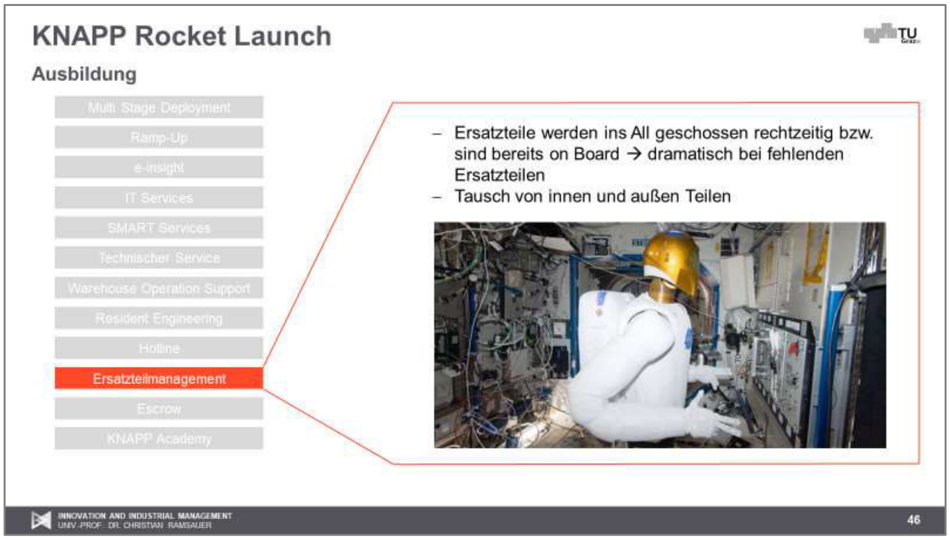
KNAPP Rocket Launch
Ausbildung
Multi Stage Deployment
Ramp-Up
e-insight
IT Services
SMART Services
Technischer Service
Warehouse Operation Support
Resident Engineering
Hotline
Ersatzteilmanagement
Escrow
KNAPP Academy
– Ersatzteile werden ins All geschossen rechtzeitig bzw. sind bereits on Board → dramatisch bei fehlenden Ersatzteilen
– Tausch von innen und außen Teilen
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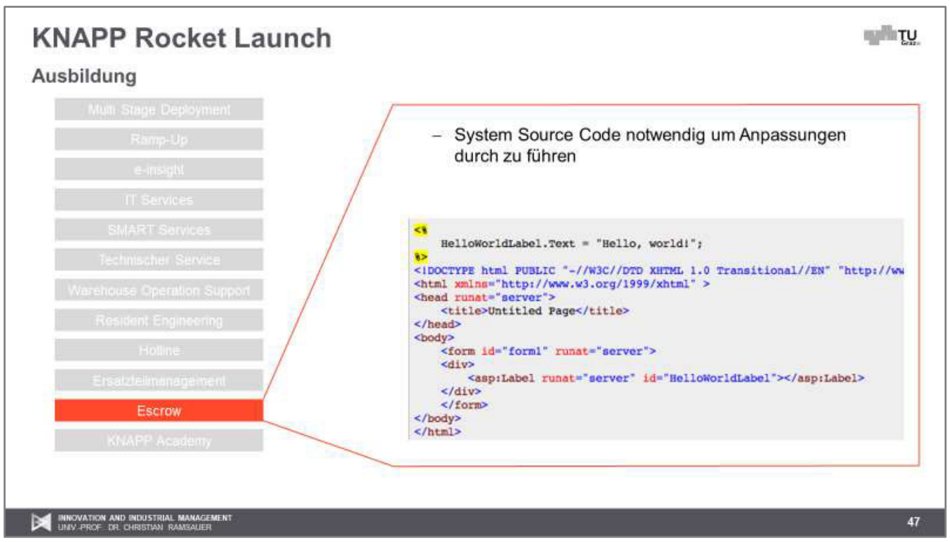
KNAPP Rocket Launch
Ausbildung
Multi Stage Deployment
Ramp-Up
e-insight
IT Services
SMART Services
Technischer Service
Warehouse Operation Support
Resident Engineering
Hotline
Ersatzteilmanagement
Escrow
KNAPP Academy
– System Source Code notwendig um Anpassungen durch zu führen
<%
HelloWorldLabel.Text = "Hello, world!";
%>
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN" "http://ww
<html xmlns="http://www.w3.org/1999/xhtml" >
<head runat="server">
<title>Untitled Page</title>
</head>
<body>
<form id="form1" runat="server">
<div>
<asp:Label runat="server" id="HelloWorldLabel"></asp:Label>
</div>
</form>
</body>
</html>
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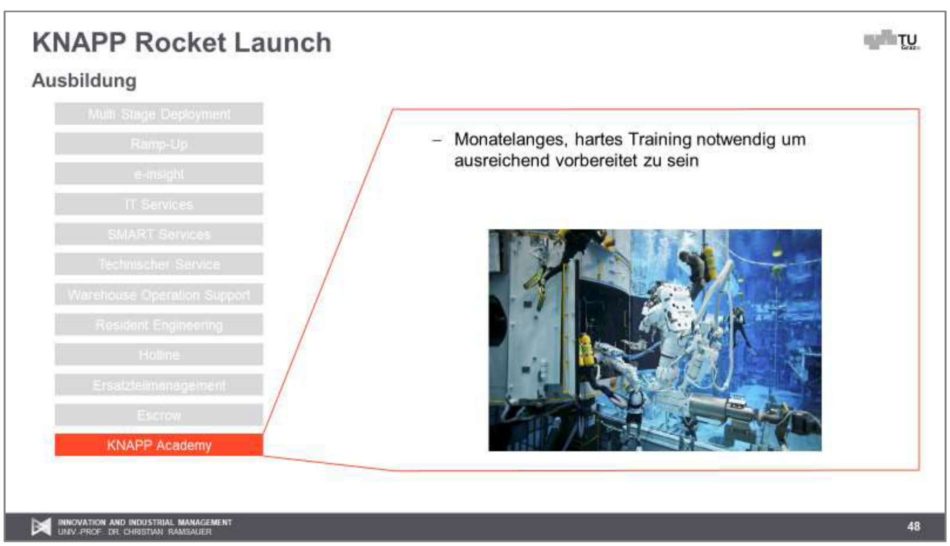
KNAPP Rocket Launch
Ausbildung
Multi Stage Deployment
Ramp-Up
e-insight
IT Services
SMART Services
Technischer Service
Warehouse Operation Support
Resident Engineering
Hotline
Ersatzteilmanagement
Escrow
KNAPP Academy
– Monatelanges, hartes Training notwendig um ausreichend vorbereitet zu sein
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KNAPP Bakery

KNAPP Bakery

Systemlandschaft “KNAPP Bakery”

Das System umfasst eine Backmöglichkeit, Kühlvorrichtung und eine Rührmaschine.

Ablauf:

1. Zutaten bereitstellen und Qualität prüfen
2. Zutaten nach Rezept vorbereiten und für das backen bereitstellen
3. richtige Einstellungen für das Backen der Ware überprüfen
4. Anweisungen vom Konditormeister an die Bäcker und Lehrlinge
5. Bestellungen werden über einen Bildschirm übermittelt

System Abstraktion:

Industrie-Backanlage

Manufaktur

Mini Backstube

Systemlandschaft "KNAPP Bakery"

Ablauf:
Das System umfasst eine Backmöglichkeit, Kühlvorrichtung und eine Mixmaschine. Im ersten Schritt werden die nötigen Zutaten zusammengetragen und auf ihre Qualität geprüft. Im nächsten Schritt werden die Zutaten nach Rezept vermengt und für das Backen vorbereitet. Der letzte Schritt ist das Setting der richtigen Einstellungen für das Backen der Ware. In der Systemumgebung leitet der Konditormeister das Geschehen und gibt Anweisung an die Bäcker und Lehrlinge. Die Bestellungen werden über einen Bildschirm übermittelt.

System Abstraktion:

Industrie-Backanlage → Manufaktur → Mini Backstube

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KNAPP Lager vs. KNAPP Bakery

Teamstruktur Lager:
- Manager
- operativer Leiter
- technischer Leiter

Services im Lager:
Multi Stage Deployment
SMART Services
E-Insight
Ersatzteilmanagement
Escrow
Ramp-Up
Warehouse Operation Support
Resident Engineer
Hotline
Training
IT-Services
Technischer Service

Teamstruktur KNAPP Bakery:
- 1 Besitzer
- 1 Bäckermeister
- 2+ Bäcker/Lehrling

Service in der Alternative:
Bäckerei König (Vorschlag Viktoria)
Forcasting Sortenvielfalt, Backeigenheiten
Dienstpläne, Maschinenbeschreibungen
notwendige Backelemente (Zutaten)
Geheim Rezept
Küchenerklärung und optimale Nutzung
Layout- und Prozessoptimierungen
gelernte Küchenkraft (Trainerrolle)
technische Hotline oder andere
Skillset erlernen
Überwachung, Kapazitätsmanagement
Austausch/Reparatur der Backutensilien

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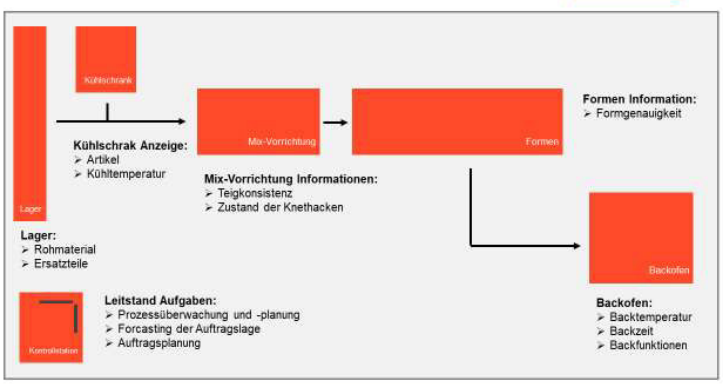
Grobkonzept

Übersicht „KNAPP Bakery"

Erstellung von Funktionen aus Anforderungskatalog	Auswahl / Einarbeitung von Systemlandschaften	Aufbereitung von 4 Grobkonzepten	Entscheidung



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KNAPP Bakery
Zutaten bereitstellen
•Ersatzteilmanagement
•SMART Services
•E-Insight
•Multi Stage Deployment
Zubereiten
•Hotline
•Ramp-Up
•Warehouse Operation Support
•Resident Engineer
•Training
Backen
•IT-Services
•Technischer Service
INNOVATION AND INDUSTRIAL MANAGEMENT
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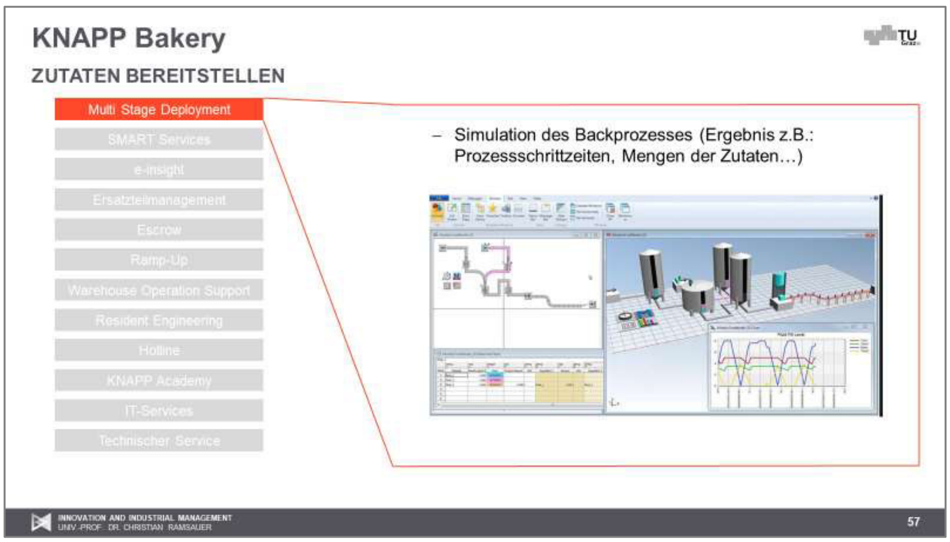
KNAPP Bakery
ZUTATEN BEREITSTELLEN
Multi Stage Deployment
SMART Services
e-insight
Ersatzteilmanagement
Escrow
Ramp-Up
Warehouse Operation Support
Resident Engineering
Hotline
KNAPP Academy
IT-Services
Technischer Service
– Simulation des Backprozesses (Ergebnis z.B.: Prozessschrittzeiten, Mengen der Zutaten…)
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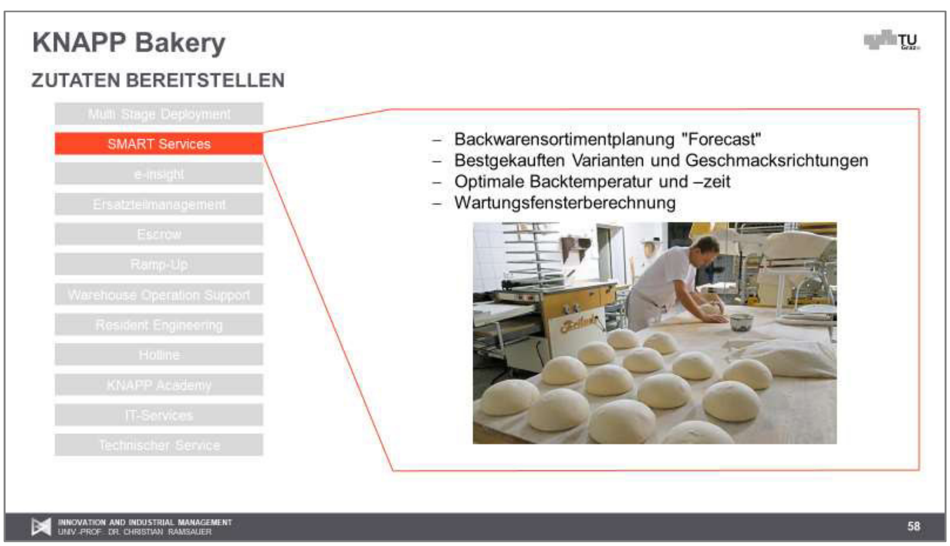
KNAPP Bakery
ZUTATEN BEREITSTELLEN
Multi Stage Deployment
SMART Services
e-insight
Ersatzteilmanagement
Escrow
Ramp-Up
Warehouse Operation Support
Resident Engineering
Hotline
KNAPP Academy
IT-Services
Technischer Service
– Backwarensortimentplanung "Forecast"
– Bestgekauften Varianten und Geschmacksrichtungen
– Optimale Backtemperatur und –zeit
– Wartungsfensterberechnung
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KNAPP Bakery

ZUTATEN BEREITSTELLEN

- Multi Stage Deployment
- SMART Services
- **e-insight**
- Ersatzteilmanagement
- Escrow
- Ramp-Up
- Warehouse Operation Support
- Resident Engineering
- Hotline
- KNAPP Academy
- IT-Services
- Technischer Service

– Technische Dokumentation der Maschinen, Wartungspläne
– Roadmap der einzelnen Maschinen und Komponenten
– Schichtenplan

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KNAPP Bakery

ZUTATEN BEREITSTELLEN

- Multi Stage Deployment
- SMART Services
- e-insight
- **Ersatzteilmanagement**
- Escrow
- Ramp-Up
- Warehouse Operation Support
- Resident Engineering
- Hotline
- KNAPP Academy
- IT-Services
- Technischer Service

– Temperatursensor
– Backofenlicht
– Mixmesser/Mixstäbe

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KNAPP Bakery

ZUTATEN BEREITSTELLEN

- Multi Stage Deployment
- SMART Services
- e-insight
- Ersatzteilmanagement
- **Escrow**
- Ramp-Up
- Warehouse Operation Support
- Resident Engineering
- Hotline
- KNAPP Academy
- IT-Services
- Technischer Service

– Backrezept (ähnlich wie Coca Cola im Safe hinterlegt)
– Notwendig bei z.B.: Änderung vom Lieferanten

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KNAPP Bakery
Zutaten bereitstellen
•Ersatzteilmanagement
•SMART Services
•E-Insight
•Multi Stage Deployment
Zubereitung
•Hotline
•Ramp-Up
•Warehouse Operation Support
•Resident Engineer
•Training
Backen
•IT-Services
•Technischer Service
INNOVATION AND INDUSTRIAL MANAGEMENT
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KNAPP Bakery
ZUBEREITUNG
Multi Stage Deployment
SMART Services
e-insight
Ersatzteilmanagement
Escrow
Ramp-Up
Warehouse Operation Support
Resident Engineering
Hotline
KNAPP Academy
IT-Services
Technischer Service
– Einführung durch Küche (Backrohr erklären, etc.)
– Trainer übernimmt Rolle eines Konditormeister
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KNAPP Bakery
ZUBEREITUNG
Multi Stage Deployment
SMART Services
e-insight
Ersatzteilmanagement
Escrow
Ramp-Up
Warehouse Operation Support
Resident Engineering
Hotline
KNAPP Academy
IT-Services
Technischer Service
– Beratung durch externe Back-Experten (Konditormeister)
– Layoutänderung (Verbesserung vom Prozessablauf, Personaleinsparung, etc.)
– Lagersystem für Zutaten
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KNAPP Bakery

ZUBEREITUNG

- Multi Stage Deployment
- SMART Services
- e-insight
- Ersatzteilmanagement
- Escrow
- Ramp-Up
- Warehouse Operation Support
- **Resident Engineering**
- Hotline
- KNAPP Academy
- IT-Services
- Technischer Service

– Gelernte Backkraft – sofort Einsetzbar
– Trainer übernimmt Rolle als zusätzlicher Konditor

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KNAPP Bakery

ZUBEREITUNG

- Multi Stage Deployment
- SMART Services
- e-insight
- Ersatzteilmanagement
- Escrow
- Ramp-Up
- Warehouse Operation Support
- Resident Engineering
- **Hotline**
- KNAPP Academy
- IT-Services
- Technischer Service

– Technische Hotline zu den Maschinen (Backrohr etc.)
– „Fernwartung“ des Backrohrs

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KNAPP Bakery

ZUBEREITUNG

- Multi Stage Deployment
- SMART Services
- e-insight
- Ersatzteilmanagement
- Escrow
- Ramp-Up
- Warehouse Operation Support
- Resident Engineering
- Hotline
- **KNAPP Academy**
- IT-Services
- Technischer Service

– Training um richtigen Techniken zu erlernen
– Gezielte Handwerkstechniken notwendig für Zöpfe, Brezeln, Kränze, etc.
– Richtige Nutzung der Geräte

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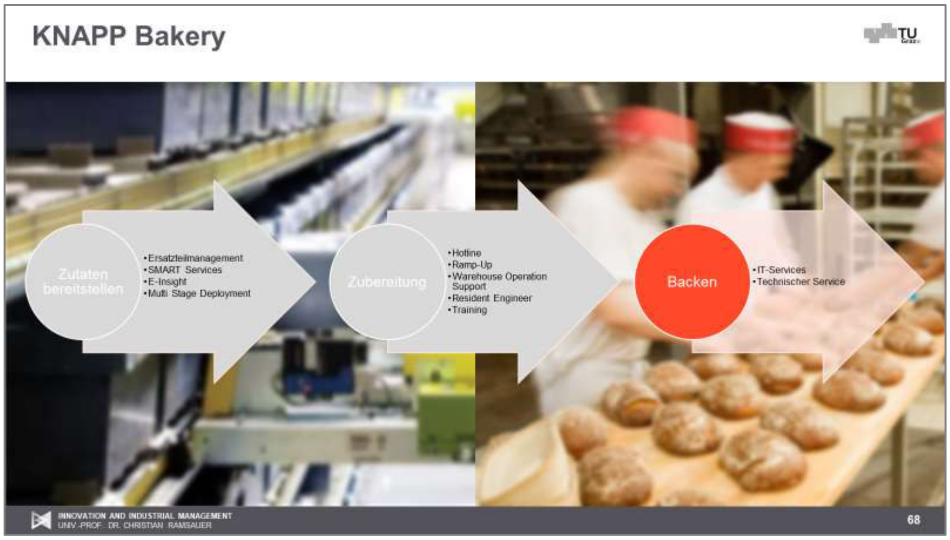
KNAPP Bakery
Zutaten bereitstellen
•Ersatzteilmanagement
•SMART Services
•E-Insight
•Multi Stage Deployment
Zubereitung
•Hotline
•Ramp-Up
•Warehouse Operation Support
•Resident Engineer
•Training
Backen
•IT-Services
•Technischer Service
INNOVATION AND INDUSTRIAL MANAGEMENT
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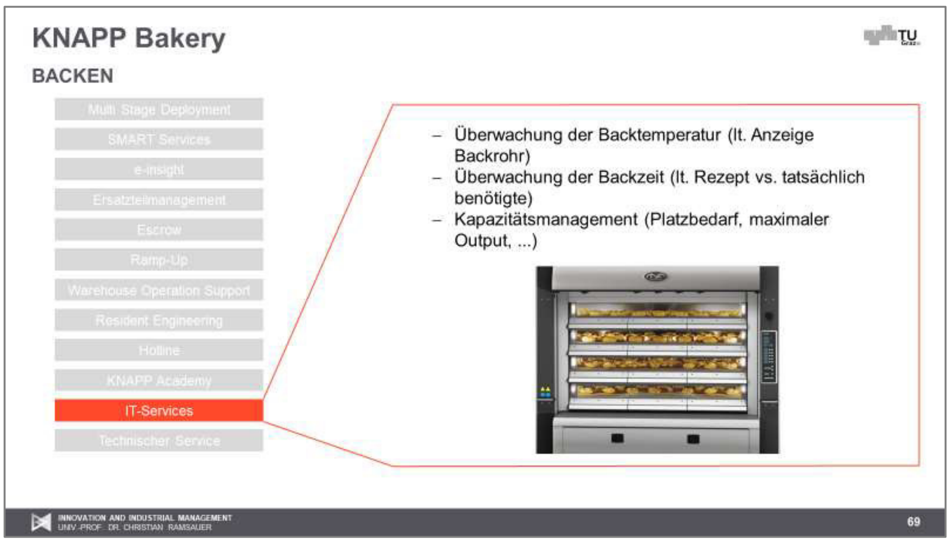
KNAPP Bakery
BACKEN
Multi Stage Deployment
SMART Services
e-insight
Ersatzteilmanagement
Escrow
Ramp-Up
Warehouse Operation Support
Resident Engineering
Hotline
KNAPP Academy
IT-Services
Technischer Service
– Überwachung der Backtemperatur (lt. Anzeige Backrohr)
– Überwachung der Backzeit (lt. Rezept vs. tatsächlich benötigte)
– Kapazitätsmanagement (Platzbedarf, maximaler Output, ...)
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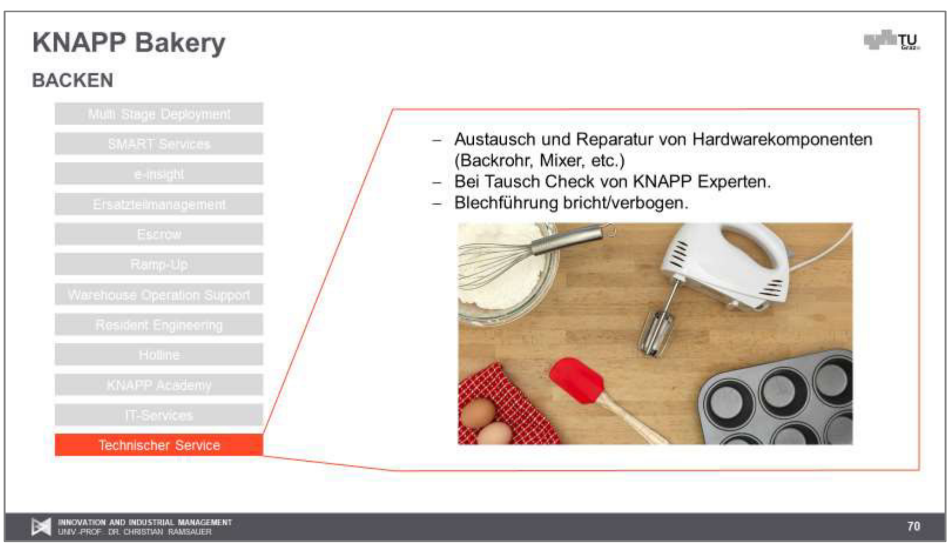
KNAPP Bakery
BACKEN
Multi Stage Deployment
SMART Services
e-insight
Ersatzteilmanagement
Escrow
Ramp-Up
Warehouse Operation Support
Resident Engineering
Hotline
KNAPP Academy
IT-Services
Technischer Service
– Austausch und Reparatur von Hardwarekomponenten (Backrohr, Mixer, etc.)
– Bei Tausch Check von KNAPP Experten.
– Blechführung bricht/verbogen.
INNOVATION AND INDUSTRIAL MANAGEMENT
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Appendix C

Use Cases and Customer Benefits

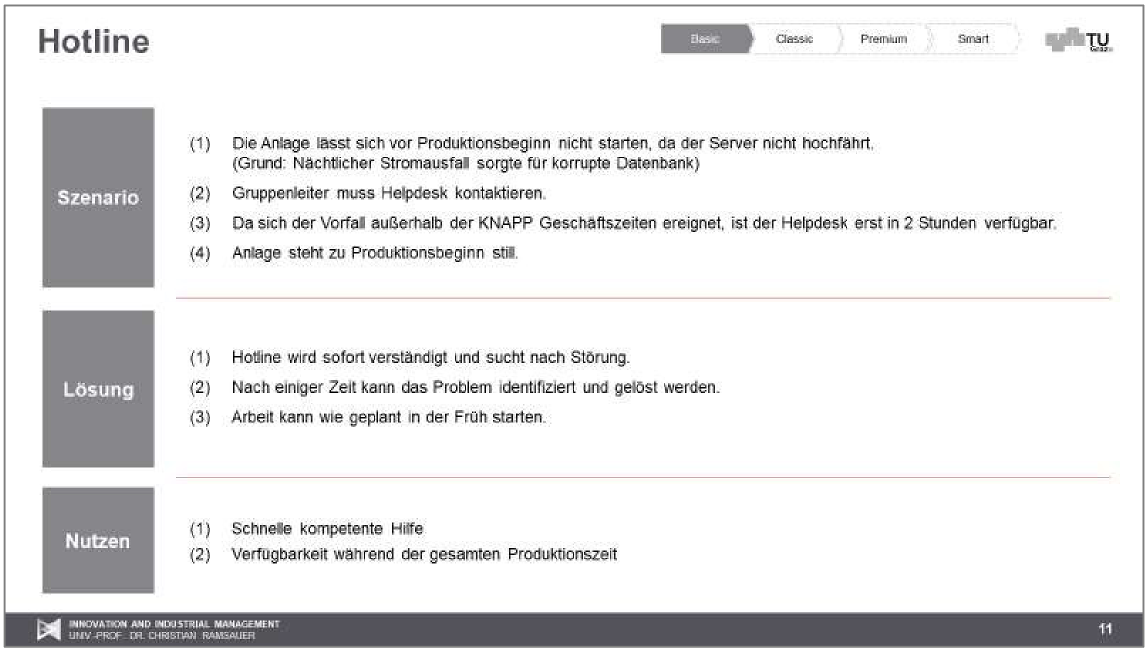
Gewichtung für Konzept	Services	Beschreibung	Kundennutzen	KNAPP Leistungen	Kundensicht (Kaufmotivation)	Störfälle	Ohne Service	Mit Service
hoch	**Ramp Up**	KNAPP stellt einen Techniker für die mechanischen und elektrischen Belange in den ersten x Monaten der Inbetriebnahme zur Verfügung. Der KNAPP-Techniker unterstützt den Kunden bei Angelegenheiten, wie Einstellungen, Wartungen, Problemmanagement und Ersatzteilmanagement, in der Ramp-up Phase.	Unterstützung und Erleichterung in der Startphase	Erleichterung in der Startphase Tipps und Tricks von KNAPP-Experten Rasche Antwort bei Fragen strukturierte, gezielte Einführung – weniger Fehler erfolgreiches hochziehen und bedienen der Anlage durch erfolgreiches Consulting Erkennung von anlagenspezifischen Verbesserungsmöglichkeiten in der frühen Phase Schnellere Leistungssteigerung des Lagers Stabiles System durch richtige Bedienung	Absicherung gegen Fehler und Kopempetenzen übertragen	* Systemleistung ist um bis zu 50% verschlechtert – Übergangslösung ist möglich;	Die Anlagen werden immer komplexer durch den hohen Grad der Automatisierung. Die Kunden haben teils wenig Erfahrung mit den neuen Anlagensystemen und bemerkt erst spät, dass sie nicht in der Lage sind das Lager selbstständig richtig zu betreiben. Das eigene Wissen wird anfänglich überschätzt.	Ein KNAPP-Experte oder Experten-Team ist vor Ort und leitet das richtige Hochfahren der Anlage und schult dem Kunden auf das Betreiben der Anlage ein. Es werden Fehler verhindert in dem die Anlage von Beginn an stabil zum Laufen gebracht wird und zusätzlich werden spezifische Verbesserungen früh erkannt.
sehr hoch	**Warehouse Operation Support**	Alle Arten von Daten werden gesammelt visualisiert, sodass wichtige Information lesbar und sofort verfügbar sind und einfach überwacht werden können. Warehouse Operation Support liefert nicht nur Daten über die technische Verfügbarkeit, sondern geht noch einen Schritt weiter: Es integriert auch die Warehouse Management Daten aus dem Kundensystem. Diese Daten werden in leicht lesbaren Diagrammen und verschiedenen Graphen dargestellt und visualisieren dabei gleichzeitig Soll- und Ist-Stand nahe Echtzeit. Die Graphiken, Diagramme und Daten werden auf die Bedürfnisse des Kundenbusiness maßgeschneidert angepasst.	Performance Steigerung und mehr Transparenz durch Kennzahlensteuerung	Detaillierte Analyse des Ist-Stands als Vorbereitung des Workshops sowie der Vor-Ort Analyse der realen Gegebenheiten durch KNAPP Logistic Consultants im Rahmen des Workshops Erheben von Optimierungspotentialen und Empfehlungen hinsichtlich möglicher Lösungen Gemeinsames Erarbeiten und Überprüfen von KPIs zusammen mit KNAPP Logistik Experten Impulse setzen für neue Ideen, Prozesse und Lösungen für die bestehende Anlage Alle zuvor definierten KPIs können auch vom Kunden selbstständig überprüft werden Unabhängiges System, welches Kunden die nötigen Messwerte zeitnahe zur Verfügung stellt Maßgeschneidertes Dashboard angepasst an die eigenen Prozesse und Bedürfnisse Integration und Visualisierung von multiplen Niederlassungen im selben Dashboard, was gleichzeitig für Vergleichbarkeit aufgrund der definierten KPIs sorgt.Möglichkeiten zusätzliche Spitzen im saisonalen Geschäft ebenfalls zusammen mit KNAPP abzudecken Einfache und verständliche Aufbereitung von komplexen Abläufen in allen logistischen Prozessen.	Transparenz	Der Kunde hat Probleme sein Lager zu betreiben. Er kann trotz seiner Ressoucen die Waren nicht optimal umschlagen.	Der Kunde hat Probleme sein Lager rentabel zu betreiben. Die logistische Umsetzung ist nicht zeitgemäß und hat sich den veränderten Marktbedingungen nicht angepasst, Waren können nicht umgeschlagen werden, etc.	KNAPP Experten nehmen sich dem Kunden-Problem an und kümmern sich um die Fehlerbehebung, Kundenbedürfnisse und die nachhaltige Prozessoptimierung damit die Qualität und Produktivität gesteigert werden kann.
hoch	**Technical Services - On-Site Resident Software Techniker**	Ein von KNAPP geführter und ausgebildeter Software Techniker zur lokalen Produktions-Unterstützung direkt vor Ort. Der IT-Service Engineer dient für jegliche Software sowie auch logistischen Themen als zentrale Anlaufstelle für den Kunden. Bei aufkommenden und von Kunden gemeldete Störungen an der KNAPP Anlage führt er Maßnahmen zur möglichen Behebung durch oder leitet diese ein im engen Kontakt zur KNAPP Hotline. Ebenfalls wird der Kunde bei der Ausarbeitung von Verbesserungen und Changes unterstützt sowie auch bei deren anschließenden Einrichtung bzw. Installation.	Maximierung der Anlagenverfügbarkeit	Techniker mit einem umfangreichen Wissen über die KNAPP Systemlandschaft vor Ort Während der Arbeitszeit im Lager sofort Verfügbar, alle KNAPP Zugriffsrechte auf die installierte Software Schnellere Antwortzeiten bei aufkommenden Incidents und Problemen		Der Kunde ist nicht in der Lage seine Anlage softwaretechnisch zu betreuen.	Kunde stellt sämtlich benötigtes IT-Support Personal vor Ort selbst. Meldung über Störungen, fortlaufende Kommunikation und auch die mögliche Durchführung einer Störfallbehebung muss der Kunde selbst unter der Anweisung KNAPP Hotline koordinieren.	KNAPP definiert zusammen mit dem Kunden die Aufgaben und Pflichten von einem oder mehreren lokal stationierten IT-Service Engineers. KNAPP rekrutiert die gewünschten Personen und bildet diese aus (erfolgt im besten Fall in der Projektphase). KNAPP übernimmt ebenfalls die direkte Führung und Weiterbildung des IT-Service Engineers.
sehr hoch	**Operation & Logistics Support**	Im Rahmen des Operation & Logistics Supports (OL&S) beraten KNAPP-Experten den Kunden hinsichtlich der operativen und strategischen Lagerlogistik (bestehende Prozesse werden optimiert und neue logistische Prozesse werden erarbeitet und auf die Kundenbedürfnisse angepasst). Das Team verfügt über langjährige Erfahrung im operativen Lagermanagement. Die OL&S-Experten führen Warenstromanalysen, ABC-Analysen und Lagerplatzdefinitionen etc. durch. Des Weiteren unterstützen sie den Kunden bei der Erstellung von Kennzahlen (KPIs) und helfen Qualitätsstandards einzuführen bzw. bei der Steigerung der Qualität.	Leistungs- und Effizienzsteigerung durch beste Beratung vom KNAPP-Experten	Nachhaltige Prozessoptimierung und Kostensenkung durch ganzheitliche Prozessberatung Optimierung des Workflows Produktivitäts- und Qualitätssteigerung durch Analysen und Expertenwissen Entdecken von möglichen Engpässen und Nutzung des vorhandenen Potenzials Optimaler Einsatz von neuen Technologien		Liefer- und Leistungsengpässe	Ohne dieses Service muss der Kunde mit viel Aufwand alleine seine Prozesse durcharbeiten und daraus Verbesserungspotentiale ableiten.	Mit diesem Service kann das System eine maximale Leistung bringen. Die richtigen Prozesse werden optimiert und die Artikel richtig gelagert. Darüber hinaus werden kosten eingespart und Ressourcen optimal eingesetzt.
mittel/hoch	**Training**	Die Trainings der KNAPP Academy erhöhen die Kompetenz und das nötige Fachwissen der Mitarbeiter des Kunden für eine sichere Bedienung, effiziente Fehlerbehebung sowie eine ordnungsgemäße Instandhaltung der Anlage.	bestens geschulte Mitarbeiter	gutes Handling von Anfang an - geringe Ausfallszeiten, ordnungsgemäße Instandhaltung der Anlage Gezielte Ausbildung der Mitarbeiter Gewinn an Kompetenz, nötiges Fachwissen, selbständige Arbeitsweise	Fehlerminimieren	Die Wissenslücken beim Kunden kommen bei der Hotline zum Tragen, wo man auch Rückmeldungen bekommt, dass Schulungen notwendig wären. Wir geben diese Ratschläge weiter, jedoch nimmt man diese nur in den seltensten Fällen an. Was hat das Service dazu beigetragen: Hätte präventiv dem Problem vorgebeugt	Bei allen Kunden werden die meisten Störung durch einfache Handlingfehler ausgelöst (falsche Anlagenutzung, falsche Informationen für Ersatzteile, etc.). Durch Unwissenheit passieren aller Art vom Menschen verursachte Störfälle.	Das Training hilft den Lagermitarbeitern sich optimal auf die Anlage vorzubereiten und die Aufgaben ordnungsgemäß durchzuführen. Mit gezielten Schulungen kann Know-How aufgebaut und vielen Handlingfehlern somit präventiv vorgebeugt werden.
mittel	**Hotline - Problem Management**	Im Rahmen des Problem Managements werden vorerst noch nicht bekannte Ursachen für Incidents analysiert und deren Behebung gesteuert. Anders als im Zuge des Incident Management Prozesses, dient der Problem Management Prozess einer nachhaltigen Lösungsfindung bzw. der Ursachenforschung eines Problems.	Ursachenfindung und nachhaltige Lösung	periodische Überprüfung der gemeldeten Incidents sowie die daraus resultierende Erstellung eines Problemmanagement-Ticket durch die 2nd Level Hotline Techniker Koordinierte Analysen der Problem Management-Tickets durch 3rd Level Entwicklungstechniker Im Problemmanagement erfolgen die Basis-Analysen und Lösungsfindung für das eventuell resultierenden „Bugfixing" (Change Management)		Die gleichen Störfälle treten mehrmals beim Kunden auf. Die Ursache für die häufige Auftretung derselben Störfälle wird nicht genauer untersucht bzw. analysiert.	Kunde erhält in seiner „Gewährleistungsphase" nur „Helpdesk-Zugang" zur KNAPP Hotline. Ein „Helpdesk-Zugang" beinhaltet keine automatische/periodisch gesteuerte Überprüfung der eingemeldeten Incidents. Problem Tickets werden nur in der Gewährleistungsphase auf „Kundenzuruf" erstellt und daraus auch „Bugfixing Changes" bearbeitet.	Die Problem Management-Tickets werden in einem vorgegebenen Interval für den Kunden analysiert. Basierend auf der Analyse werden Verbesserungsvorschläge für den Kunden erarbeitet. IT Service Vertragskunden erhalten zusätzlich einen eigenen technischen Betreuer (IT Engineer) zur Koordination aller erstellten Problemtickets.
mittel	**Hotline - Bugfix Changes**	Wird im Zuge des Problemmanagement festgestellt das im KNAPP Lieferumfang ein Mangel oder Fehlfunktion existiert so wird zur Behebung eine koordinierte und nach ITIL prozessgesteuerter Änderung (Bugfix-Change) ausgearbeitet. Der Kunde erhält ein „Request for Change (RFC) – Dokument" in dem alle relevanten Informationen zum Nutzen, Funktion, Installation und Testen des Bugfix-Changes beschrieben sind.	koordinierte, schnellere Umsetzung von Bugfix-Changes	Dokumentation und Spezifikation eines Bugfix Change Termin-Koordination Koordination während der Change Einspielung auf Test & Live Systeme des Kunden Remote-Testbegleitung durch einen KNAPP Techniker		Beim Kunden kommt der gleiche Fehler immer wieder vor. Er bekommt kein ausgearbeitetes Bugfix-Change, sodass seine Anlage opitmiert werden kann.	Bugfix-Changes werden nur in der Gewährleistungsphase erstellt und abgewickelt. Es gibt keine priorisierten Ressourcen bzw. Zeiten in dem diese Bugfix-Changes entwickelt und ausgebracht werden. Gewünschte Bugfix-Change Installationen und Remote Testbegleitungen sind kostenpflichtig.	Während der Gewährleistung übernimmt KNAPP die Kosten für Bugfixes (Changes). Nach Ablauf der Gewährleistungszeit sind Bugfixes (Changes) kostenpflichtig, wenn diese auf Kundenwunsch umgesetzt werden möchten. Kunden mit einem IT Service Vertrag erhalten einen eigenen technischen Betreuer zur Koordination aller durchzuführenden Bugfix-Changes.
mittel	**Changemanagement - Problem Change**	Sicherstellung einer nachhaltigen Problembeseitigung aus einem Problemticket heraus	nachhaltige Problembeseitigung	• Analyse und Ursachenfindung • Spezifikation • Release-Planung • Implementierung • Validierung und Abnahme • Abschluss * Dokumentation		Wenn bei der Analyse eines Problem-Ticktets festgestellt wird, dass ein Fehler in der Software vorliegt, stellt KNAPP innerhalb der Gewährleistung einen Bugfix zur Verfügung	Der Kunde erhält in seiner „Gewährleistungsphase" „Bugfix-Changes", die durch die allgemein verfügbaren KNAPP Ressourcen bearbeitet und umgesetzt werden.	Gezielte Release-Planung von "Bugfix-Changes" durch den technischen Projektleiter kombiniert mit verkauften Changes, sowie Umsetzung durch das exklusive Entwicklungsteam
sehr hoch	**e-insight**	Transparente Abbildung der wichtigsten Servicebelangen, u.a. Anlage und installierte Komponenten sowie Support-Status (Roadmap) der Produkte des Kunden (Lifecycle-Management), Dokumente, Incidents, Berichte etc., des Logistiksystem des Kunden. Plattform für Informationen Zugriff auf das Ticketing-System und RFCs Unterlagen für Wartung und Instandhaltung Ersatzteil-Mgmt und Bestellungen	Transparenz - bietet Übersicht	zentrale Anlaufstelle Abrufen von individuellen Statusinformationen Online-Anfrage zu Ersatzteilen Anlage und Komponenten Support-Status der Produkte (Roadmap) **Life-Cycle-Management** Dokumente, Incidents, Berichte, etc.	Aktuelle Daten, mehr prozessunterstützende Funktionen die richtigen Informationen zur richtigen Zeit, richtig aufbereitet	1. Störfall: Ersatzteile für Reparatur nicht ermittelbar Was hat das Service dazu beigetragen: Zugang zu Elektrikplänen und zum elektronischen Ersatzteilkatalog löst dieses Problem. 2. Störfall: Aktueller Status der Tickets und laufenden Change Requests nicht ermittelbar Was hat das Service dazu beigetragen: Kunde hat die Möglichkeit die Tickets samt Historie im E-Insight einzusehen 3. Störfall: Dem Kunden ist nicht klar wer bei KNAPP wofür zuständig ist Was hat das Service dazu beigetragen: Kunde kann im E-Insight alle zuständigen Personen samt Tätigkeitsbereich und Kontaktdaten einsehen.	Ohne e-insight könnte der Kunde Ersatzteile für Reparatur nicht ermitteln. Der aktuelle Status der Tickets und laufenden Change Requests ist für den Kunden nicht ermittelbar. Das aktuelle e-insight erhält der Kunde momentan jedoch immer.	e-insight bietet Zugang zu Anlagenplänen und zum elektronischen Ersatzteilkatalog, womit der Kunde das richtige Ersatzteil bestimmen und bestellen kann. Es beinhaltet auch die Wartungsberichte, Supportstatus, etc. Außerdem hat der Kunde die Möglichkeit Tickets samt Historie im e-Insight einzusehen. auf jeden Endgerät (Smartphone, Tablet, PC) verfügbar
falls es ins Basic Paket kommt/ sehr hoch	**Smart Services- Digital Twin**	Mit dem Digital Twin von KNAPP können zukünftige Simulationen erstellt und nachträglich Warenflüsse visualisiert und abgespielt werden. Es werden alle Bewegungen im Lager aufgezeichnet und über ein Modell gelegt, welches dem realen Lager-Layout entspricht. Damit können Warenflüsse nachträglich in Zeitraffer nachgespielt und analysiert werden. Mit dem darauf aufbauenden Simulationstool können zukünftige Erwartungen im Business simuliert werden und frühzeitig Bedürfnisse erhoben werden	Ermittlung von Engpässen	Optimierung des Warenflusses. Simulation von zukünftigen Business Veränderungen. Schnelle Entscheidunggrundlage für Investitionsentscheidlungen. Darstellung des Warehouse model. Tool zur einfachen und schnellen Lagerabstraktion (Replay basiert darauf)		Die visuelle Abbildung von warenflussbedingten Störfällen, sowie die Simulation und die daraus resultierende Verhinderung von Störfällen.	Ohne diesem Service kann es passieren, dass der Kunde nicht die gewünschte Warenmenge bereitsstellen kann	Mit diesem Service können Lagerengpässe erkannt werden. So kann frühzeitig in einer Lagervergrößerung investiert werden und es kommt zu keinen Warenflussproblemen.
hoch	**Smart Services**	SMART SERVICES verknüpfen digitale und physikalische Systeme und Dienstleistungen auf intelligente Weise. Informationen aller relevanten Systeme von Anlagen werden zuammengeführt, bewertet, angereichert und mit Mehrwert wieder Kunden zur Optimierung ihrer logistischen Prozesse zur Verfügung gestellt. Kunden behalten ihre Anlagen auch gruppenweit oder über mehreren Anlagen im Griff und können durch mehr wertvolle Insights in ihre Prozesse neue Potentiale ausschöpfen	Maximale Optimierung & Transparenz	verschafft raschen Überblick eigenständige Interpretation (auch ohne KNAPP möglich) Empowerment Tools mit Frühwarnsystem intuitive und einfach bedienbare Elemente Präventive und Monitoring Tools Mobile Assistenzsysteme und Verfügbarkeit aller relevanten Kennzahlen weltweit und das, ohne sich im KNAPP Netzwerk befinden zu müssen. Überwachung aller Systeme in Bezug auf Kunden- oder KNAPP-Schwellwerte und somit die Möglichkeit zur sofortigen Reaktion oder proaktiven Lösungen eines sich anbahnenden Problems. Laufende Überwachung von Komponenten hinsichtlich Alter, Schaltspiele,Temperatur, Vibration usw. -> Einstieg in die prädiktive Wartung!	Empowerment Tools mit Frühwarnsystem State of the Art Technologien die in anderen Bereichen genutzt werden auch im Arbeitsumfeld nutzen Selbst Informationen/ Entscheidungsgrundlagen herbeiführen und nicht wegen allem bei KNAPP nachfrage Optimierung der Anlage & der logistischen Prozesse Erhöhung der Verfügbarkeit, die richtige Information zum richtigen Zeitpunkt an die richtige Person, erhöhte Transparenz	Mechanische, elektrische, IT oder logistische Störfälle treten auf. Im Idealfall werden Störfälle durch die Smart Services verhindert - wenn es berechenbar, ableitbar, vorraussehbar ist. Ein gewisses Restrisiko bleibt bei unvorhergesehenen Dingen.	Wenn eine Störung auftritt muss man sich zuerst auf die Ursachensuche machen, bevor man diesen beheben kann. Dies kostet wertvolle Zeit während die Anlage still steht. Anlagen werden immer komplexer, schwerer beherrschbar. Die Anlagen werden auch immer größer, es gibt viel mehr Einflussfaktoren, viel mehr Informationen. Zudem wird das Geschäft von Tag zu Tag zeitkritischer (E-Commerce) – was eine möglichst schnell Verarbeitung und Interpretation der Systeme benötigt.	KNAPP bietet einen zentralen Datenspeicher für alle Anlagen eines Kunden mit langfristiger Aufbewahrung der Daten. Das System optimiert Lagerprozesse. Es gbit daher ein besseres Berichtswesen mit geringen Kosten und anonymen Benchmarks mit anderen Regionen, Branchen.
sehr hoch	**Smart Services - KPI Dashboard**	Das personalisierte KPI-Dashboard ermöglicht dass mehrere Anlagen gleichzeitig in Dashboard und Reports visualisiert werden. Alle dargestellten Kennzahlen sind von KNAPP gepürft und über alle angebundenen Systeme einheitlich berechnet. Alle Kennzahlen sind innerhalb von 5 Minuten im Dashboard verfügbar. Wie die Zahlen dargestellt werden, ist vom Benutzer selbst wählbar und personalisierbar.	Verringerung der Komplexität & Zeitersparnis	Es ist multianlagenfähig - ideal für Gruppenkunden personalisierbar & individualisierbar multi-site capability zuverlässige Informationen Fast-Echtzeit solide Unterstützung bei der Entscheidungsfindung		Störfällmeldungen können kundenspezifische angezeigt/angepasst werden.	Keine Visualisierung der relevanten Kennzahlen. Kein unmittelbares Wissen darüber, wie die Anlage performed.	Alle wichtigen Kennzahlen sind für den Kunden sofort ersichtlich. Das personalisierte KPI-Dashboard ermöglicht dass mehrere Anlagen gleichzeitig in Dashboard und Reports visualisiert werden. Der Kunde weiß sofort die Performance seiner Läger und kann bei Bedarf Verbesserungen durchführen.
sehr hoch	**Smart Services - Benchmark**	Benchmarking erlaubt Kunden eine anlagenübergreifende Optimierung der Performance der Anlage Alle Benchmarking-Teilnehmer stellen anonym Kennzahlen zur Rechnung von geografischen oder branchenbezogenen Kennzahlen ihrer Anlagen zur Verfügung	Objektive Perspektive zur besseren Selbsteinschätzung	Kunden können diese Vergleiche und Benchmarks INTERN (innerhalb Kundenanlagen) oder darüber hinaus abgleichen. Dies ermöglicht eine Einschätzung der eigenen Performance im Verhältnis zum Rest der Industrie. Wenn gewünscht können auch branchenfremde Kennzahlen herangezogen werden, um noch weiter zu optimieren und sich Potenziale anderer Branchen zu erarbeiten.		Die "gesunde Leistung" meiner Anlage kann mit anderen Niederlassungen, später auch branchenübergreifend, verglichen werden.	Der Kunde hat keine Einschätzung der eigenen Performance im Verhältnis zum Rest der Industrie.	Mittels Benchmarking bekomt man eine umfassende Stärken- und Schwächendarstellung seiner Anlage sowie Verbesserungspotenziale. Die Vergleiche mit dem Durchschnitt und den Besten der Branche zeigen, welche Optimierungsschritte in Angriff genommen werden sollten um das eigene Business noch erfolgreiche zu machen.

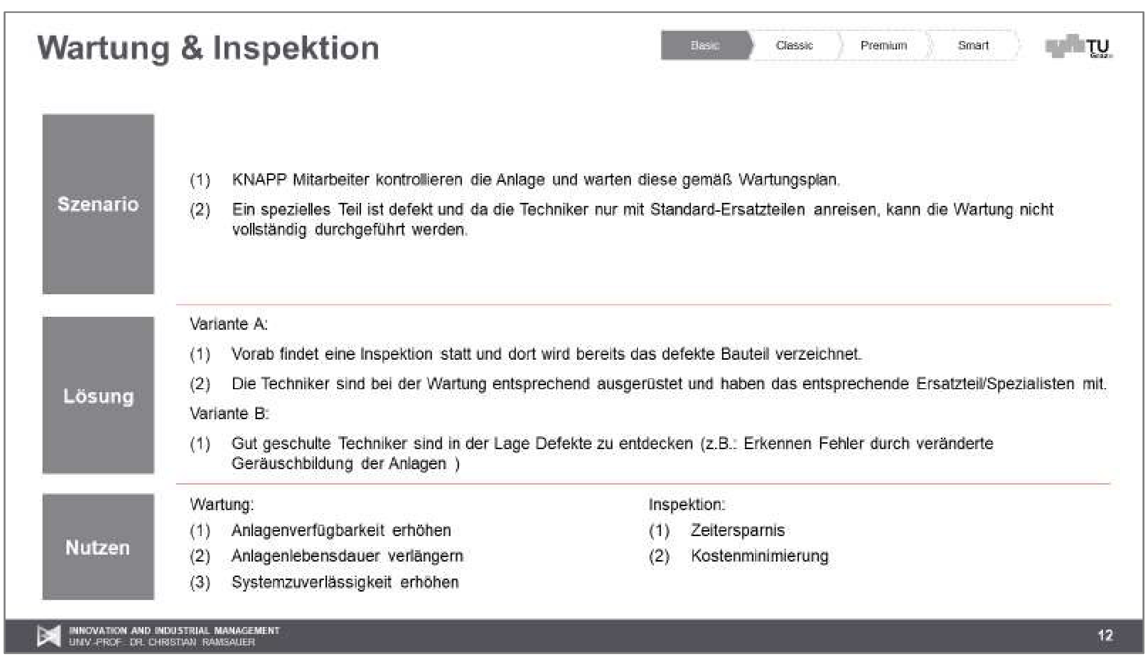
sehr hoch	**Smart Services - System Monitoring**	Condition Monitoring: Hier geht es 1) um die Überwachung logistischer Prozesse und deren Kennzahlen und 2) um die Überwachung von Hardware Komponenten (Lebenszyklus, Wartungsintervalle...) System Monitoring im herkömmlichen Sinn überwacht die Softwareinfrastruktur/Kapazitäten	Kosten- und Zeitersparnis	abrufen/speichern/verarbeiten der Daten Interpretation und Analyse der Daten Anzeigen von Warnungen, Schwellwerten Handlungsempfehlungen Start einer Kommunikationskette / RACI Matrix Vorhersagen	Zeit und Kostenersparnis Einen Überblick zu sämtlichen lagerrelevanten Themen	Logistische und klassische Störfälle werden früh erkannt und können verhindert werden	Ohne das Service muss der Kunde sich alle Kennzahlen selbst zusammensuchen und immer wieder berechnen. Er muss auch selbst dafür sorgen, dass alle relevanten Personen im Falle eine Warnung informiert werden.	Kunde kann sich darauf veralassen, dass das System alle Abweichungen erkennt und die notwendingen Schritte einleitet um vorbeugend Maßsnahmen zu setzen.
sehr hoch	**Smart Services - Wartungsfensterbereich**	Intelligente Wartung heißt für KNAPP die „richtigen Dinge zu tun“! KNAPP klassifiziert vollautomatisiert alle mechatronischen Komponenten in der Anlage mit Algorithmen, welche Wartungskategorien finden. Die Kategorien sind: - Run To Failure: Nicht kritisch, erst bei Ausfall tauschen - Präventive Wartung: alle X Wochen inspizieren um Wahrscheinlichkeit eines Ausfalls frühzeitig zu erkennen -> Generierung von Wartungsplänen - Condion Based: Zustand der Komponenten wird aktiv mit Sensorik (Temperatur, Vibration) überwacht -> Mit Machine Learning wird im Voraus alarmiert BEVOR Komponenten ausfallen. Wartungstechniker haben ein mobiles Wartungslogbuch am Smartphone zur Erfassung und Verteilung von Wartungstätigkeiten. Das ermöglicht im Detail Wartungsauswertungen und Bewertungen	Effizienzsteigerung durch Wartungsfensteroptimierung	Vorbeugende Wartung Condition Based Vorhersagemodelle Mobile Arbeitsgeräte optimierte Wartung-Slots		Gezieltere Wartung und Minimierung von Störungen	Ohne dieses Service können Wartungen oftmals zu spät bzw. auch in einem falschen Zeitpunkt durchgeführt werden, sodass wichtige Warenflüsse der Kunden gestört werden können.	Mit diesem Service können Anlagenstillstände bzw. Komponentenausfälle vorgebeugt werden. Die Wartungen werden auch dann durchgeführt, wenn sie für den Kunden den optimalsten Zeitraum darstellen.
hoch	**Technical Services - Resident Engineering**	Ein KNAPP-Techniker unterstützt die Kundentechniker vor Ort bei der präventiven und reaktiven War-tung/Instandhaltung der KNAPP-Anlage zu den vereinbarten Zeiten. Dabei stellt der KNAPP-Techniker sein technisches Know-how dem Kunden zur Verfügung. Eine Krankenstands- und Urlaubsvertretung ist nicht vorgesehen. Recruiting-Kosten im Fall von Kündigung werden von KNAPP getragen.	Maximierung der Anlagenverfügbarkeit langfristige Unterstützung des Kunden-Lagers	qualifizierter, zertifizierter Techniker vor Ort direkter Ansprechpartner agiert bei Störungen sofort erkennt Verbesserungspotentiale Expertise, Erfahrung und Servicekultur von KNAPP Hohe Kosteneinsparung durch präventive Instandhaltung und Wartung – Werterhalt der Anlage, Kostentransparenz (Kostenplanbarkeit der Fixkosten) Leitet das Ersatzteillager beim Kunden Management von Technikern von Sublieferanten **Leistungen** A. Wartungskalkulation, ideales Wartungsfenster nutzen B. Personalkalkulation, Personaleffizienz C. Kompetenzen des Resident-Teams D. Flow Controller **Aufgaben Resident:** Wartung u Reparatur Präventive Wartung Reaktive Wartung Notfallwartung Routinewartung Reinigung Überwachung des Systems KVP	Übernahme der Verantwortung der technischen Betreuung der Anlage, Partnerschaft, Ansprechperson Vorort und Versicherung für Anlagenverfügbarkeit direkten Ansprechpartner Vorort qualifizierter und zertifizierter Techniker vor Ort, wodurch die Maximierung der Anlagenverfügbarkeit erreicht werden kann kümmert sich um den gesamten Wartungs- und Instandhaltungsbedarf, agiert bei Störungen sofort und erkennt Verbesserungspotentiale	Kunde bemerkt, dass er nicht in der Lage ist das Lager selbstständig zu warten. Kunde Überschätz sich und hat zu wenig Erfahrung mit den neuen Anlagensystemen.	Der Kunde muss sich um die Einstellung, Einweisung und Schulung der Lagermitarbeiter kümmern. Bei Problemen oder im Falle eines Anlagenausfalls entstehen enorme kosten und Mitarbeiter müssen sich um die Reparatur und die Störmeldung bei KNAPP kümmern, ggf. muss ein KNAPP-Techniker anreisen.	Resident Engineers sind das Bindeglied zwischen KNAPP und dem Kunden. KNAPP übernimmt das Recruiting und die Schulung der Mitarbeiter für den Kunden. Der Resident Engineer vor Ort ist mit den Anlagen vertraut und kann richtig Störmeldung an KNAPP übermitteln und den Fehler sofort beheben.
sehr hoch	**Modul Changemanagement - Multi Stage Deployment**	Das Multi Stage Deployment umfasst die Betreuung der definierten Testsysteme durch KNAPP. Diese Betreuung beinhaltet einen dedizierten Ansprechpartner (Patch Manager) - inklusive dahinterstehendem Team - seitens KNAPP, welcher zu den definierten Zeiten die Anfragen des Kunden jeglicher Art für die bei ihm installierte Lösung, KNAPP intern koordiniert.	Risikominimierung bei "Software-Changes"	Sicherheit bei Systemänderungen Koordination der Betreuung der Testsysteme Beratung des IT- und Hotline-Prozesses Bereitstellen von Ressourcen zur Unterstützung des „Patch Managers“ Normen und interne Vorgaben entsprechen	Normen und interne Vorgaben (Risikominimierung, um Normen und interne Regelungen zu entsprechen)	Ein SW-Change wird direkt auf das Live-System eingespielt und verursacht Fehler.	Versteckte Fehler bei Aufträgen z. B. falsch verpackte Produkte sind schwer erkennbar. Beispiel: Ein falsches Medikament wird verpackt und zum Kunden (Apotheke) geliefert. Diese vertraut auf die Richtigkeit und verkauft es an den Endkunden, welcher plötzlich, das falsche Produkt in der Hand hält - hohe Risiken.	Beim Durchlauf neuer Versionen im Testsystem können durch Testphasen Fehler erkannt und behoben werden, bevor es auf das Live-System überspielt wird. Dadurch wird das Risiko durch die Einspielung neuer Versionen stark gesenkt.
sehr hoch	**Changemanagement - Request for Change**	Änderungen und Erweiterungen durch standardisierte Verfahren, effiziente Abarbeitung unter Minimierung von Risiken	effizient Abarbeitung von Changes lt. dfiniertem Prozess	**Planung, Implementierung, Aktivierung von Changes** • Analyse und Beratung im Bereich der Logistikprozesse • Unterstützung des Kunden bei der Ausarbeitung und Konzeption von neuen Lösungen • Beschreibung, Spezifikation und Risikobewertung eines Changes • Release-Planung unter Berücksichtigung der Erfordernisse des Kunden und Verfüg-barkeiten von KNAPP • Testplanung, Testdurchführung und Testdokumentation • Inbetriebnahme und Deployment von Releases • Begleitung von Kundentests • Durchführung von Kundenschulungen		Der Kunde möchte seine Anlage aufgrund von geänderten technologischen, logistischen bzw. branchenspezifischen Anforderungen weiterentwickeln	Änderungen und Erweiterungen der Anlage werden durch die allgemein verfügbaren KNAPP Ressourcen bearbeitet und umgesetzt.	Beratung, gezielte Planung, Umsetzung und Inbetriebnahme von Changes durch den technischen Projektleiter und das exklusive Entwicklungsteam kombiniert mit "Bugfix-Changes". Das Delivery-Team ist mit dem Business des Kunden und den Prozessen der Anlage vertraut und darauf trainiert.
sehr hoch	**Changemanagement (Delivery-Team)**	effiziente und effektive Durchführung von Changes und die Minimierung der negativen Auswirkungen von Veränderungen auf die Geschäftsprozesse der Kunden.	effiziente und effektive Change-Umsestzung	A. Technischer Ansprechpartner B. Delivery-Team C. Problem Change D. Request for Change E. Multi Stage Deployment	ganzheitliche Betreuung von der Testumgebung bis live system reservierte und auf Kunden-System geschulte Ansprechpartner dadurch hat man eine kurz und direkte Kommunkation zum Team	Anlagen werden immer komplexer und größer, dh besteht immer häufiger die Notwendigkeit Anlagen im bereits laufenden Produktivbetrieb weiterzuentwickeln.	Ohne Delivery-Teams kann auf neue technologische und logistische Möglichkeiten nicht in kürzester Zeit reagiert werden.	Delivery-Team Kunden erhalten zusätzlich einen dedizierten Ansprechpartner (technischer Projektleiter) für die Koordination und Planung aller technischen Belange, sowie ein exklusiv zur Verfügung stehendes und auf die Anlage trainiertes Team an Entwicklungsressourcen. Eine höhere Qualität sowie eine höhere Ressourcenverfügbarkeit kann dadurch erreicht werden.
hoch	**Technischer Service**	Die Technischen Services dienen der langfristigen Aufrechterhaltung der Systemzuverlässigkeit und dem Erhalt der Funktionsbereitschaft durch proaktive und professionelle Unterstützung von KNAPP bei der Instandhaltung der Anlage des Kunden. Ziel: Feststellung und Beurteilung des Istzustandes oder Minimierung des Verschleißes	lange Aufrechterhaltung der Systemzuverlässigkeit	a. Wartung b. Inspektion c. On-Site Techniker d. Add-Ons Professionelle Wartung und Instandhaltung erhöhen die Zuverlässigkeit der Anlage Gut gewartete Anlagen erhalten länger Ihren Wert. „Zero Defect“ Anlagen brauchen auch Wartung um ihre Lebensdauer zu verlängern.	Maximieren der Lebensdauer und Vermeidung von Anlagenausfällen	Ausfall oder Defekt einer mechanischen oder elektrischen Komponente	Eine Anlage wird vom Kunden nicht gewartet (oder nicht ordnungsgemäß gewartet) und wird defekt, die Garantie ist dadurch erloschen und der Kunde muss sich eine neu Anlage anschaffen.	Da die Anlage regelmäßig professionell gewartet wird und dabei auch eine Besichtigung erfolgt und der Zustand genauer betrachtet wird, können Defekte bevor diese entstehen aufgespürt und durch gezielte Maßnahmen verhindert werden. Der Kunde kann mit einer höheren Anlagenverfügbarkeit rechnen.
mittel	**Technischer Service - Add-Ons**	KNAPP bietet daräuber hinaus folgende Zusatzleistungen zu den Technischen Services Thermografische Inspektion Druckluft-Dichtheitsüberprüfung Schienenüberprüfung des Regalbediengeräts Profibus-Messung Netzqualität-Netzanalyse Technische Anlagenreinigung Wiederkehrende Prüfung gemäß § 8 AM-VO (eingeschränkt auf die KNAPP Anlage) Technische Anlagenreinigung	langfristige Aufrechterhaltung der Anlagenfunktion und der Systemzuverlässigkeit			Ausfall oder Defekt einer mechanischen oder elektrischen Komponente		
hoch	**Technischer Service - Inspektion**	Mechanische und Elektrische Anlagen sind in einem ordnungsgemäßen Zustand zu halten um die stabile und sicherheitstechnische Funktion zu Gewährleisten. Um über den aktuellen Zustand der mechanischen/elektrischen Anlage Bescheid zu wissen unterstützt ein KNAPP Techniker in regelmäßigen Abständen mit professionellen Prüfungen (Inspektionen) vor Ort. Der KNAPP Techniker erstellt einen Reparatur und Maßnahmenplan für den Kunden um die Anlage in einen ordnungsgemäßen Zustand zu bringen. Direkte Anweisungen an die Kundentechniker zu komplizierten Reparaturen vor Ort können während der Inspektion durchgeführt werden.	Voraussetzung für eine optimale Wartung Ist Zustand der Anlage - präventiv etwas tauschen, externer Blick	Anlagenprüfung/Inspektion durch einen KNAPP Experten (inkl. Überprüfung der Sicherheitseinrichtungen). Erstellung eines Reparatur- und Wartungsplan für den Kunden.		Proaktives Erkennen von mechanischen und elektrischen Defekten kann nicht durchgeführt werden.	Kunde ist für die Überprüfung der gesamten Anlage selbständig verantwortlich. Werden Punkte zur ordnungsgemäßen Wartung und Instandhaltung übersehen die in weiterer Folge zu „Defekts„ führen, ist jeder Support von KNAPP zur Behebung diesen Störungen zusätzlich kostenpflichtig.	KNAPP Elektrik und Mechanik Experten prüfen die Anlage in regelmäßigen Abständen direkt vor Ort. Es werden Reparatur-, Wartungs- und Maßnahmen- Listen von dem KNAPP Experten erstellt die entsprechend von den Kundentechniker abzuarbeiten sind. Anweisung bzw. Erklärung von komplizierten Reparaturen während der Inspektion. Überprüfung der Sicherheitseinrichtungen direkt vor Ort (Betriebserlaubnis-Zertifikat).
sehr hoch	**Technischer Service - Wartung**	Die KNAPP-Wartung dient der Minimierung des Verschleißes der Systeme oder Gewerke des KNAPP Leistungsumfanges in mechanischer, pneumatischer und elektrischer Hinsicht. Im Zuge der KNAPP-Wartung werden Maßnahmen zur präventiven Instandhaltung, wie Überprüfungen und Einstellungen, Nachstellen von Spanneinrichtungen, Schmieren/Ölen von technischen Einrichtungen sowie der Austausch von Verschleißteilen, ergriffen. Des Weiteren wird nach jeder Wartung ein kundenindividueller Wartungsbericht in xxx Sprache, mit einer Auflistung der Tätigkeiten, der Verschleißteilen, der aufgefundenen Mängel sowie Empfehlungen, erstellt.	Verlängerung der Anlagenlebensdauer Erhöhung der Anlagenverfügbarkeit	Regelmäßige Wartung und Reparaturen durch KNAPP Experten direkt vor Ort (Personalersparnis). Einsatz von modernsten Mess- und Prüftechnik durch KNAPP zur Sicherstellung der Anlagenverfügbarkeit. Überprüfung und Zertifikate für die Betriebserlaubnis können ausgestellt werden Überprüfung der Kunden Ersatzteillager.		Elektrische und mechanische Komponenten sind defekt, verschleißerscheinungen führen zu längeren Stillständen.	Kunde ist selbstständig für die Wartung und Instandhaltung der KNAPP Anlage zuständig. Werden in der Gewährleistungszeit keine Wartungen bei KNAPP bestellt, verliert der Kunde den Gewährleistungs-Anspruch wenn Wartung und Instandhaltung nicht ordnungsgemäß durchgeführt werden.	KNAPP erstellt anhand der Anlagengröße und verbauten Gewerke einen Wartung und Instandhaltungsplan für die gelieferte Anlage. KNAPP organisiert in Absprache mit dem Kunden die Terminpläne, Anreise und Einsätze der KNAPP Wartungstechniker. Der Kunde erhält Einsatz- und Wartungsberichte nach jedem durchgeführten Einsatz.
hoch	**Ersatzteilmanagement**	Für den ordnungsgemäßen Betrieb eines logistischen Systems ist es erforderlich, dass die richtigen Ersatzteile zur richtigen Zeit und in der richtigen Menge zur Verfügung stehen. Der Kunde sollte daher eine von KNAPP empfohlene Anzahl und Auswahl von Ersatzteilen am Anlagenstandort vorrätig halten.	rasche Bereitstellung eines Ersatzteiles	A. Ersatzteilberatung B. Ersatzteilbeschaffung C. Online-Plattform für Ersatzteile Experten-Beratung über maßgeschneidertes Ersatzteilpaket Möglichst rasche Lieferung von einzelnen Ersatzteilen im Bedarfsfall Online-Anfrage zu Ersatzteilen (e-insight) Laufende Datenerhebung und Analyse für optimale Lebenszyklusplanung	Transparenz und Vertrauen	Wenn Ersatzteile dringend erforderlich sind werden in dringenden Fällen alle mittel ausgereizt um ein Teil zu organisieren und es dann dem Kunden zu bringen auch wenn der Aufwand die Kosten des Teils weit überschreitet. In seltenen Fällen kommt es zu direkter Interaktion mit Hotline oder Resident tech-nikern. Wenn dies erfolgt läuft die „Rettungskette effizient „ weil eben nicht per-manent und und oft. Für eine Häufung derartiger Maßnahmen sind wir bei KNAPP nicht aufgestellt. Die Kosten die ein Kunde auf Grund eines Stillstands hat sind wesentlich größer	Es kommt zum Stillstand der Anlage aufgrund eines fehlenden Ersatzteils bzw. die Ausfallszeit verlängert sich.	Optimale Ersatzteilberatung sodass ein maßgeschneidertes, sinnvolles Ersatzteilpaket für den Kunden erstellt werden kann. Im Fall eines Störfalles sollte somit das erforderliche Ersatzteil vorhanden sein, um einen Austausch vorzunehmen und den Betrieb schnellstmöglich wieder aufzunehmen.
nieder	**Ersatzteilmanagement - Konsignationslager**	KNAPP errichtet, gegen Entrichtung einer Konsignationslagergebühr, am Standort des Kunden ein Konsignationslager für die Ersatzteile.	Maximale Verfügbarkeit von Ersatzteilen	Konsi-Lager mit oder ohne Resident	Der Mehrwert von einem Konsilager für unseren Kunden, ist das er die Kosten nicht als Inventar führt da die Komponenten als Knapp Eigentum bis zur Entnahme gefürt werden und er trotzdem flexiblen/schnellen Zugang zur Lagerware hat.			
mittel	**Services - Ecsrow**	Im Rahmen des Escrow-Service können der Source Code sowie die technische Dokumentation (geistiges Eigentum von KNAPP), in weiterer Folge "Material" genannt, der von KNAPP gelieferten Computerprogramme bei einem von KNAPP vorgegebenen Escrow-Partner (Escrow-Agent) hinterlegt werden. Bei Eintritt bestimmter Umstände werden die hinterlegten und vertraulichen Daten an den Kunden freigegeben.	Absicherung zum Aufbau und Installation gegenüber KNAPP	Abwicklung des Escrow-Vertrags sowie die Lieferung und Hinterlegung des Materials (Source Code und die technische Dokumentation, welche zum Aufbau und zur Installation benötigt wird) beim Escrow-Agent	Sicherheit 100% Sicherheit und Verfügbarkeit bei Ausfall und bei Insolvenz von KNAPP Normen und Firmenvorgaben erfüllen durch die gesicherte Version des Sourcecodes	KNAPP geht in Konkurs und Kunde kann ohne Source Code Fehler nicht beheben somit muss er entweder ein neues System suchen, dass mit allem anderen kompatibel ist, oder aber jemanden beauftragen der ein Stoppelsystem programmiert. Was hat das Service dazu beigetragen: Er würde den Code nutzen und mit der umfassenden Dokumentation sich ein-arbeiten, damit könnte der Kunde Verbesserungen und Weiterentwicklung an seinem System durchführen.	KNAPP meldet Konkurs und Kunde kann ohne Sourcecode keine Änderungen an seinem System vornehmen und ist gezwungen auf ein neues System umzustellen, welches kompatibel mit seinem aktuellen sein muss.	Der Sourcecode wird bei einem Notar mit einer ausführlichen und umfassenden Dokumentation hinterlegt. Der Kunde kann Verbesserungen und Weiterentwicklung an seinem System durchführen. (Vor allem notwendig, wenn man auf einen Code seine gesamten Systeme aufbaut.)

nieder	**Hotline - RACI-Matrix**	Matrix zur Festlegung von Verantwortlichkeiten und Zuständigkeiten R Responsibility A Accountable C Consulted I Informed Definiert die Leistungsbestandteile, technischen und organisatorischen Rahmenbedingungen, beinhaltend auch die Anforderungen an den Kunden zur ordnungsgemäßen Leistungserfüllung der KNAPP Hotline	bietet Übersicht der Zuständkigkeiten im Hotlinefall	Klärung der Verantwortlichkeiten Zusammenfassung der Ansprechpartner				
sehr hoch	**Hotline**	Service mit der Aufgabe, telefonisch und/oder per Fernwartung, bzw. persönlich, die Betriebsbereitschaft der Anlage wiederherzustellen. Die Leistung umfasst alle ~~mechanischen~~ und elektrischen KNAPP-Komponenten sowie KNAPP-Software bzw. Komponenten der IT Infrastruktur.	schnelle, ~~unkomplizierte~~ Hilfe	Mögliche Leistungen bei bestehenden Hotlinevertrag: 24/7: professionelle Hilfe zu jeder Uhrzeit In 8 Sprachen (ideal: Kundensprache) schnellstmögliche Wiederherstellung der Betriebsbereitschaft der Anlage Hohe Anlagenverfügbarkeit, Zuverlässigkeit, beste Lösungszeit, Stabilität ITIL Expert zertifiziert – Hotline spricht die IT Sprache des Kunden Erhebung und optimale Steuerung durch Kennzahlen	Verfügbarkeit der Anlage und damit einhergehend schnelle Lösungen Hilfe in seiner Landessprache Versicherung, welche mich bei Problemen schnell zu Lösungen berät.	Die Anlage des Kunden hat einen Störfall und läuft nicht in ihrer voller Auslastung. Es kann auch sein, dass die Anlage stillsteht.	Ohne Hotlinevertrag hat der Kunde immer Kosten bei Kontaktaufnahme über den Helpdesk zu tragen, welche schwer kalkulierbar sind. Der Helpdesk ist nur in den KNAPP Geschäftszeiten erreichbar. Die Dauer des Anlagenstillstandes bzw. die Lösungszeit erhöht sich. Die höhere Ausfallszeit der Anlage führt zu Umsatzminimierung des Kunden.	Kunden können 24/7 die technische Hotline kontaktieren, welche professionelle Hilfestellungen leistet (in 8 Sprachen) und um die schnellstmögliche Wiederherstellung der vollen Betriebsbereitschaft bemüht ist. Kosten sind für Kunden transparent.
hoch	**Hotline - Call out Service**	Der Technikereinsatz vor Ort (Call Out Service) ist ein von KNAPP angebotener kostenpflichtiger Dienst (ausserhalb der Gewährleistung), der dann beansprucht werden kann, wenn eine Incident-Behebung nicht mehr über Telefon, E-Mail oder Fernwartung möglich ist.	schnellstmögliche Hilfe vor Ort	Techniker-Einsatz vor Ort mit Prioritätsbezug Eine priorisierte Experten- bzw. Techniker-Entsendung wird über die KNAPP Hotline organisiert, wenn remote bzw. telefonisch in Zusammenarbeit mit dem Kunden keine Entstörung möglich ist. Dieser Service steht Hotline Vertrags-Kunden zur Verfügung in den im Vertrag definierten Zugangszeiten des jeweiligen Kunden.		Der Störrfall der Anlage ist so komplex, dass er nicht mehr über Telefon, E-Mail oder Fernwartung gelöst werden kann.	Technikereinsätze können nur zur KNAPP Bürozeiten beim zuständigen Kundenbetreuer beantragt werden. Keine Priorisierung der gewünschten Techniker-Einsätze, diese werden je nach Verfügbarkeit der Ressourcen organisiert.	Kann bei einem Hotline Vertrags-Kunden eine produktionskritische Störung remote oder telefonisch nicht innerhalb einer angemessenen Zeit behoben werden, kann der Kunde direkt bei KNAPP HOTLINE schriftlich (E-Mail) die Entsendung eines Technikers zum Installationsort anfordern.
hoch	**IT Services - Systemüberwachung & Kapazitätsmanagement**	Die Systemüberwachung beinhaltet eine automatische, proaktive, rund-um-die-Uhr Überwachung der IT-Infrastruktur anhand einer von KNAPP bereitgestellten und installierten vollautomatisierten Überwachungssoftware. Die Überwachungssoftware wertet Fehler aus und teilt diese je nach Komponente und Kritikalität (durch diese Größen wird die Priorität definiert) einem Techniker in der Hotline zu. Somit wird der Hotline-Incident-Prozess angestoßen. Im Incident-Prozess werden vorbeugende Maßnahmen getroffen um Auswirkungen auf die Verfügbarkeit weitestgehend zu vermeiden.	Ableitung von präventiven Maßnahmen zur Vorbeugung von Systemausfällen	Automatisches Alarm-System bei Grenzwertüberschreitung von definierten IT Werten (HW / OS / Applikation). Automatische Mail oder VPN Benachrichtigung der KNAPP Hotline inkl. Bearbeitung Basis für Langzeit-Analysen + monatlichen Kapazitäts-Report aller überwachten Werte.		Störfall / IT-Service - Monitoring: * Datenbanktabelle oder Filesystem einer KNAPP Anwendung läuft aufgrund einer Fehlfunktion voll, es droht ein Anlagenstillstand wann die Speicherkapazitäten erreicht sind. Die Überwachung des installierten IT-Service Monitoring erkennt eine Grenzwertüberschreitung und meldet das automatisch an die KNAPP Hotline. KNAPP Hotline kann entsprechend Aktionen setzen um einen Stillstand der Anlage vorzubeugen.	Es wird von KNAPP keine Überwachungssoftware installiert. Ein aufkommendes IT-Problem kann von KNAPP nicht proaktiv erkannt und bearbeitet werden.	Die Systemübermachung & Kapzitätsmanagement bietet dem Kunden eine Rund-um-die-Uhr Überwachung des IT-Systems sowie Analysen und Identifizierung von möglichen Systemfehlern und Kapazitätsgrenzen. Aufgrund der Beobachtugen und Analysen erhält der Kunde empfehlenswerte Maßnahmen.
hoch	**IT Services - Update Services**	Mittels Update Services wird die Support-Situation der gelieferten IT-Komponenten (siehe Liste der IT Komponenten) überwacht. Dabei werden notwendige Aktualisierungen und Patches der Firmware, der Betriebssysteme und, falls daraus zwingend erforderlich, auch resultierende Aktualisierungen und Patches der Datenbankanwendungen getestet und nach Absprache mit dem Kunden einmal jährlich installiert. Zudem werden bei Bedarf Hotfixes auch außerhalb des jährlichen Patchzyklus geliefert.	Sicherheitslücken durch Updates schließen	Gewartete und aktualisierte IT-Systeme Proaktives installieren von Hotfixes Kontinuierliche Qualitätsverbesserung Installierte Versionen werden nach Verfügbarkeit einmal pro Jahr auf den letzten Patch-Level gebracht (Sicherheit, Stabilität, Performance) Kritische Sicherheits-Updates werden bei Hersteller und KNAPP Freigabe jederzeit durchgeführt.		Aufgrund einer Systemschwäche im Betriebssystem oder Datenbankversion kommt es zu Performance Einbrüche oder zu Sicherheitslücken. Durch die regelmäßige Installation von Versions-Patches, die vom Betriebssystem- oder Datenbank-Hersteller zur Verfügung gestellt werden können Systeme gegen diese Schwächen abgesichert werden und dadurch diese Art von Störfälle vermieden werden.	Kunde erhält keine proaktive Überwachung seines Support-Status in Bezug auf Betriebssysteme und Hardware. Ebenfalls keine jährliche Aktualisierung (Patches) seiner aktuell installierten Betriebssystem-Versionen. Jeder Support durch KNAPP bei Hardware Reparaturen ist kostenpflichtig.	Kunde erhält diesen Services bei abgeschlossenen IT-Service Vertrag einmal pro Jahr (zu einem vereinbarten Zeitpunkt). Kritische Sicherheitsupdates oder Unterstützung bei notwendigen Firmware Updates während Hardware-Reparaturen können nach KNAPP und Kunden Freigabe jederzeit im Jahr installiert werden. KNAPP informiert automatisch den Kunden über kritische Sicherheitsupdates.
hoch	**IT Services - Überprüfung des Backup-Systems und der IT Infrastruktur**	Die vorhandene Backup-Lösung für die von KNAPP gelieferten IT-Komponenten werden überprüft und analysiert, um sicherzustellen, dass die Wiederherstellung des geregelten Betriebs bei Bedarf reibungslos ablaufen kann. Falls entscheidende IT-Komponenten ohne Backup-System genutzt werden, erarbeitet KNAPP Maßnahmen zur Risikominimierung. Ansonsten konzentriert sich KNAPP auf Maßnahmen zur schnellen Wiederherstellung	hohe Sicherheit in Falle eines Systemausfalls	jährliche Funktions-Überprüfung der gelieferten Backup-Systeme. jährliche Überprüfung der täglich und wöchentlichen generierten Applikations-Backup Dateien die im Notfall die Wiederherstellung des Systems möglich machen (Produktions-Daten, Full-Backup Daten). Schulung des Kundenpersonals in Bezug auf Sicherungs-, Wiederherstellungs- und Umschaltverfahren der KNAPP IT-Systeme.		Bei Serverausfall funktioniert das eingerichtete Backup-System (Backup-Server) nicht.	Keine Überprüfung der Backupsysteme sowie keine Überprüfung der täglichen bzw. wöchentlichen erstellten Backupdateien der IT-Systeme.	Kunde erhält diesen Services bei einem abgeschlossenen IT-Service Vertrag einmal pro Jahr (zu einem vereinbarten Zeitpunkt). Ein KNAPP IT Techniker führt diese Prüfungen und Tests direkt vor Ort durch in direkter Koordination mit dem Kunden.
mittel	**IT Services - KiSoft Client Management**	Mit KiSoft Client Management bietet KNAPP eine zentrale Oberfläche für die Verwaltung von Benutzerkonten, Gruppen und Clients. Updates, sowohl für Microsoft Produkte als auch für Antiviren Software, werden zeitnah und gebündelt an die Client Computer verteilt und vorab von KNAPP geprüft. Der KiSoft Client Management Server kann individuell an die Anforderungen des Kunden vor Ort angepasst werden.	Zeitersparnis durch optimales Client Management von KNAPP-Experten	Zentrale Verwaltung der Clients zugeschnitten auf die Anforderungen des Kunden Periodische Prüfung der Updates von Windows und Ausbringung dieser inklusive Überprüfung der erfolgrei-chen Installation der Updates auf die Clients Wartung und Update der Antiviren Software		Virusinfizierung auf den Workstations (Kundenclient-PCs auf der Anlage)	Kunde muss seine Client Rechner auf der Anlage nach der ersten Inbetriebnahme selbst verwalten und pflegen. Keine softwaretechnische Einrichtung durch KNAPP.	KNAPP liefert ein komplettes Hard- und Software-Paket mit aufeinander abgestimmten Komponenten. KNAPP Service übernimmt die fortlaufende Pflege und Instandhaltung des gelieferten Client Management Domänen-Servers über den sämtlich eingebundene Client Rechner auf der gelieferten KNAPP Anlage softwaretechnisch verwaltet werden. Kunde kann nach einer Einschulung ebenfalls Benutzerkonten und Gruppen des operativen Kunden-Personal zentral anlegen und verwalten.
sehr hoch	**IT Services - Monitoring Appliance**	Die Monitoring Appliance ist ein eigenständiges System (Server-Hardware oder virtuelle Maschine auf Kunden- oder KNAPP Infrastruktur) für das Modul Systemüberwachung & Kapazitätsmanagement inklusive Visualisierung aus IT-Sicht und/oder zur Ablage und Verwaltung von Backups aller KNAPP Serversysteme.	Erleichterung im Falle einer erforderlichen Systemwiederherstellung	Auch bei Ausfall des laufenden Monitoring Systems kann alarmiert werden Überwachung auch von nicht von KNAPP gelieferten IT-Infrastruktur möglich Zentrale Ablage und Verwaltung von Backups Erleichterung bei der Widerherstellung der Systeme im Bedarfsfall		Ausfall von kompletten Kundenserver werden ebenfalls durch die zentrale Überwachung erkannt.	Nur Standard und lokales Monitoring der gelieferten Server und Applikationen möglich. Keine zentrale Sammlung von Backupdateien durch KNAPP. Der Kunde muss alle Backupdateien auf den einzelnen von KNAPP gelieferten Systemen abholen.	Lieferung und Einrichtung eines Appliance Server in der direkten IT-Kundenumgebung (einmal Service). Bietet alle Vorteile für die Überwachung der IT Systeme (zentrales Monitoring der von KNAPP gelieferten Server und Applikationen). Auf Wunsch Sammlung und Weiterleitung von sämtlichen Backupdateien auf ein vom Kunden gewünschten Ablageort.
hoch	**Hotline - Incident Management**	Der installierte Incident-Prozess umfasst für alle gemeldeten Störfälle eine zugesagte Prioritätensteuerung, vorgegebene Ziellösungszeiten, einen automatischen Eskalationsprozess sowie ein detailliertes Reportwesen.	schnellstmögliche Wiederherstellung der Betriebsbereitschaft	Koordinierter remote und/oder telefonischer Support zur Störfallbehebung über 3 Support Levels. Prioritätensteuerung in 5 Stufen Reaktionszeiten und Ziellösungszeiten Interner zeitlich und automatisch gesteuerter Eskalationsprozess bei kritischen Störfällen Detaillierte Dokumentation und Endbericht zu allen gemeldeten Störungen Aufbau von Know-how durch detaillierte Incident-Berichte mit Ursachenbeschreibung		Die Hotline bekommt sehr viele Störfälle gemeldet. Diese werden jedoch nicht priorisiert. Das führt dazu, dass die beim Kunden vereinbarte Problemlösungszeiten nicht eingehalten werden können.	Kunde erhält in seiner „Gewährleistungsphase" nur „Helpdesk-Zugang" zur KNAPP Hotline. Ein „Helpdesk-Zugang" ist nur zu KNAPP AT Geschäftszeiten verfügbar und der dazu verfügbare Helpdesk Incident-Prozess beinhaltet keine zugesagte Prioritätensteuerung, keine Reaktions- und Ziellösungszeiten sowie keine automatische Eskalationssteuerung.	Der Kunde erhält eine zugesagte Prioritätensteuerung, konkrete Reaktions- und Ziellösungszeiten sowie eine automatische Esklationssteuerung. Kunde erhält diesen Services mit einem abgeschlossenen Hotline-Vertrag und den im Vertrag definierten Zugangszeiten (siehe auch Hotline).
hoch	**SLA auf Anlagenverfügbarkeit**	KNAPP übernimmt im Rahmen des Service Level Agreement für technische Anlagenverfügbarkeit (SLA) die Erfassung und Auswertung der Daten für den Nachweis der aktuell erzielten Key Performance Indicators (KPIs). Hierfür müssen seitens des Kunden von KNAPP vorgegebene Voraussetzungen erfüllt werden.	Garantierte Lösungszeiten	Wir gewähren 2 Arten von Service Leves (die mit Nr. 2 sind mit Bedingungen verknüpft) : 1) Service Levels zur Reaktionszeit der Hotline, Pönalen gibt es nur auf Prio 1 und Prio 2 versagen 2) Logigistischeverfügbarkeit nach FEM 9.22 (wenn der Kunde HL+IT+ETP+RE Services gekauft hat monatliche Review-Meetings, zur Erreichung der individuellen Optimierung Keine finanziellen Überraschungen – Kostenvereinbarung im Vorfeld	Garantie, die wir dadurch anbieten und womit er sich absichert Individuell optimierte Serviceleistungen für die bestmögliche Anlagenbetreuung Kombination von vielen Serviceprodukten bei gleichzeitiger Ausnützung von Synergieeffekten zwischen den Services Auswahl aus zahlreichen, modular aufgebauten Serviceplänen Flexible Anpassung der Verträge Professionelle Beratung über den gesamten Lebenszyklus der Anlage Flexible Mitgestaltung des Dienstleistungsangebots Ihr individueller Service Level ersichtlich auf e-insight	* z.B. zeitweise funktioniert 1 Erkennungslinie nicht.	Wenn es bei einem Kunde mit 24/7 Betriebszeiten zu einer Störung kommt, müssen die Ausfallzeiten müssen aufgrund seiner Lieferzeiten gegenüber seinen Kunden (z. B.: e-Commerce) möglichst kurz sein. Ausfallszeiten bzw. Stillstand der Anlage kann er sich nicht leisten.	Der SLA-Kunde bekommt über KPIs Auswertungen zu seiner Anlage. Der Störfall wird von KNAPP priorisiert behandelt und somit schnell und ohne große Ausfallzeiten der Anlage behoben. Am Monatsende wird jeweils ein Bericht verfasst, welcher telefonisch besprochen wird um präventive Maßnahmen zu treffen, um sich wiederholende Fehler zu vermeiden.
hoch	**SLA auf Service**	KNAPP übernimmt im Rahmen des Service Level Agreement für Services (SLA) die Erfassung und Auswertung der Daten für den Nachweis der aktuell erzielten Service Levels. Die Auswertung erfolgt mit Hilfe einer kundenspezifischen Scorecard. Hierfür müssen seitens des Kunden von KNAPP vorgegebene Voraussetzungen erfüllt werden. Das Service Level Agreement bezieht sich auf das Hotline Service. In diesem Zusammenhang werden definierte Service Levels (z.B. Reaktions- und Lösungszeiten) garantiert und bei nicht Einhaltung in Form von Service Credits pönalisiert. KNAPP sorgt für die korrekte Erfassung der Incident-Daten (Start und Ende der Störfallbehebung etc.).	Garantierte Lösungszeiten	Maximale Sicherheit und maximaler Erfolg bei minimalen Risiko - garantierte Priorisierung von SLA Kunden bei der Problemlösung über die Hotline Absicherung, dass der Endkunde rechtzeitig beliefert wird monatliche Review-Meetings, zur Erreichung der individuellen Optimierung Keine finanziellen Überraschungen – Kostenvereinbarung im Vorfeld	Sicherheitsaspekt. Sie wollen sich absichern. Die Pönalien sind dabei nicht erwähnenswert. Es ist wichtig, dass die versprochenen Zeiten auch eingehalten werden, damit es zu keinen Verzögerungen kommt	P1 Störfall - Lösungszeit ist sicher niedriger und sollte sie nicht eingehal-ten werden können – wird gezahlt und ein Problemanalyse-Prozess wird im Hintergrund gestartet. Um die Ursache für das nicht einhalten gefunden behoben oder verbessert wird. Was hat das Service dazu beigetragen: Trendanalysen und -report und Gespräch mit Techniker der über alles Be-scheid weiß und sich mit der Anlage auskennt. Damit Fehler behoben und verbessert werden sowie um Feedback für die Zukunft zu bekommen. Ganz wichtig! Am Jahresende gibt es einen Gesamtreport.	Wenn es bei einem Kunde mit 24/7 Betriebszeiten zu einer Störung kommt, müssen die Ausfallzeiten müssen aufgrund seiner Lieferzeiten gegenüber seinen Kunden (z. B.: e-Commerce) möglichst kurz sein. Ausfallszeiten bzw. Stillstand der Anlage kann er sich nicht leisten.	Bei Meldung des Störfalls an die Hotline wird der SLA-Kunde vorgereiht und priorisiert gegenüber Nicht-SLA-Kunden. Der Störfall wird somit schnell und ohne große Ausfallzeiten der Anlage behoben. Am Monatsende wird jeweils ein Bericht verfasst, welcher telefonisch besprochen wird, um präventive Maßnahmen zur Fehlerminimierung zu beschließen.
hoch	**IT Services**	Die IT-Services bieten abgestimmte Lösungen für die KNAPP-Software-Produkte und deren IT-Infrastruktur die langfristig zu einer optimalen Verfügbarkeit des Systems beitragen sowie dem Kunden den täglichen Umgang mit dem System soweit als möglich erleichtern.	stabiles IT System	langfristig, optimale Verfügbarkeit des Systems täglichen Umgang mit dem System erleichtern angestrebte Zielreaktions-, Ziellösungs- bzw. Ziellieferzeiten erreichen a. Systemüberwachung & Kapazitätsmanagement b. Update Services c. Überprüfung des Backup-Systems und der IT Infrastruktur d. KiSoft Client Management e. Monitoring Appliance f. IT-Service Engineering	Verfügbarkeit Sicherstellung Reduktion der Ausfälle	Störfälle an der IT-Umgebung des Kundens liegen vor.	Ohne IT Services kommt es viel häufiger zu Systemfehlern. Die Behebung von Störfällen dauert beträchtlich länger.	Durch die IT Services wird eine hohe Anlagenverfügbarkeit sichergestellt. Durch die Systemüberwachung werden proaktiv Störfälle verhindert und je nach Serviceleistung das gesamte IT-System und die Software überprüft und gewahrtet. Dadurch kann eine lange Lebensdauer und nachhaltig Problembehebung garantiert werden

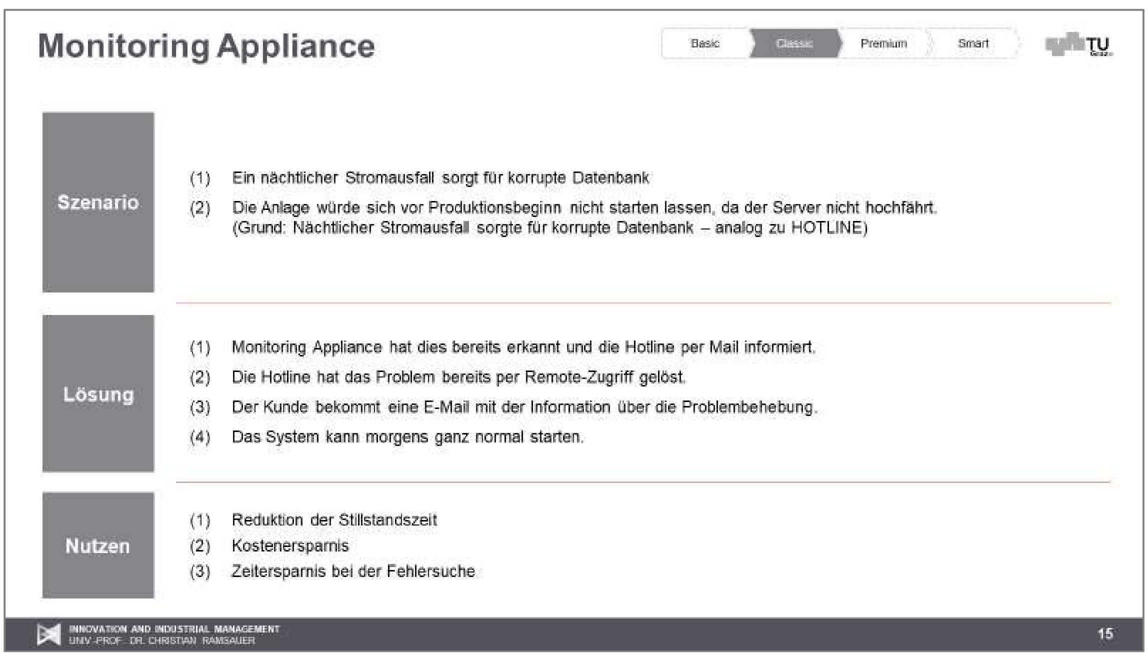
Appendix D

Package BASIC





Package CLASSIC



Monitoring & Capacity Management

Basic | Classic | Premium | Smart

Szenario

(1) Kunde hat Saisongeschäft oder plant Expansion und seine Server drohen voll zu laufen.
(2) Der Kunde bemerkt dies nicht.
(3) Volle Server sorgen für ein langsameres System.
(Umsetzung: künstlich hohe Latenzzeiten in Software implementiert)

Lösung

(1) Monitoring erkennt den Zustand und informiert die KNAPP Hotline.
(2) Die Hotline beginnt am Problem zu arbeiten. (nicht mehr benötigte Daten werden bereinigt)
(gegebenenfalls Beratung hinsichtlich Speichererweiterung)
(3) Da KNAPP bereits im Hintergrund am Problem arbeitet, wird der Fehler innerhalb weniger Minuten behoben.
(4) System läuft wieder normal.

Nutzen

(1) Performancesteigerung
(2) Kostenersparnis
(3) Zeitersparnis bei der Fehlersuche

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Backup-System Check & IT-Infrastruktur

Basic | Classic | Premium | Smart

Szenario

(1) Während des Betriebs tritt nach mehreren Jahren ein Hardwaredefekt auf dem Mainboard des Hauptservers (Server 1) auf.
(2) Der Hauptserver ist nicht mehr produktionstüchtig -> eine Umschaltung auf den Backup-Server ist erforderlich.
(3) Die Umschaltung auf den Backup Server funktioniert aufgrund eines defekten Hardware-Switch nicht.
(4) Die Anlage steht - ein mehrstündiger Ausfall droht.

Lösung

(1) Es erfolgt eine regelmäßige (jährliche) Überprüfung des Backup Systems inklusive Umschaltung.
(2) Ein defekter Switch wäre erkannt und getauscht worden.
(3) Umschaltung problemlos möglich -> Produktion läuft normal weiter.

Nutzen

(1) Schutz vor Anlagenausfall
(2) Risikominimierung

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Update Service

Basic | **Classic** | Premium | Smart

Szenario

(1) Während des Betriebs wird eine neue Sicherheitslücke an der Firmware an verschiedenste Server von den globalen Sicherheitsexperten aufgedeckt.

(2) Es kann nicht mehr garantiert werden ob alle Daten sicher sind und ob sich Malware auf dem System installieren könnte.

(3) System wird durch Virus infiziert, da Lücke nicht geschlossen wurde. -> (Fenster wird geöffnet -> Virusmeldung auf allen Bildschirmen -> danach Rewind und Darstellung der Situation MIT Update Service -> Fenster wird geöffnet -> keine Auswirkung)

Lösung

(1) Kunde besitzt das Update Service und bekommt Sicherheitswarnung von Knapp per E-Mail.

(2) Verschiedene Lösungsvarianten bzw. Sicherheits-Patches werden erarbeitet.

(3) Die Lücke wird schon vor der Infektion geschlossen.

(4) Das Virus landet dadurch gar nicht im System.

(5) Zusätzlich wird durch den Update Service die Performance des Systems gesteigert.

Nutzen

(1) Schutz vor Anlagenstillstand

(2) Risikominimierung

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Package PREMIUM

Resident Engineering

Basic | Classic | **Premium** | Smart

Szenario

(1) Die Teilnehmer arbeiten in der Lernfabrik und bekommen einen Resident zur Verfügung gestellt.

(2) Der Resident verwaltet ein Ersatzteillager. (gleicher Inhalt, jedoch durch Resident geordnet)

(3) Zusätzlich führt der Resident Instandhaltungsarbeiten durch und erstellt Wartungspläne. (mögliche Kombination mit Smart Services / Auslastungs-Heatmap)

(4) Derselbe Wartungsfall tritt an 2 gleichen Teilen der Anlage gleichzeitig auf.

(5) Resident übernimmt eine Wartung, die andere übernehmen die Teilnehmern.

Erkenntnisse

(1) Der Resident erledigt die Wartung wesentlich schneller und kann danach die Teilnehmer mit seinem Know-How unterstützen.

(2) Wesentlich schnellere Wartung nicht zuletzt durch Ersatzteilverwaltung und ordentliches Ersatzteilmanagement seitens des Residents.

Nutzen

(1) Bindeglied zwischen KNAPP und Kunden

(2) Geschultes Personal

(3) Sicherheit bei Personalausfall

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Technischer Leitstand

Basic | Classic | **Premium** | Smart

Szenario

(1) Der Leitstand ist im Ausgangszustand ein einfacher Schreibtisch mit Bildschirmen
(2) Auf den Bildschirmen sind Live-Kamerabilder des Lagers zu sehen.
(3) Es wird keine weitere Information übermittelt.
(4) Im Zuge des Premium Servicepakets bekommt der Kunde einen vollausgestatteten technischen Leitstand zur Verfügung gestellt.

Erkenntnisse

(1) Der technische Leitstand verwendet zur Visualisierung KiSoft SCADA. Das System liefert Echtzeitinformationen.
(2) Es kann die Betriebsbereitschaft der technischen Systeme wie z.B. Fördertechnik oder Server zu jedem Zeitpunkt geprüft werden.

Nutzen

(1) Visualisierung des Anlagenstatus
(2) Kontrollorgan des Lagers

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Package SMART

Logistischer Leitstand

Basic | Classic | Premium | **Smart**

Szenario

(1) Der technische Leitstand liefert lediglich Informationen über die technischen Systeme.
(2) Prozessmonitoring ist nicht möglich.
(3) Im Zuge des Smart Servicepakets bekommen die Teilnehmer einen logistischen Leitstand zur Verfügung gestellt.

Erkenntnisse

(1) Der logistische Leitstand ergänzt den technischen Leitstand um das Dashboard der Smart Services
(2) Er liefert KPIs mit einer Detailstufe von 5min
(3) Kundenspezifische Kennzahlen können ebenfalls erfasst und analysiert werden
(4) Auslastungsberechnungen ermöglichen effizientere Wartungspläne

Nutzen

(1) Intelligente Übersicht
(2) Maßgeschneiderte Inhalte
(3) Effizienzsteigerung
(4) Empowerment

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Mobiler Assistent

Basic | Classic | Premium | Smart

Szenario

(1) Die Informationen des Smart Service Dashboards sind zunächst lediglich am Leitstand verfügbar.

(2) Im Zuge des Smart Servicepakets erhält der Kunde Zugriff auf das Service „Mobiler Assistent".

Erkenntnisse

(1) Der mobile Assistent ermöglich jederzeit und überall Zugriff auf relevante Informationen.

Nutzen

(1) Ort- und Zeitpunktunabhängige Live-Daten

(2) Zusammengefasste Inhalte

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Logistisches Consulting

Basic | Classic | Premium | Smart

Szenario

(1) Es wird eine Case Study vorgegeben, die von den Teilnehmern zu lösen ist. (z.B. Durchlaufzeit verringern / Durchsatz erhöhen)

(2) Eine Gruppe Teilnehmer soll das Problem manuell lösen - dafür stehen ihnen die zuvor selbst erfassten KPI Daten zur Verfügung.

(3) Eine weitere Gruppe erhält für die Lösung Zugriff zu einem logistischen Leitstand oder mobilen Assistenten und zusätzlich einen geschulten KNAPP Mitarbeiter der sie unterstützend berät.

(4) Die Daten müssen analysiert und Maßnahmen abgeleitet werden.

Erkenntnisse

(1) Die Gruppe mit Zugriff zu Smart Services und KNAPP Mitarbeiter kann mit einem vielfachen an Daten und KPIs arbeiten.

(2) Aufgrund der höheren Informationsbereitstellung kann die Aufgabe deutlich leichter und schneller gelöst werden.

(3) Den Teilnehmern wird gezeigt, wie Training als Enabler zur optimalen Lagernutzung dienen kann.

Nutzen

(1) Performancesteigerung

(2) Optimierung der Anlage

(3) Ressourcenschonung

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Appendix E

INTRO

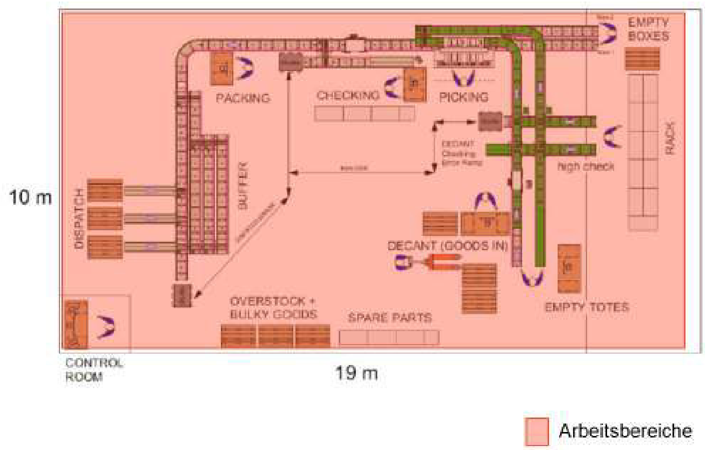
Intro Basic Classic Premium Smart Outro

Intro
Übersicht

Lehrunterlagen
- Unterlagen Einführungspräsentation
- Moderationshinweise/-anweisungen

Lernunterlagen
- Standard Operating Procedures

Übungsmaterial
- Präsentationsvideo
- Handout e-insight



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Intro Basic Classic Premium Smart Outro

Intro
Ablaufbeschreibung

Agenda	Inhalt	Modus	Dauer (in Min.)
1. Vorstellung der Lernfabrik	► Die "KNAPP Service Factory" wird den Teilnehmern vorgestellt. ► Idee und Intention ► Überblick über die Trainingsinhalten ► In einem Kurzvideo/Präsentation wird das e-insight vorgestellt. ► Kurze Einführung in ein KNAPP Lager und den logistischen Prozessen als Präsentation. (z.B. mittels Video um eine bessere Verlinkung zur realen Situation zu ermöglichen) ► Rollenverteilung	(De-)Briefing	10
2. Kennenlernen der Arbeitsstationen	► Kennenlernen der Anlage bzw. Stationen: ► Die Teilnehmer begeben sich an die Arbeitsstationen und fahren das Lager zum ersten Mal hoch. ► Ein Standard Arbeitsszenario wird von den Teilnehmern durchgespielt.	Übung	20

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Package BASIC

Hotline

Intro | Basic | Classic | Premium | Smart | Outro

Übersicht

Lehrunterlagen

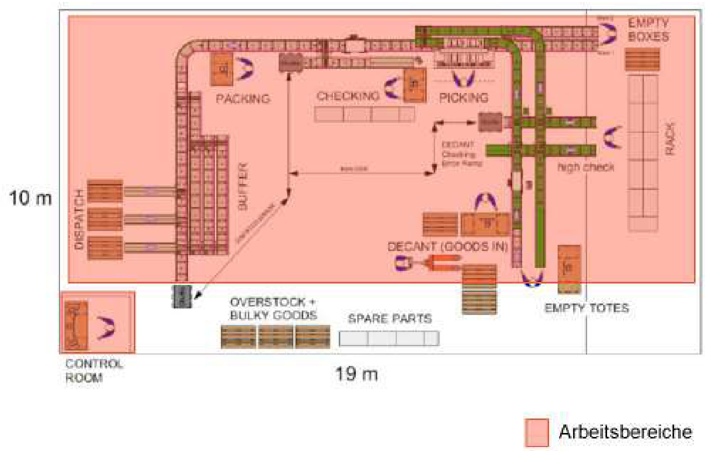
- Ablaufbeschreibung
- Moderationshinweise/-anweisungen

Lernunterlagen

- Kurze Beschreibung Ausgangszustand
- Standard Operating Procedures

Übungsmaterial

- Poster für Debriefing
- Notizzettel für Teilnehmer
- Kommunikationsgerät (Telefon)
- Mappe mit Notfallnummern



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Hotline

Intro | Basic | Classic | Premium | Smart | Outro

Ablaufbeschreibung

Agenda	Inhalt	Modus	Dauer (in Min.)
1. Einführung	► Vorstellung Übungsinhalt: ► Hochfahren der Anlage morgens soll simuliert werden ► Alle Teilnehmer begeben sich auf ihre Stationen ► Vorbereitungsarbeiten werden gestartet ► Störfall tritt ein und muss gelöst werden	(De-)Briefing	5
2. Arbeiten ohne Service	► Teilnehmer beginnen Anlage hochzufahren ► Störfall tritt ein ► Server fährt nicht hoch, Anlage steht ► Gruppenleiter schaut im Handbuch nach ► Handbuch empfiehlt Helpdesk einzuschalten ► Helpdesk wird angerufen ► Automatischer Anrufbeantworter, da außerhalb der Geschäftszeiten ► Problem kann nicht gelöst werden (bis Helpdesk erreichbar ist) ► Übung wird nach 2-3 Minuten beendet	Übung	10

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Intro | Basic | Classic | Premium | Smart | Outro

Hotline

Ablaufbeschreibung

Agenda	Inhalt	Modus	Dauer (in Min.)

3. Nachbesprechung	▸ Nachbesprechung des Erlebten
	  ▸ Welche Probleme traten auf?
	  ▸ Was hätte geholfen?
	  ▸ Wie könnte man das Problem besser lösen?
	▸ Nachbesprechung wird durch KNAPP moderiert
	▸ Punkte werden auf vorbereitetem Poster festgehalten
		(De-)Briefing	10

4. Arbeiten mit Service	▸ Teilnehmer beginnen Anlage hochzufahren
	▸ Störfall tritt ein
	  ▸ Server fährt nicht hoch, Anlage steht
	  ▸ Gruppenleiter schaut im Handbuch nach
	  ▸ Handbuch empfiehlt Hotline einzuschalten
	  ▸ Hotline wird angerufen
	  ▸ Hotline gibt Hilfestellung bzw. löst das Problem remote
	▸ Anlage kann ganz normal gestartet werden
	▸ Arbeit könnte beginnen -> Ende der Übung
		Übung	10

5. Wrap-up	▸ Erlebnis wird aufbereitet/nachbesprochen ▸ Teilnehmer reflektieren den Impact des Services	(De-)Briefing	5

Intro | Basic | Classic | Premium | Smart | Outro

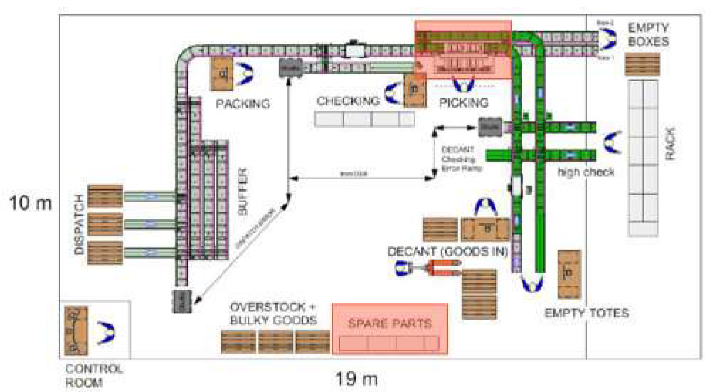
Wartung & Inspektion

Übersicht

Lehrunterlagen
- Ablaufbeschreibung
- Moderationshinweise/-anweisungen

Lernunterlagen
- Kurze Beschreibung Ausgangszustand
- Inspektionsablaufplan (falls es sowas gibt)

Übungsmaterial
- Poster für Debriefing
- Notizzettel für Teilnehmer



Arbeitsbereiche

Wartung & Inspektion

Ablaufbeschreibung

Intro | Basic | Classic | Premium | Smart | Outro

TU Graz

Agenda	Inhalt	Modus	Dauer (in Min.)
1. Einführung	► Vorstellung Übungsinhalt: ► Anlage läuft bereits längere Zeit und muss gewartet werden ► KNAPP Wartungstechniker kommen und führen die Wartung vor Ort durch	(De-)Briefing	5
2. Arbeiten ohne Service	► Teilnehmer sind Beobachter ► KNAPP Servicetechniker warten die Anlage ► Ein spezielles Verschleißteil ist zu tauschen, KNAPP Techniker haben dieses nicht mit ► Auch im Ersatzteillager ist dieses nicht zu finden ► Wartung kann nicht vollständig durchgeführt werden ► Gruppenleiter muss sich um die Bestellung des Teils kümmern ► Nach dem die Lieferzeiten angezeigt werden, wird die Übung beendet	Übung	10

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Wartung & Inspektion

Ablaufbeschreibung

Intro | Basic | Classic | Premium | Smart | Outro

TU Graz

	Inhalt	Modus	Dauer (in Min.)
3. Nachbesprechung	► Nachbesprechung des Erlebten ► Welche Probleme traten auf? ► Was hätte geholfen? ► Wie könnte man das Problem besser lösen? ► Nachbesprechung wird durch KNAPP moderiert ► Punkte werden auf vorbereitetem Poster festgehalten	(De-)Briefing	5
4. Arbeiten mit Service	► Teilnehmer werden vom KNAPP Techniker im Zuge einer Inspektion durch die Anlage geführt ► Techniker zeigt Teilnehmern wie eine Inspektion durchgeführt wird ► Der Techniker zeigt was ein erfahrener Techniker durch Hören/Sehen entdeckt und zeigt so, dass bei entsprechend geschultem Personal vor Ort die Inspektion entfallen kann ► Es wird ein Wartungstermin vereinbart bei dem Teile und Spezialisten bereits mitgeschickt werden	Übung	10
5. Wrap-up	► Erlebnis wird aufbereitet/nachbesprochen ► Teilnehmer reflektieren den Impact des Services	(De-)Briefing	10

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Ersatzteilpaket & Managementsystem

Übersicht

Intro | Basic | Classic | Premium | Smart | Outro

Lehrunterlagen

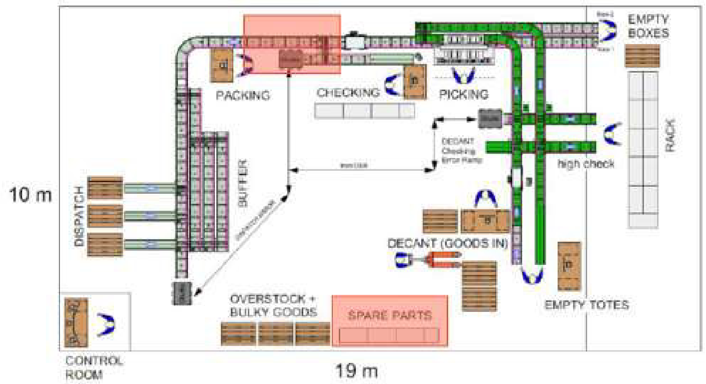
- Ablaufbeschreibung
- Moderationshinweise/-anweisungen

Lernunterlagen

- Kurze Beschreibung Ausgangszustand
- Standard Operating Procedures

Übungsmaterial

- Poster für Debriefing
- Notizzettel für Teilnehmer
- Tablets mit e-insights



Arbeitsbereiche

Ersatzteilpaket & Managementsystem

Ablaufbeschreibung

Intro | Basic | Classic | Premium | Smart | Outro

Agenda	Inhalt	Modus	Dauer (in Min.)
1. Einführung	▸ Vorstellung Übungsinhalt: ▸ Teilnehmer kommissionieren ▸ Störfall tritt ein und muss gelöst werden ▸ Verschleißteil ist zu tauschen ▸ Teilnehmer (Techniker) soll Ersatzteil finden und tauschen	(De-)Briefing	5
2. Arbeiten ohne Service	▸ Teilnehmer arbeiten im Lager ▸ Störfall tritt ein und die Zeit wird gestoppt ▸ Verschleißteil (z.B. Rolle am Conveyer) ist defekt, Teile der Anlage stehen ▸ Techniker muss herausfinden welches Ersatzteil gesucht wird. (e-insight wird genutzt) ▸ Der Techniker wird das Ersatzteil nicht finden (weil es nicht im gebuchten Paket vorhanden ist) ▸ Problem kann nicht gelöst werden ▸ Übung wird nach 2-3 Minuten beendet	Übung	10

Ersatzteilpaket & Managementsystem

Ablaufbeschreibung

Intro | Basic | Classic | Premium | Smart | Outro

Agenda	Inhalt	Modus	Dauer (in Min.)
3. Nachbesprechung	▸ Nachbesprechung des Erlebten ▸ Welche Probleme traten auf? ▸ Was hätte geholfen? ▸ Wie könnte man das Problem besser lösen? ▸ Nachbesprechung wird durch KNAPP moderiert ▸ Punkte werden auf vorbereitetem Poster festgehalten	(De-)Briefing	10
4. Arbeiten mit Service	▸ Störfall tritt ein und die Zeit wird gestoppt ▸ Beginn der Übung mit Eintritt Störfall ▸ Techniker sucht das Ersatzteil im nun bereitgestellten, seitens KNAPP geordneten Ersatzteillager ▸ Das Ersatzteil ist Inhalt von Paket B, das nun zur Verfügung steht ▸ Ersatzteil wird schnell gefunden und getauscht ▸ Anlage ist wieder betriebsbereit	Übung	8
5. Wrap-up	▸ Erlebnis wird aufbereitet/nachbesprochen ▸ Teilnehmer reflektieren den Impact des Services	(De-)Briefing	10

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Package SMART

Smart Services

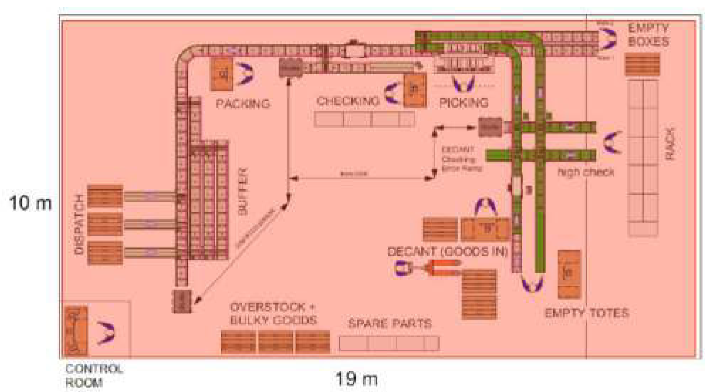
Übersicht

Intro | Basic | Classic | Premium | Smart | Outro

Lehrunterlagen
- Ablaufbeschreibung
- Case Study
- Moderationshinweise/-anweisungen

Lernunterlagen
- Standard Operating Procedures
- Case Study & Vorbereitungsfragen
- Handout zu KPIs

Übungsmaterial
- Poster für Debriefing
- Notizzettel für Teilnehmer
- Pinboard
- Stoppuhr
- Tablet



für die Übung relevante(r) Bereich(e)

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Smart Services

Ablaufbeschreibung

Intro | Basic | Classic | Premium | Smart | Outro

Agenda	Inhalt	Modus	Dauer (in Min.)
1. Einführung	► Vorstellung Übungsinhalt: ► Operators (KNAPP Mitarbeiter) betreiben die Anlage ► KPIs sollen erfasst werden um ein Fallbeispiel (z.B. Durchlaufzeit verringern / Durchsatz erhöhen) lösen zu können	(De-)Briefing	10
2. Einlesen in Fallbeispiel	► Teilnehmer werden in 3 Gruppen eingeteilt und lösen Fallbeispiel unabhängig voneinander ► Gruppe „Pinboard und Stoppuhr" ► Gruppe „Logistischer Leitstand + Mobiler Assistent" ► Gruppe „Logistischer Leitstand + Mobiler Assistent + Logistisches Consulting" ► Fallbeispiel wird von den Teilnehmern durchgelesen, anschließend kurz diskutiert	Übung	50

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Smart Services

Ablaufbeschreibung

Intro | Basic | Classic | Premium | Smart | Outro

Agenda	Inhalt	Modus	Dauer (in Min.)
3. Arbeiten mit Service	► Teilnehmer beginnen KPIs zu erfassen: ► Gruppe „Pinboard und Stoppuhr" ► Teilnehmer erfassen KPIs händisch mit Stoppuhr durch Beobachten vor Ort ► Gruppe „Logistischer Leitstand + Mobiler Assistent" ► Teilnehmer bekommen KPIs durch den Logistischen Leitstand zur Verfügung gestellt ► Der mobile Assistent ermöglicht zusätzlich die simultane Begehung der Anlage um Interviews zu führen oder den Prozess zu besichtigen ► Gruppe „Logistischer Leitstand + Mobiler Assistent + Logistisches Consulting" ► Teilnehmer erhalten zusätzlich Unterstützung durch einen KNAPP Logistik-Experten der sie bei der Lösung des Fallbeispiels berät ► Teilnehmer erarbeiten Lösungen zum Fallbeispiel ► Übung endet nach 20 Minuten	Übung	20

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Intro | Basic | Classic | Premium | Smart | Outro

Smart Services

Ablaufbeschreibung

Agenda	Inhalt	Modus	Dauer (in Min.)

4. Nachbesprechung/ Wrap-up	► Vergleichen der Ergebnisse der Fallstudie
	► Evaluierung der Ergebnisse
	
	► Nachbesprechung des Erlebten
	  ► Wie schwer fiel es die KPIs zu sammeln?
	  ► Wie wurde die Fallstudie empfunden?
	  ► Was hätte geholfen?
	  ► Wie könnte man die Fallstudie leichter lösen?
	
	► Nachbesprechung wird durch KNAPP moderiert
	► Punkte werden auf vorbereitetem Poster festgehalten
	
	ZIEL: Teilnehmer erkennen den Mehrwert der Services „Logistischer Leitstand", "Mobiler Assistent" und „Logisitisches Consulting". Die dadurch hohe Verfügbarkeit von KPIs erleichtert anfallende Planungs-, Optimierungs- und Ädaptierungsarbeiten.
		(De-)Briefing	20

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Appendix F

Dimension	Attribute															
1. Operating model	1.1 Operator	Academic institution	**Non-Academic institution**	Profit oriented operator												
		University	College	BA	Vocational school/high school	Chamber	Union	Employer' association	Industrial network	Consulting	**Producing company**					
	1.2 Trainer	Professor	Researcher	Student assistant	**Technical expert/int. specialist**	Consultant	Educationalist									
	1.3 Trainer	**Own development**	External assisted development	External development												
	1.4 Initial funding	**Internal funds**	Public funds	Company funds												
	1.5 Ongoing funding	**Internal funds**	Public funds	Company funds												
	1.6 Funding continuity	Short term funding (e.g., single events)	Mid-term funding (projects and programs <3 years)	**Long-term funding (projects and programs >3 years)**												
	1.7 Business model for trainings	**Open models**	Closed models (training program only for single company)													
		Club model	Course fees	BA												
2. Purpose and targets	2.1 Main purpose	Education	**Vocational training**	**Research**												
	2.2 Secondary purpose	Test environment/pilot environment	Industrial production	Innovation transfer	Advertisement for production											
	2.3 Target groups for education and training	Pupils	Students	**Employees**	Profit oriented operator											
			Bachelor	Master	PhD students	**Apprentices**	**Skilled workers**	**Semi-skill. W.**	**Un-skilled workers**	**Lower mgmt**	**Middle mgmt**	**Top mgmt**	Entre-preneurs	Free-lancer	Unem-ployed	Open public
	2.4 Group constellation	**Homogenous**	**Heterogeneous (knowledge level, hierarchy, students + employees, etc.)**													
	2.5 Targeted industries	Mechanical & plant eng.	Automotive	**Logistics**	Transportation	FMCG	Aerospace									
		Chemical industry	Electronics	Construction	Insurance/banking	Textile industry	…									
	2.6 Subject-rel. learning contents	Prod. Mgmt & organization	Resource efficiency	Lean mgmt	**Automation**	CPPS	Work system design	HMI	Design	**Intralogistics design & mgmt**	Enabling Services					
	2.7 Role of LF for research	**Research object**	**Research enabler**													
	2.8 Research topics	Production management & organization	Resource efficiency	Lean mgmt	**Automation**	CPPS	**Changeability**	HMI	Didactics	**Use of Service**						
3. Process	3.1 Product lifecycle	Product planning	Product development	Product design	Rapid prototyping	Manufacturing	Assembly	**Logistics**	**Service**	Recycling						
	3.2 Factory lifecycle	Investment planning	Factory concept	Process planning	Ramp-up				Maintenance	Recycling						
	3.3 Order lifecycle	Configuration & order	Order sequencing	Production planning and scheduling					Picking, packaging	Shipping						
	3.4 Technology lifecycle	Planning	Development	Virtual testing					Maintenance	Modernization						
	3.5 Indirect functions	SCM	Sales	Purchasing	**HR**	**Finance/controlling**	**QM**									
	3.6 Material flow	**Continuous production**	Discrete production													
	3.7 Process type*	Mass production	Serial production	Small series production	One-off production											
	3.8 Manufacturing organization*	Fixed-site manufacturing	Work-bench manufacturing	Workshop manufacturing	Flow production											
	3.9 Degree of automation	**Manual**	**Partly automated/hybrid automation**	**Fully automated**												
	3.10 Manufacturing methods*	Cutting	Trad. primary shaping	Additive manufacturing	Forming	Joining	Coating	Change material properties								
	3.11 Manufacturing technology*	Physical	Chemical	Biological												
4. Setting	4.1 Learning environment	Purely physical (planning + execution)	**Physical LF supported by digital factory (see line "IT-integration")**	**Physical value stream of LF extended virtually**	Purely virtual (planning + execution)											
	4.2 Environment scale	**Scaled down**	Life-size													
	4.3 Work system levels	Work place	Work system	**Factory**	Network											
	4.4 Enablers for changeability	**Mobility**	**Modularity**	**Compatibility**	**Scalability**	**Universality**										
	4.5 Changeability dimensions	Layout and logistics	Product features	Product design	**Technology**	**Product quantities**										
	4.6 IT-integration	**IT before SOP (CAD, CAM, simulation)**	**IT after SOP (PPS, ERP, MES)**	IT after production (CRM, PLM …)												
5. Product	5.1 Materiality	**Material (physical product)**	Immaterial (service)													
	5.2 Form of product	**General cargo**	Bulk cargo													
	5.3 Product origin	**Own development**	Development by participants	External development												
	5.4 Marketability of product	Available on the market	Available on the market but didactically simplified	Functional, could be available on the market	**Without function/application, for demonstration only**											
	5.5 No. of different products	1 product	2 products	3-4 products	**>4 products**	Flexible, developed by participants	Acceptance of real orders									
	5.6 No. of variants	**1 variant**	2-4 variants	4-20 variants	…	Flexible, depending on participants	Determined by real orders									
	5.7 No. of components	**1 comp.**	2-5 comp.	6-20 comp.	21-50 comp.	51-100 comp.	>100 comp.									
	5.8 Further product use	**Re-use/re-cycling**	Exhibition/display	**Give-away**	Sale	Disposal										
6. Didactics	6.1 Competence classes	Technical and methodological competencies	Social and communication competencies	Personal competencies	**Activity and implementation oriented competencies**											
	6.2 Dimensions learning targets	**Cognitive**	**Affective**	**Psycho-motorical**												
	6.3 Learn. scenario strategy	**Instruction**	**Demonstration**	**Closed scenario**	**Open scenario**											
	6.4 Type of learn. environment	Greenfield (development of factory environment)	**Brownfield (improvement of existing factory environment)**													
	6.5 Communication channel	**Onsite learning (in the factory environment)**	Remote connection (to the factory environment)													
	6.6 Degree of autonomy	**Instructed**	**Self-guided/self-regulated**	Self-determined/self-organized												
	6.7 Role of the trainer	Presenter	**Moderator**	**Coach**	Instructor											
	6.8 Type of training	Tutorial	Practical lab course	**Seminar**	**Workshop**	Project work										
	6.9 Standardization of trainings	Standardized trainings	**Customized trainings**													
	6.10 Theoretical foundation	Prerequisite	In advance (en bloc)	**Alternating with practical parts**	**Based on demand**	Afterwards										
	6.11 Evaluation levels	Feedback of participants	Learning of participants	**Transfer to the real factory**	**Economic impact of trainings**	Return on trainings/ROI										
	6.12 Learning success evaluation	Knowledge test (written)	Knowledge test (oral)	Written report	Oral presentation	Practical exam	**None**									
7. Metrics	7.1 No. of participants per training	1-5 participants	**5-10 participants**	**10-15 participants**	15-30 participants	>30 participants										
	7.2 No. of standardized trainings	1 training	**2-4 trainings**	5-10 trainings	>10 trainings											
	7.3 Aver. duration of a single training	**<1 day**	1-2 days	3-5 days	5-10 days	10-20 days	>20 days									
	7.4 Participants per year	<50 participants	50-200 participants	**201-500 participants**	501-1000 participants	>1000 participants										
	7.5 Capacity utilization	<10%	10-20%	21-50%	**51-75%**	76-100%										
	7.6 Size of LF	<100 sqm	**100-300 sqm**	300-500 sqm	500-1000 sqm	>1000 sqm										
	FTE in LF	**<1**	2-4	5-9	10-15	>15										

*not of use for/ depict in the KNAPP "Service Factory"