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Concept of developing a new Storage Management System

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Storing food items has a long history and is becoming more and more important to humanity. In times of rising prices for food items, it is essential to be aware of how to store food items according to the perfect conditions. Storing foods is not just placing them at a certain place and grabbing them whenever you need. Nearly all items contain special requirements to their storing position, storing temperature as well as to the humidity of the surroundings.

Storing food items in case of the hospitality industry means more than just placing them into refrigerators or freezers. All storage areas can be seen as bank accounts and all items can be seen as money bills due to the value they represent.
A reasonable interaction with stored items is the foundation of high quality courses in the hospitality industry.

Therefore, it is essential to minimize or delete factors like wrong temperature for stored items, wrong place in storage, or spoilage which can have a negative impact on the quality of stored food items.

The scope of this dissertation is an analysis of the current situation of storing items in the hospitality industry. Based on the accounted weaknesses a newly created storage management system will be presented and qualitative research will be conducted.

The results of the research suggest that there is a need for improvement in the current situation and the presented system is reasonable for the future hospitality industry. However, the new system entails its own weaknesses and fine adjustments would be need before implementing it into the hospitality industry.

The thesis was written in May and the beginning of June. Besides starting the literature review the author contacted the interviewees and those were conducted in the last week of May. Finally the Thesis was handed in at the 5th of June 2017.

Keywords
food storage, storage management system, recordkeeping, fully automated, weaknesses

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1 Introduction

The objective fact of storing food items is an essential part of the food handling industries. Over the years, several changes in methods of preserving food were developed and have reached great importance.
By storing food or beverage items it is essential to keep in mind, that those products reflect money which was invested to receive them. By running a storage as efficiently as possible, the hospitality industry needs to take aspects into consideration which are explained in chapter 2.

According to the weaknesses which can occur in the current storage situation, this thesis tries to eliminate those by creating a new fully automated system explained in chapter 3. In times of modern technology, adaptation to industries and the need for a responsible use of resources lead to the fact that nearly every industry is taking advantages by the use of automated systems.

However, the hospitality industry has yet to embrace the advantage of fully automated storage systems and there combined technology.

1.1 Topic Background

During this thesis, the author takes a closer look at the current situation of food storing in the hospitality industry. To create a complex background of the present procedure in hotels, certain secondary sources were analyzed. Within this process of secondary research, weaknesses were identified and are highlighted in chapter 2.
Based on these weaknesses the author came up with the idea of developing and implementing a new storage system which will be beneficial for the hospitality industry. The idea of creating a new storage system arose during the second year of studies, were the author was entitled to create an inclusion hotel.

1.2 Goal

The goal of this dissertation is to create and present a new storage system which could be implemented in the future hospitality industry. The fundamental idea of the new system is a fully automated operating storage system which should eliminate all existing weaknesses in the current situation in the hospitality industry. In chapter 3, it will be explained how

this system could look as well as how it would function. Other industries, which are already operating fully automated systems, were used as role models.
After analyzing existing automated storage management systems the author created a system which could fit to the hospitality industry. During the creation of the new system the question 'is this a reasonable system for the hospitality industry' came up.
To answer this question, a qualitative based research was implemented. To receive a comprehensive formation of opinions, semi-structured interviews were conducted. The decision to run the interviews semi-structuredly was made after analyzing qualitative and quantitative research methods in chapter 4.

To reach a wide range of experts, not only hospitality experts like chefs or a food and beverage manager, but also engineering industry experts were questioned. It is essential to conduct interviews with experts from the engineering industry to prove, if this system can operate like it is presented in chapter 3 or if there is a need for changes.

After conducting the interviews the results presented in chapter 5 are not only used to answer the research question, but rather should also assist the author in making fine adjustments to hopefully implement this storage management system to the hospitality industry in the near future.

1.3 Limitation

Because of the complexity of the food storage situation in general, the combined regulations for food handling industries provided from health authorities as well as the intricacy of the new system which will be presented in chapter 3, several aspects were not taken into consideration during this thesis.
Aspects like profitability, engineering details, physical dimensions, construction costs, as well as amortization of the new system cannot be discussed in detail. The presented system was investigated according to certain aspects which are explained in chapter 2.4. On the basis of the aspects in chapter 2.4 the research questions were formed and interviews were conducted.
Furthermore, the missing access to professional computer-aided design programs lead to the fact that the sketch of the new system (Appendix 1) was created with PowerPoint and without physical dimensions.
To prove that the new system is reasonable for the hospitality industry, face to face interviews were conducted. To prevent linguistic barriers as well as misunderstanding during the presentation of the new system and the asked questions, seven out of eight interviews were conducted in German which is the mother tongue of these interviewees.

According to Flink (2014.) the collected data is primary data and cannot be generalized to the industry. The small number of selected interviewees is provides just a peak of feedback. To receive a coherent data collection further researches are needed.
Additionally this thesis cannot give a comprehensive statement if this is a reasonable system for the hospitality industry according to the point that certain aspects were not taken into consideration within this research. To provide a detailed statement, further studies including the aspects, which were not taken into consideration, need to be conducted.

2 Food Storage Management System in the Hospitality Industry

The following chapter will introduce the reader to the food storage management and to the actual handling within the hospitality industry. To provide the reader with a sufficient understanding, the chapter was divided into four parts.

The first part familiarizes the reader with the definition of food storage and the corresponding management systems, which apply in the hospitality industry.
This is followed by a historical food print of development in storing food, wich will guide the reader's attention to the changes over the years. Attached to part two, the third part gives the reader an overview of the storage management in the hospitality industry. Therefore, the author is going to take a look at the systems which are used in the industry and how the storing is taking action based on sources.
Sub chapter 2.4 enlightens the reader with the weaknesses which are connected to the current situation of storage management in the hospitality industry. The author is taking a closer look on the previous sub chapters to analyses if there is a need for changes.

Moreover, the author was observing within a time period of one week the current cold storage situation in a Hotel. For this, the author was selecting three times a day he was checking the cold storage areas.
The hotel, which was observed, is a five star superior elegant nature resort located in the south of Bavaria. It contains 176 rooms and three restaurants as well as one three star Michelin restaurant. In the following text, the hotel is named Hotel X, due to the fact that the hotel doesn't want to be named in person within the Thesis.

2.1 Definition of Food Storage Management System

After food products are purchased and delivered, they need to be stored. However, storing is more than just placing items into storing areas and giving employees the possibility to retrieve the food products whenever they need them (Ninemeier 2010, 200). Therefore, it is necessary to take certain aspects into consideration which will be further explained in the following text.

Storage management is an essential part for every type of industry. A good organized storage is the foundation of a business to ensure an adequate provision throughout a certain period of time as well as a sustainable use of the financial resources (Sprenger 2014, 87).

To define storage management it is very important to take into account, that the definition consists a combination of “functions of a storage” and the warehouse-management system to run a storage. (Dr. Thomas + Partner GmbH & Co. KG 2014.)
A storage has the function to hold and secure items for a certain time and in a defined place. The most common locations of a storage, referring to the size of a business, are buildings (warehouse) or special rooms (storage).
Moreover, a storage is used to interrupt the flow of material from the producer until the end customer. This interruption is created on purpose due to the fact, that buffer stocks are build. (BWLwissen.net 2016.)
Furthermore, nearly every kind of items and products can be stored. This includes items like tools, raw products, spare parts or intermediary products. In addition, it is necessary to mention, that personnel however is something which cannot be stored. (BWLwissen.net 2016.)

If a new storage is going to be build, the architect needs to clarify certain aspects in advance. Therefore, it is essential to take the sections like storage type, storage strategy and functions of storage into consideration.

At the beginning of planning a storage the business should think about which storage type would suit the company best. Thus, it is important to know, that the type of a storage can be classified from different perspectives such as, storage for value added process, classification in administration, location/destination, number of essential users and classification according to weather. (BWLwissen.net 2016.)

The classification for a value-added process storage will be explained later in this chapter. For defining a storage, a business needs to clarify the administration of a storage. This classification is connected with the classification of the location. Those classifications can be divided into two options: An own storage which will be placed on businesses property, or an externally operated storage which is commonly outsourced due to business space issues. Moreover, the business needs to clarify the number of essential users. This is necessary to guarantee a smooth flow within the production process. The number of essential users can result in having a general storage, which is at a central place within the business, or a supply- or hand storage, which is commonly located directly next to the workstation at the production line (BWLwissen.net 2016). Lastly a business should clarify what circumstances and regulation need to take into consideration for the stored items. Those issues have an impact on the classification according to weather condition. Whereas, wooden panels need no regulations and can be stored outside, covered by a small roof above the upper panels, food products must be stored due to hygiene regulations

which often include a certain temperature and humidity as well as an air circulation. Therefore the storage need to be protected against weather conditions and must be placed inside of a building. (BWLwissen.net 2016.)

A storage for the value-added process differentiate itself within sub- categories. Those sub categories are important to categorize and classify a storage for the value-added process. The differentiation includes, storing of raw materials, auxiliary materials, operating materials, interim storage for semi-finished products and output storage for manufactured products

Firstly the business needs to figure out, which kinds of items are going to be stored. The main difference between those categories is the aspect of time. For example, storing raw materials is temporally before the production process whereas stored items need to pass through a production process to create an end product. Moreover, an interim storage goes hand in hand with the production. In this case, items are commonly semi-finished and often just need to be placed in an objectively good looking way whereas items, which are stored in an output storage, are finished products and just need to be issued from the storage and unpacked from package. (BWLwissen.net 2016.)

A storage used in the hospitality industry is commonly a storage for the value-added process. The majority of hotels have a storage for raw materials and a small interim storage. However, it is also possible, that a hotel is working with convenience products, they employ an additional output storage, but those are the exceptions in the industry.

In addition to the type of storage, it is important to take a closer look at the strategies which can be used for storage. Therefore, the business needs to identify which strategy makes the most sense in relation to its business concept. By analyzing the strategies, the business needs to be aware of the way, how a strategy can affect storage and that strategies are built on the type of storage. (Dr. Tomas + Partner GmbH &Co. KG 2014.)

The first in first out (fifo) strategy is the most common strategy by running a storage. This means, items which entered the storage first, are leaving the storage first, too. Running a storage by the last in first out (lifo) strategy is quite the contrary to the fifo strategy and means, that items which came in the latest leave the storage the first. This strategy can be seen as a result of weak control and wrong placing of items within the storage. The consequence of this strategy can be spoilage and exceeding the expiry date which will have an impact on the financial use of resources. (Sprenger 2014, 87; International Hotel School 2016; Seal 2016.)

Another strategy, which is closely connected to the fifo, is the first expire first out (fefo) strategy. To operate by this s every stored item must be labeled by an expiration date, so the storage users can identify, which item is scheduled to leave the storage first.

The next two strategies which will be explained are sparely used. One of the sparely used strategies is the lowest in first out (lofo) strategy which assumes that the cheapest items leave the storage first. This will result in the fact, that the storage contains just high priced items at the end of a certain time period. This strategy is against the basics of accounting and is not allowed for tax purposes. The other strategy is the highest in first out (hifo) strategy which describes that the highest priced item leaves the storage first. This is used, if a company will reduce the taxable income for a certain time period. However both strategies are forbidden to use in Germany. (BWLwissen.net 2016.)

The last aspect, which needs to be taken into consideration for defining storage, is its function. While considering the functions of storage, the purpose of storing items is in the predominant.
Storing items has several functions as listed as follows: Backup- and supply function, equalizing function (buffer function), sorting function, presentation function, transformation- and production function, speculation function.

A good storage consists of a variety of those functions. On this occasion, it is not necessary to combine all functions mentioned above to create a good storage. (Wannenwetsch 2008, 65-66.)
The backup- and supply function describes the punctual delivery and supply of all departments with the needed items. In addition to that, a storage should have an equalizing function to create a buffer stock because storages can equalize heavy fluctuations caused by suppliers. This is needed in case of delayed supplies or other circumstances which will affect delivery. Moreover, every storage should fulfil the sorting function. This is necessary for an efficient way of the use of resources as well as a clear and structured picture of the storage. This will also affect the working conditions of an employee. Furthermore, the presentational function is commonly used in grocery stores. Items which the customer can purchase are stored and presented in a clear way. Additionally, some storages, especially storages in the hospitality industry, include the transforming and production function. Raw materials or items need to pass a maturing process or need to be transformed into courses which are delivered to the guest. (Wannenwetsch 2005, 194; Wannenwetsch 2008, 65-66.) In addition, the most common example of a maturing process is wine which needs to be stored at strict circumstances to gain the perfect quality (Martin 2006, 310). An improper practice in storing food items occur a detrimental quality of the products.

2.2 History Footprint

Preservation of food has a long history and becomes more and more important for humanity. Valley food storage suggests that the ability of preserving and storing food has led to an essential development in civilization. Our ancestors were hunting and harvesting the food just in time whereas the modern civilized world is able to store food for days or weeks or even years (Valley Food Storage 2015).

Over time humanity has come up with innovated methods to preserve and store food prevent spoilage and loss of nutrition It is suggested, that especially antique high cultures like the Egyptians or Greeks were the pioneers in finding ways of storing food (Valley Food Storage 2015).

The first method of preserving food is dated around 12,000 B.C., cultures located in the Middle East and orient, were using sun light to dehydrate some of their food, which led to a preservation of those items. Throughout the years and with the development of machines, humanity made some huge steps in preserving food and is able to dehydrate food with machines nowadays (Valley Food Storage 2015).

The impact that microorganisms organ could have on the longevity of certain foods was discovered by chance long before it had been scientifically proven. For example, fermentation was used to make wine out of fruits or convert cabbage into sauerkraut by using water microorganisms and time, letting the microorganism such as yeast do their job. This method was valuable for food preservation, due to the fact that it not only could preserve but it also created more nutritious verities of food adding vitamins by fermentation (Valley Food Storage 2015).

Pickling was invented on the basis of the fermentation process. Further, the ancient man found out, that food can be preserved by putting it into beer and wine. Moreover, with the discovery of vinegar, pickling was increasing within the sixteenth century. To preserve food with the pickling method, it is essential to use a container which is made out of stoneware (in former times) or glass (nowadays).

Another method, which was mainly reserved for cultures that had the climate to support it, was freezing. Cultures from northern regions of the world were using their climate to preserve food with cold. By using coldness, microorganisms are not able to multiply like in normal conditions. This has a huge impact, stalling the rotting process (Valley Food Storage 2015).

After the ancient cultures had been using ice blocks to cool the food to a certain temperature, modern scientists started researching methods to develop an artificial cold. One of the Pioneers on the field was the German scientist Carl von Linde. He was born in 1842 in a northern region in Bavaria. Linde had 8 siblings and grew up in poor conditions. When

the family moved to Kempten, Austria, Linde discovered a passion for technology by visiting a factory which produced woolen items. He began studying at the polytechnic institute in Zurich in 1861. After three years of studying he was ex-matriculated for participating in a student's riot and left the university without a degree.
However, Linde acquired a job in a drawing office in Berlin due to a recommendation letter of two professors from Zurich. During his time in Berlin, he developed his drawing and conception skills. Nevertheless, five years after he left university, he was selected to become a board member of the "Lockomotivenfabrik Krauss & Co." in Munich. In 1868 Linde was appointed professor at the polytechnic school in Munich. (Kloska 2011.) From this on, he researched and developed a cooling machine. His success led with the foundation of his own company "Linde's Eisfabrik". Linde was able to create a machine, which could produce artificial ice, taking advantage of the thermodynamics. He developed a system to withdraw warmth from its surroundings. This innovation, in combination with new technological inventions, is the base of modern day cooling system. (Kloska 2011.)

2.3 Factors of storing

As mentioned before, after food products are purchased and delivered, they need to be stored. However, storing is more than just placing items into storage areas and giving employees the possibility to retrieve the food products whenever they need them. (Ninemeier 2010, 200.)

It also plays an important role in linking product receiving and production. Moreover, food and beverage managers must recognize that several factors like product costs, quality and availability are affected by storing and issuing systems (Ninemeier 2013, 223).
A lack of an adequate control system leads to raising cost and lowering the quality of the stored items. Furthermore, Jack Ninemeier (2013, 223) compares a storage to a bank account. In this case a food and beverage manager can view stored items as bank notes. In addition to the value, which is represented by the stored items, a lack of adequate control will have an effect on both the initial cost and the cost to replace the items if they are damaged, spoiled or stolen by employees. (Ninemeier 2013, 223; Seal 2016.) Therefore, Ninemeier (2012, 200) defines an effective storage to security-, quality- and recordkeeping issues and he recommends a strict control policy within the hotel.

In addition, he divides the security aspects into the following sub-aspects: Lockable storage areas, precious storage, limited access, effective inventory control procedures, central inventory control, secure design, lighting and monitoring.

As mentioned before, food items which are stored represent money. Therefore, the hotel should provide lockable storage areas which though could be impractical if employees need to enter refrigerators and freezers frequently. As a result, Ninemeier (2012, 201) recommends protecting high priced items with a cage or limited access. In addition to lockable storage areas, Ninemeier (2012 ,201) adds precious storage. This is needed if a hotel storage contains very expensive products. In that case, it is also recommended to have limited access to those areas. Limited access should be provided to employees, who are trustworthy and preferably employed in a higher position in the hierarchy (e.g. managers). In addition, employee theft is less likely, if the storage issuing is directly recorded and controlled by a manager. Moreover, an effective inventory control procedure is needed to protect all items, especially expensive items and theft-prone items (Ninemeier 2013 226). Therefore, it is essential to have efficient recordkeeping system which will be further discussed later in this chapter.

To have a more efficient inventory control, Ninemeier (2013, 226) recommends, items which are stored in work station storage should be returned to the central storage, after the shift is over. Moreover, the security aspect should start while the storage area is designed because good design will assist the security of the items. For that reason, certain regulations need to be taken into consideration. In addition to regulations which are compulsory for food handling industries, a manager should keep the security aspect in mind, to protect the stored items. A secure storage needs to have an adequate lighting and a monitoring system which monitors the storage areas. (Ninemeier 2010, 201; Ninemeier 2013, 226; Seal 2016.) An obvious visible monitoring system is able to have an impact on employee's behavior, which can prevent theft.

Furthermore, an improper storage procedure can reduce the quality of food products in storage. In detail, nearly every food product loses quality if it is stored to long. (Ninemeier 2013, 227; Mahmood 2015.) Therefore it is very important, that the recordkeeping issue is at its best to minimize the loss of quality of items stored. If the recordkeeping is not followed strictly, food costs will increase as items judged as unfit for use are replaced (Ninemeier 2013, 227). In addition, procedures to maintain the quality during storage are needed.

As mentioned in Chapter 2.1, a storage needs to have a strategy besides the facilities. The most common and useful strategy for the hospitality industry is the first in first out (fifo) strategy (Ninemeier 2013, 227; Schaetzing 2013, 43; Dittmer & Keefer III 2009, 143; Sprenger 2014, 93; Seal 2016). Fifo is often the preferred storage strategy for perishable and non-perishable items. (Dittmer & Keefer III 2009, 143). When new items enter the storage areas, they need to be placed behind or under products which are already in stor-

age to guarantee an adequate use of the fifo strategy (Ninemeier 2013, 228). A failure in the fifo system can result in an excessive product loss due to shrinkage, deterioration of quality and spoilage. Ninemeier (2013, 228) recommends putting a date of receipt on every item which is stored. With this method it is easy to control the proper performance of the storage strategy. In this case items in production areas should have an older date of receipt than items placed in storage. An adequate stock rotation, which is desirable due to the quality of products, is implemented by adding a storage strategy.

In addition, to secure quality of the stored items, certain products need to be stored at a specific temperature, humidity and ventilation (Sprenger 2014, 96; Ninemeier 2013, 228). To fulfil the requirements of the perfect temperature, storages in the hospitality industry are divided into a dry storage with a perfect temperature of 10° Celsius to 21° Celsius, into a refrigerated storage, 5°Celsius or lower, and a freezer storage, -18°Celsius or lower. (Ninemeier 2013, 227; Dittmer & Keefer III 2009, 141; Sprenger 2014, 88-90.) To familiarize the reader with the different kind of temperatures for different items, the following table is used. The table contains a summary of certain items due to Sprenger (2014.); Dittmer & Keefer III (2009.); Ninemeier (2010; 2013) and Pezel (2009.).

Table 1. Temperatures for food items (Sprenger 2014; Dittmer & Keefer III 2009; Ninemeier 2013; Pezel 2009)

Food Product	**Temperature**
meat (pork/beef) raw	7 °C good air movement
cooked meat	4°C
chicken	4 °C
deer	7 °C
wild rabbit / wild chicken	4° C
mince meet	4 °C
prepared meat	7 °C
salad	7 °C
butter/ crème chees/ milk (pasteurized)/milk products	10°C
certified raw milk	8°C
soft- hard chees	10°C
live bivalve mussel	10°C
fresh fish / other fresh fish products	2°C
food products contain raw eggs (e.g. mayonnaise)	7°C
eggs	4°C
tropical fruits (bananas pineapple etc.	10-13°C
fruits and vegetables	own cooling conditions
deep-frozen products	-18°C
frozen products	-12°C
ice cream	-12°C

As shown by the table, that almost every single item needs a certain temperature to keep up the best quality. In addition, food items like poultry, meat, fish, eggs and milk products, are committed to providing an expiry date which needs also to take into consideration to keep up the quality. Due to the LMHV (Lebensmittelhygieneverordnung) (Food Hygiene Regulations) it is compulsory to fulfil the cooling temperature and the usage of the food items within the expiring date. Overdue items must be immediately wasted (Hildebrand 2014).

In addition to the stock rotation and the temperature, an effective sanitation practice is another aspect to secure the quality of the stored items. Therefore, the storage areas need to be cleaned periodically. Moreover, storage areas, especially freezers, refrigerators and walk in refrigerators should be made out of nonporous and easily cleaned materials. That is why the storage equipment should be placed at least five centimeters from walls and the lowest shelf at least 15 centimeters above the floor, to permit cleaning with

mops under shelves (Ninemeier 2013, 228). To discourage insect and rodent infestation, the hotel needs to follow a strict cleaning procedure and should use professional pest control service. In addition, the hotel should add an introduction of a Hazzard Analyzed Critical Control Point (HACCP) concept, as an internal self-control system, in order to ensure food safety and food quality for the customer. (Hildebrand 2014; Sprenger 2014, 5.) The HACCP system is able to support the employees during the cleaning process by focusing the attention to the critical control points as well as it is able to ensure the food safety and food quality during the production process. (Hildebrand 2014.)

In conclusion, to secure the quality of stored items the hotel needs to ensure a proper storage. Therefore, the items have to be stored away from the walls to allow an air circulation, which is important to prevent spoilage (Ninemeier 2013, 229). Furthermore, the exact amount of items stored is desirable to make purchasing decision, especially for perishable items which cannot be stored over a long period of time.

The last major aspect in defining an effective storage, besides security and quality, is the afore mentioned recordkeeping. An effective recordkeeping system is essential for the hotel to keep the control of stored items and invested money. This will have an impact in the balance sheet, which is mirroring the property's current asset, and the income statement (Ninemeier 2013, 229). Due to an effective recordkeeping control, food and beverage managers are able to track the quantity of stored items. Moreover, they can see when they need to place an order to receive needed items in time. Ninemeier (2013, 231) is explaining two basic kinds of recordkeeping systems. On the one hand, the physical inventory system, which involves counting and observation on a periodic basis, for example monthly, and on the other hand the perpetual inventory system which involves keeping a running balance of the quantity of products and the quantity of issued products (Ninemeier2013, 231). Within the perpetual inventory system, an employee specifically commissioned the hotel continually updates the inventory records to account for adding and subtraction from the inventory for the following activities: items damaged, items issued for production process, items entered Storage.

This happens on a daily basis, which gives the food and beverage manager up-to-date inventory information. In addition to that, the perpetual inventory system requires a reduced level of physical inventory counting. However, the calculated inventory should be controlled periodically, due to possible theft or uncontrolled activities (Bragg 2013). To prevent further mistakes in control, the person who maintains the perpetual inventory system should not be the same person who conducts the physical inventory (Ninemeier 2013, 235).

In contrast to the perpetual inventory system, the physical inventory system does not track items which are added or subtracted on a daily basis. Rather, this system only updates

the food and beverage manager at the end of a selected time period. Therefore, every time an inventory report is needed, every single item needs to be counted (Bragg 2013). Moreover, the physical inventory system avoids the time which is needed for the record within the perpetual inventory system. However, a control of the inventory on a daily basis as well as the traceability of issued items is thought to be nearly impossible (Ninemeier 2013, 235).

2.4 Criteria now

Ninemeier describes an efficient storage by taking three aspects, as described before, into consideration. During his aspect of security, he further dividing the security part into seven partial aspects as mentioned in chapter 2.3. He also lists facilities and systems which assist food and beverage managers to control their inventory; their money. Within the explained security point, the author sees some weaknesses which will be described at the end of this chapter. A storage should contain a lighting and monitoring system to monitor the access area of the storage. (Ninemeier 2010, 201.) However, even if there is a monitoring system which is able to back up the film material for a certain period of time, there is no theft prevention guarantee. Due to the fact, that in most case only the entrance area is monitored, people with access to the storage room are still able to potentially steal stored items, hiding them underneath their working clothes or pockets. In addition, inventory control is only effective, if the items are strictly recorded at delivery. If delivered items are not properly recorded they can also be removed without noticing. Inventory control and issuing procedures are commonly operated while a control person (purchasing department) is present, thus being supervised. But since there is no 24 hour supervision, there are still plenty of chances for employees to remove items from the storage without notice. In addition, a small lack of adequate control can influence described procedure positively.

Apart from theft and lack of supervision, storage management can face other challenges for example incorrect practice of storage strategy. If a hotel operates by using the first in first out (fifo) strategy, following the order of delivered items is essential. In stressful situations just delivered items may be taken immediately for production process. A repetition could easily cost expiration of older goods (Ninemeier 2013, 225).

Correspondingly, items which are stored and issued need to be handled with care. In stressful situations, items might be dropped, which could contaminate the storage floor and possibly other stored items. If the contamination is not cleaned within a short time, it is the perfect breeding ground for bacteria. In addition, it needs to be taken into consideration, that employees enter storage areas with their working shoes. In this way the storage can be contaminated with dirt the employee carries under his shoes. Additionally, while

entering the storage for storing or issuing aspects, the door of the freezer or cold storage needs to be opened. Within this time the storage will be exposed to an increase of temperature. As shown in chapter 2.3, cooled items need to have a constant temperature according to the LMHV. An increase of the temperature for a short time will not be any problem. However, if the storage doors stay open for too long and the storage temperature rise, the stored items are at risk of spoiling. Plus, cooling systems contain a certain humidity and air circulation to prevent moisture. Frequently open doors can lead to a change in humidity due to condensation. As a result the cooling machines will not be able to keep the temperature at a low level. The storage will slowly start to heat up, and even small increases within the temperature of about 5-10°Celsius are enough to ruin food items.

The following graph will show the reader how often cold storage areas were not closed properly during the day in Hotel X. The observed hotel contains nine cold storages from which three are placed behind a fence with limited access. Those storages were closed the entire time and are not taking into consideration of the observation. The remaining six storages were in front of the fence and are public domain. The following graph shows how many storages were opened or not closed correctly at the selected times.

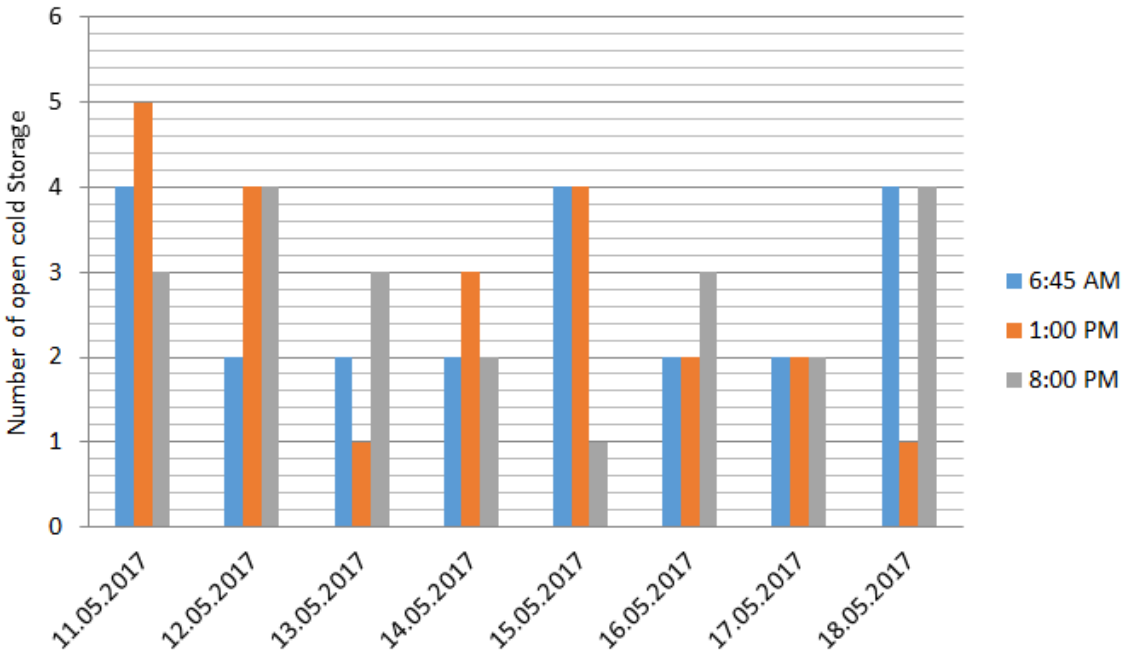

Figure 1. Results of observation at hotel X

Throughout the observation period, the author gathered the final information, that a total average of 2.74 (rounded three) storages were open or not closed correctly after entering the storage each day. Furthermore, it is essential to say that during the observation period there was not one single time in which all cold storages were closed. At least a minimum of one cold storage was open. An open door of a cold storage can result in the fact that the cold storage starts to heat up slowly and more energy is needed to prevent the warming. In addition, it shows that the employees are not aware of how to handle a cold storage; however, a sign which is pointing out that the door needs to be closed is placed at every single storage door.

To summarize the above mentioned, the author sees weaknesses of the current storage system in the following aspects: Disregard of storage strategy, wrong temperature for stored items, wrong place in storage, damaged items, theft, spoilage, lack of control procedures, contamination of storage (dirt), inventory for stock control.

3 New Storage Management System

In this chapter the reader will get an impression about how the assumed concept could look like and how it would function. To follow the explanation of this chapter it is essential to have a closer look at the drawing of the system. (Appendix 1) Followed by a general overview, the reader will receive more detailed information about single parts which are used for that system.
After receiving a comprehensive explanation about the new system the reader will receive further detailed information about the process of storing and issuing items from the new storage.
As afore mentioned, this system was created without taking aspects like profitability, engineering details, physical dimensions, construction costs, as well as amortization of the new system into consideration.

3.1 Introduction to new System

By looking at the weaknesses described in chapter two, the author was thinking about how to change the current situation, by taking all necessary aspects, like storage type, storage strategy and recordkeeping into consideration. Taking a closer look at the end of chapter 2.4, all weaknesses of the current storage situation are caused by humans. Many companies see the only way of elimination of errors in high priced technological innovations. (Hoffmann 2015.) The backgrounds of the emergence of errors can include ergonomic, organizational and personal problems. Furthermore, the mistakes which are caused by the factor human are becoming increasingly important. Also weaknesses in defective concept thinking, planning thinking and way of thinking can be the foundation of mistakes within the business. Theoretically, every mistake can be caused by a human. Moreover, if a human programs a machine, in case of a failure, the insufficient programming can be selected as the foundation of the mistake. The human developed a lot of technological innovation; however, the human is always the origin of the mistake. (Hoffmann 2015.)
To minimize the factor human, the author suggests a huge increase in the controlling and issuing process. Moreover, to prevent spoilage, theft and other aspects mentioned by Feinstein & Stefanelli (2012, 294-295.); Ninemeier (2013, 223-235.); Dittmer & Keefer III143-150), and Hildebrand (2014.), flawlessly executed strategy and recordkeeping are absolutely vital. To fulfill those requirements, the author sees the need of a fully automated storage system like it is already implemented in other industries. Therefore, the Author has contemplated and observed the storage industry as well as companies which have a fully automated storage area.

To follow the explanation of the new storage system it is necessary to take a look at appendix one (drawing of the system) on which the description is based.

To minimize the influence of employees on the storage, the idea to implement a fully closed and protected storage area is presented. Within this area, all storage areas like dry storage, cold storage and freezer, are included.

The storage system has an input and output area which is placed in front of the whole storing complex as shown in the drawing. This area will contain a table which is placed in an ergonomic supporting height to prevent mistakes due to ergonomic issues. The input and output system as well as the box storage located on the right side, are the only things the employee is able to touch. The box storage is part of the system, as it is an essential detail of the presented module, that all stored items are kept in boxes. To support the employee in storing the items and using the right boxes, the boxes will have the same color as the HACCP color scheme concept, already used in the a majority of kitchens in the European hospitality industry. This color scheme consists out of five colors blue, red, yellow, green and white and will be explained in detail in chapter 3.2.(Nireolen GmbH 2016.)

The whole complex is placed in a room with an open front, which is protected by a fence. This protection is necessary to protect items from employees as well as protect the employees from the machines which are working inside the system. The green line, which goes around the complex, in a shape of an U, should show the input way the items will drive through to the perfect storage position. The conveyor belt for the input line is located behind the storages. This will guarantee a perfect use of the first in first out (fifo) storage strategy. According to this strategy, new items need to be place behind the old items within the storage. Therefore, the input line is placed behind the storage shelves and will insert the items inside from behind.
The skin colored area symbolizes the dry storage. Every item which does not require a temperature below 10° Celsius will be stored in this area. Furthermore, as shown in the drawing, the system is covered with temperature sensors to receive information about the temperatures inside the storage. The second part of the drawing which is colored in blue and in light blue symbolizes the cold storage (light blue) and the freezer (blue). Between those areas there is a black line which symbolizes a row of vertical blinds. These vertical blinds are separating the cold storage and the freezer and were selected due to the conveyor belt which is issuing the items and is placed through the whole complex. Items can easily drive through these vertical blinds. For cooling proposes, the same machines used in cold storages today can be used. To be more efficient, the cooling machines are con-

nected to a computer based control system as well as to sensors which are going to be explained later in this chapter.

The output line is colored yellow and is located in the middle of all storage areas to support the fifo strategy. All shelves have a gentle gradient to the output line. At the front of the shelves which is pointing to the output line, there are flaps which retain the boxes. In case of an order, the flaps open electronically and the first box slides on the output conveyor belt. In front of the cold storage and the freezer, there is a wall (white colored line) which separates the cold storage from the dry storage. The challenge was to implement a system which can control and keep the temperature within the cold storage as well as be able to let items pass this barrier. Therefore, the author selected sluice gates which are located at the numbers one, two and three within the drawing. Those gates will work with a sensor which is able to recognize the box with items and opens the gate automatically in time. On the other side of this gate is another sensor which is recognizes the passing box and the gate will close. This is necessary to prevent a loss in cooling which will have positive consequences for the energetic efficiency of the storage.

In the case of a breakdown of the whole complex as well as for an inspection of the health authorities, inspectors and technicians must be able to enter the storage for repairing or inspecting purposes. The fact that the system is fully closed and protected leads to the introduction of maintenance paths which are colored brown. Within those maintenance paths the reader can see diamonds, which are symbolize doors to enter the storage and circles which reflect maintenance flaps which are located at certain positions within the conveyor belt. Those flaps are essential, due to safety reasons for the personnel with access to the storage. To reduce the combined risk of injuries while inspecting or repairing the storage, those flaps are a compulsory aspect due to the employers' liability insurance association. In case of a breakdown the employee who enters the storage, can easily open those maintenance flaps by hand, after unlocking the safety pin.

In combination with the facilities the storage needs, the author was also thinking of develop the recordkeeping system to secure a complete verification of the items. Due to this verification, combined with the physical and technical complexity of the storage, one major impact on the current storage situation, the problem of theft is virtually deleted.

The software which is used to keep the storage's record is able to give the authorities in this case food and beverage managers, chef de cuisine or general manager the exact amount of items stored. Therefore, a report is sent automatically from the system to the e-mail accounts of those managers. However, the report can also be requested by a mouse

click at any time. By analyzing the actual amount of stored items, the system is able to place orders on its own.
Therefore, the system checks the actual amount of a certain item in relation to the minimal amount preset by the purchasing department in collaboration with the food and beverage manager and chef de cuisine. If this minimum is reached at any time, the system sends an orders to the supplier ordering the amount needed to reach the maximum capacity, which has been programmed in advance. For example, if the hotel has a maximum capacity of 40 kilograms of potatoes and the minimum which has been set to ten kilograms is reached, the system automatically orders 30 kilograms of potatoes. On this occasion, the time of day does not matter because the system operates 24/7 available and working.

The sensors which are pictured in the drawing are connected to the software. This combination has the advantage that the sensors keep checking the cooling conditions, humidity and air circulation at any time. If the sensors recognize any discrepancies from the perfect conditions, the system is able to regulate itself back to the perfect condition. If the discrepancies are getting too large, an alert is sent to the hotel technicians requesting a visual inspection. The sensors and the software are able to feel temperature discrepancies of 0, 1°Celsius and start regulating at a different of 1, 5° Celsius. Conclusively, the perfect cooling conditions are given at any time which will have a positive impact on the quality of the stored items and spoilage can be prevented.

The whole storage complex is equipped protected by a computer based control system which includes a security software to prevent a breakdown caused by hacking. In addition, the system works on two computers operating redundantly. This means, that the main control system runs permanently, whereas the second one, using the same software and functions works parallelly in the background. In a case of a breakdown of the main system, the back-up system which is provided with an independent electricity circle starts working immediately, takes over the control function for the time in which the first system is under maintenance. This will afford the advantage that even in case of an IT-breakdown the recordkeeping function can go on.

To resolve the breakdown as quickly as possible, an alert is sent to the company maintaining the recordkeeping system and the automation within the storage as well as to the hotel's internal technicians. The technicians will receive a code authorizing them to enter the storage complex by entering it into a touch panel next to the maintenance door. The hotel technicians will receive instructions from the maintenance company that has a remote access in case of a breakdown. With this remote access it is possible to find the mistake within the system as quickly as possible and give instructions to the onsite techni-

cian. This procedure will reduce the time needed to resolve the problem and is preferable over ordering a technician externally who would than need a larger amount of time to arrive at the hotel.

In case of a physical error within the system, the process of alert will be the same. In addition, it is essential to say that in both cases the issuing functions and all moving machines within the system will stop functioning as soon as the maintenance door is opened. Due to the employers' liability insurance association, this process as well as the afore mentioned maintenance flaps is compulsory.

If employees need items during this breakdown, it would be possible to enter the storage through the maintenance paths and take out the required items manually. However, this should be an exception. By taking boxes manually, the employee has to unlock the flaps in front of the shelf to receive the box. The flaps are contain a spring which will result in the fact, that the flap will retain the next box after the required box has been taken. In addition, a sensor is located at the front of every storing position. This will lead to the fact, that no box can be removed without the notice of at least one control system.

After the breakdown or the physical error is repaired all maintenance flaps and doors are closed properly, the technician has to type in a re-starting code to the touch panel next to the input and output area. The system will now start to check all functions and will make a self-test which includes a comparison of the stored items before the breakdown and after the breakdown. Therefore, the system compares the information from system one and system two and sends a final report, which includes information about the problem, which kind of mistake, information about the duration of the breakdown to the internal technicians and the maintenance company. Additionally an inventory report, including the information of removed items and the current amount in store, will be send to the food and beverage manager and the chef de cuisine.

The new storage system is able to eliminate all weaknesses of the current system which were described in chapter 2.4. Combining a closed storage area and the described control system, no item can be removed without notice. In accordance, no item will be issued from the storage without receiving an order from an authorized person. All items will receive their perfect storing condition by the use of technologies like sensors to monitor the perfect conditions at every time and the combined self-activating regulation to fulfil the perfect cooling, humidity, and air circulation conditions. Moreover, the storage complex will secure, that nobody can enter the storage without authorization and only when necessary. This will result in the fact that a proper HACCP concept can be fulfilled due to perfect

cooling condition, perfect storing place for single items, and cleanliness within the system. The hygiene within the system is maintained by using colored boxes which are leak proof and also connected to the color scheme of the HACCP, as practiced by the marina bay sands in Singapore. (mega food 2013.)

In addition, the new automated control system will support the employees of the purchasing department as well as the food and beverage manager in guaranteeing a complete traceability of the rotation of stored items. This will lead to a more practical and efficient budget planning for the food and beverage department which will have a positive impact on the balance sheet. Furthermore, it is also possible to gain detailed insight to the cost of each kitchen if the hotel contains more than one kitchen. By following this procedure each kitchen only pays for items it has issued from the storage by tracking the registered orders.

3.2 Single Parts of the System

Compared to the storage systems currently used in the hospitality industry, this new one presents several differences. The input and output tray which is located in front of the fence and in front of the whole storage has an approximate height of 75 centimeters to 105 centimeters which is the perfect ergonomic height due to the Deutsche Gesetzliche Unfallversicherung (DGUV) (German statutory accident insurance) (DGUV 2010, 19). This will assist employees by lifting heavy boxes and will prevent injuries which are mainly caused by wrong lifting procedures.

Next to the input and output tray, there is a touch panel which will assist the employees by declaring the item which is going to be stored. A detailed explanation of the storing process will be explained later in chapter 3.3.

The box storage located on the right side of the input tray is connected to the HACCP color scheme, which is already used in the majority of the kitchens. (mega food 2013.) The boxes which have the colors blue (seafood), yellow (poultry), red (meat) green (vegetables/fruits) and white (bakery- and milk-products) are stored in a structured order. In addition to the color scheme, the boxes are declared with the heading of the item group as well as a pictogram below the heading (Appendix two). (Nierolen GmbH 2016.)

All boxes will have barcodes on all four sides as well as one barcode at the bottom. The barcodes are necessary due to the fact that the system is able to locate the exact position of each box within the system and during the storage and issuing process. In addition, the

barcode is necessary to prevent a wrong declaration of items which will be explained later in chapter 3.3.
The conveyor belt which is the main innovation of the system was selected to guarantee that no employee needs to enter the storage. With this innovation it is possible to store the items in the right position. It will also prevent a contamination which is currently mainly cause by employees are entering the storage with contaminated shoes.
The conveyor belt passes all storage areas and will place the items in the designated location.

However, it also needs to access all heights of each shelf. For this matter, conveyor belts used in airport luggage transport and fully automated warehouse storages have been used as models. The conveyor belt inside the system is able to transform their angle to transport the boxes to alternating levels. This change of the angle is controlled by the system and bar code scanners which are located along the conveyor belt. The belt is made out of rubber due to hygiene aspects and the operational necessity to transport boxes on to different levels. The combination of plastic boxes and rubber belt guarantees slip-resistance which is needed to secure that the items within the boxes are not going to be damaged. In addition, the conveyor belt has a safety bar at a height of approximately 20 centimeters. This will prevent boxes to fall off. In addition, the safety bar has hinges at certain points within the complex, which are controlled by the system and will flap out to direct the box to the right storing position.

All sluice gates within the storage need to function under all circumstances. The challenge for those gates was to find a perfect solution as well as a perfect process which will work at every time. Therefore, the author was looking for different options like hydraulic systems as well as pneumatic systems and electronical systems. The major difference between a hydraulic system and a pneumatic system is that the hydraulic systems work commonly with oil which contains a high viscosity whereas pneumatic systems work with air. The use of a pump or a piston compresses the oil or the air which will generate warmth. This warmth can have negative impact on the cooling system by heating the cold storage following a huge delivery and constant work of the pump or piston. To prevent those warming effects the author decided to use an electronic system for the sluice gates.

3.3 Process

Starting with the fact, that the system is able to order the goods itself, the ordered items are delivered and controlled by the purchasing department. Following delivery the trolley with the items is transported the storage system the storing commences.
The employee responsible for storing the items needs to scan his idetificationchip at the scanner next to the touch panel of the input and output tray. The system recognizes the employee and then asks for the employee's authorization code, issued by the hotel.The combination of the work chip and the personal pin is a security aspect which will be an advantage for the recordkeeping procedure. The managers are able to identify which employee of which department, was has stored which item at what time and date.
After registration to the system the storing process can start. For this, the employee takes a box from the box storage and places the item within the box. To prevent a wrong declaration, the afore mentioned barcodes play an important role. By placing the box at the input tray, one of the five scanners will read at least one of the five barcodes on the box. The barcode contains the information about the item group (seafood, poultry etc.) and the number of the box. After the scanner has read the barcode, the registered items of the item group pop up in the display of the touch panel. The employee must now enter the exact item and the portion size into touch panel. After he has finished selecting the items he has to confirm the summary of the items the system now shows in the display. By confirming the items in the box are correct, the system calculates the shortest way to the perfect storing position and starts gives the conveyor belt the instruction to start moving. This instruction includes the right position of the height-adjustable parts of the conveyor belt. If the employee confirms the stored items in the display, a warning tone as well as a red flashlight will appear to signal the start of the storing process. The gate within the fence opens and the box moves inside the complex.

It is essential to mention that when the system receives a storing instruction, it also blocks the issuing line to prevent a collision of the boxes and as a result a blockade of the system. The same procedures apply vice versa. To fulfil these procedures, the conveyor belt needs to be separated in sectors to be able to wait within one sector until the other box is out of the way.

After the box has entered the complex, the gate will close immediately and the employee can place the next box on the input tray. If the entered box contains items which have to fulfil certain cooling conditions, the sluice gate in front of the cooling storage opens and closes just in time when the box is close to the entry. This short time the gate is opened will result in the fact, that the cold storage or freezer will, if at all, have a minimal decrease

in temperature. The procedure of how this is possible was explained before by mentioning sensors which will notice the box right be for it will pass the door.
Nevertheless, if the box is close to its final position, the safety bar will change its angle to push the box into the right storage shelf. The fact, that shelf itself consists out of rollers instead of a rubber belt as well as the fact that all shelves have a gentle gradient to the output line will let the boxes slip smoothly into their final position.

To retrieve stored items, the employee needs to give an order to the system. In that case the employee can type in the items he needs and the complex starts issuing. The flaps in front of each shelf will open and the ordered box will slide onto the conveyor belt. By sliding out, the barcode at the bottom of the box will be scanned by a scanner located between the shelf and the conveyor belt. The system then automatically subtracts the amount of stored items in the box from the total amount of stored items in the storage. After the box has passed the flap, the flap will slip up again and halt the next box. This process of issuing items is also possible when the system has a breakdown and the employee removes a box manually. The system also calculates also the shortest way to the output tray and the conveyor belt starts moving. Scanners, which are passed during the process, locate the exact position of the box and will proceed to operate all height-adjustable parts of the conveyor belt to bring the box to output tray level. The box passes all sluice gates which operate automatically as described before and will shortly stop in front of the fence. The system checks if there are items on the input tray or in the surrounding input line to prevent a collision. If there are no barriers for the box the warning signals as well as the red flash light appear and the gate of the fence will first open and then close immediately after the box has passed. The advantage that the in- and output tray has an ergonomic height leads to the fact, that the employee is now able to lift the boxes without the risk of injury. After the employee has brought the items to their final destination, the box needs to be cleaned and returned to the box storage.

4 Methodology

After analyzing the theory of the current situation in the hospitality industry as well as presenting the new system to the reader, this chapter describes the process of how the research was conducted. Thus, the author explains which method of research was used and why. In addition the reader will get a brief overview about how the interviewees were selected as well as a brief introduction to the company F.B. Wärrme- Kälte- Schall- + Brandschutz GmbH which was also interviewed due to prove the technical aspects in the new system. For detailed information about the interviewees it is recommended to have a closer look at appendix three.

4.1 Qualitative Research

Research in general is important for the researcher to understand why and how things happen the way they do. If a researcher aims for information about what happens and how often this appears, a quantitative research approach would be suitable. (Cooper & Schindler 2014, 144.)
Qualitative research provides rich data and is very powerful in supplying ideas which can be used for further studies (KW research 2017). Overall, qualitative research has several methods of collecting data for the needed research which are explained by the following text.

The data collection approach of a qualitative research commonly involves a direct interaction with one individual (Interview) or an interaction with more than one individual (focus group). Generally data collecting approaches for qualitative research can be divided into verbal data collection, including interviews, narratives, focus groups, and observation data collection, including visual observation (film, persons and situation), using documents and pictures as data and action research. (Flink 2014.)
A fundamental weakness of qualitative research is that it is time consuming. Due to this, data is usually collected from a smaller sample compared to a quantitative research. Additionally, the gathered information and results cannot be generalized to a larger population. (Cooper & Schindler 2014, 145.)Last but not least, the evaluation of the gathered information is time consuming, too.
However, qualitative research methods also have benefits which need to be taken into consideration when the researcher defines his or her method. The major benefits of a qualitative data collection with the described methods are the rich amounts of data which are provided, as well as the fact that qualitative research is often used to support theories and testing. (Cooper & Schindler 2014, 146; Flink 2014; RW research 2017.) In addition,

the qualitative research approach allows a deeper insight to the phenomena of the study which leads to more efficient answering. (Flink 2014.)

4.2 Semi- Structured Interviews

Due to the above mentioned aspects analyzed by experts of research, the author decides to do a qualitative research with interview as method. Furthermore, additional literature shows that there are several types of interviews with advantages and disadvantages on each type of interview.
Interviews can be divided into unstructured, semi-structured and structured interviews. In addition, each type of interview can be analyzed to the contained benefits and weaknesses which are shown in the following table.

Table 2. Benefits and weaknesses of each interview type (Cooper & Schindler 2014; Flink 2014)

Type of interview	Benefits	Weaknesses
Unstructured interview	• Freedom of speech • Allows discussion for greater details	• No structure • No comparability
Semi- structured interview	• Allow the researcher to prompt encourage • Open end questions allow elaboration • Freedom of speech	• Interviewee can go astray • Limited comparability
Structured interview	• Strict schedule • Gathering exact information based to questions	• Limited range of response is given • Tightly schedule leads to non-depth information provided • Freedom of speech is limited

The need of open end questions as well as the possibility to discuss certain points in depth leads to the choice of the semi-structured interview as preferred research method. Interviews should take place in a conversational way rather than just answering questions (Flink 2014). Additionally, small discussions will have a positive impact on the conclusion of this thesis. Furthermore, open ended questions will have a positive impact on collecting data due to the fact, that the interviewee can expand his or her creativity and give suggestions of how this issue could be improved. Open ended questions lead to more freedom of speech which will support the interviewees to prove their answers with professional background examples. The use of the subjective theory provided by Flink (2014, 156), which

refers to the fact that interviewees have a complex stock of knowledge about the topic is beneficial for small discussion and deeper answering of the questions.

4.3 Preparation

Before the interviews could be conducted, the author had to prepare administrative formalities. Those include formulating enquiries for interviews, decision of the interviewees, the type of how the interview will be conducted, as well as where the interview will take place. To receive a general overview about the concept which was developed by the author, it was essential to ask experts from the industry (five chefs and a food and beverage manager) as well as experts who have project planning skills and constructional skills. Thus, the author decides to split the interviewees in different experts groups like, chefs, food and beverage manager, constructions expert and project planning expert. This results in the fact that for each section of experts the main research question “Is this a reasonable system for the hospitality industry?” is the same. However different aspects were taken into consideration for the different expert groups.
To supply each interviewee with the same information about the new system, a PowerPoint presentation was prepared and presented to each interviewee in advance of the interview.
The interviews took place within one week at the end of May 2017 and were commonly face to face interviews, to observe their expressions during the presentation and the interview. However due to the distance between the interviewer located in south Germany and two interviews, (one located in Switzerland and the other one located in the United States of America) the author decided to use Skype as a suitable tool to interview these two participants in a kind of face to face interview.
After the interviews were conducted the author transcribed the interviews by repeating and writing the spoken words into text to analyze the results of the interviews. In addition, after the interviews were transcribed the author summarized each interview and sorted all unnecessary facts out.

4.3.1 Interviewees

Based on the subjective theory which was mentioned in chapter 4.2, the author was looking for interviewees which are fulfilling the requirements Fink (2014) is recommending to have. In addition, it was necessary that the interviewees had a work experience of at least 5 years.
To spread the point of view, it was necessary to find interviewees which are working in different positions and also different companies. This would guarantee, that the gathered information are not based on one hotel or company but reflecting several facts from differ-

ent points of view. However collected data cannot be generalized as mentioned in chapter 4.2.
Detailed information about each interviewee can be found in appendix three

4.3.2 Company

The chosen company for the interview is F.B. Wärrme- Kälte- Schall- + Brandschutz GmbH in Minden which is represented by Mr. Benjamin Busse, the chief executive officer of the company. The company was founded in 1986 and is expanding constantly. The company has more than 20 employees and is working all over Germany for grocery chains like EDEKA and LIDL as well as for the pharma industry and other industries which require a need for storages.
The company was chosen due to the prompt reply of Mr. Busse after receiving the enquiry and the references the company have due to building storage for food supplying companies.

5 Results

After conducting the interviews, the following chapter presents the results. For this, the interviews were summarized and will be compared in the following text. The main aim of this chapter is to show the reader the opinion of the interviewees to the main research question, “is this a reasonable system for the hospitality industry?”

All five interviewed chefs were entitled to explain weaknesses they see in the current storage situation which is used in the hospitality industry. It was very interesting to hear, that all statements of the experts analyzed in chapter two, were confirmed by the chefs. However, the major weaknesses which are seen in the current storage situation vary from chef to chef.

Mr. Boller (26 May 2017) mentions that it is very time consuming to stay informed about the current items which are reserved in the storage areas and states this as the major weakness. Commonly, the orders of needed goods are made by each chef for his position they work for and they rarely talk to each other during the ordering procedure. According to Boller (26 May 2017), this can result in the fact that items will be ordered twice. Moreover, he mentions that storing items to a perfect fifo strategy is also time consuming (Boller 26 May 2017).
Mr. Munoz (26 May 2017) also complains about the time consuming aspect to fulfil the fifo strategy within a storage. Furthermore, he gives exact examples how, in his opinion, the misuse of a fifo strategy occurs. He mentions that employees simply store items without checking the expiration date or without sorting the current items. Without the discipline of the employees a good warehousing is impossible. Additionally, he explains that employees look to receive more gratitude by taking the freshest or best looking instead of the “old” one (Munoz 26 May 2017). This behavior results in Munoz’ major weakness which is the personal attitude of each employee.

Mr. Romes (29 May 2017) confirms Munoz’ and Boller’s opinion by explaining that the misuse of the fifo strategy will have a huge impact on the stored items. He also complains about the highly time consuming inventories and finalizes his answer by saying that there is no clear recordkeeping at the moment to control the storage (Romes 29 May 2017).
Mrs. Fischer (28 May 2017) adds the aspect of spoilage and wrong storing position within the current situation. Furthermore, she also sees the people involved as a huge weakness due to mistakes commonly caused by them (Fischer 28 May 2017).
Mr. Schnitzler (28 May 2017) confirms the experts of chapter two by explaining that theft is a major problem in the hospitality industry.

In their explanations, all chefs refer to the factor human as the main cause of weaknesses. This confirms the theories of Ninemeier (2012;2013), Dittmer & Kallee III (2009), Feinestein (2012) and Hildebrand (2014) which were afore mentioned in chapter 2. However, the interviewed chefs add facts like ignorance of the employees or the general attitude on how to handle food items which are not mentioned by the experts in chapter 2.

By answering question two, all chefs agree that this system as it was presented is definitely a support for chefs. They are delighted about simplicity, the reduced workload and the fact that in their opinion this system will assist them to spend more time in kitchen instead of storing items. Furthermore, all of them confirm that such a system will develop a better overview about the stored items and will delete the inventories. Romes (29 May 2017) adds that he thinks this kind of system is definitely needed in kitchens with high hygiene regulations like hospitals or cantinas.
Schnitzler (28 May 2017) adds that the presented system could prove to be very useful in the cruise shipping industry due to the fact that a perfectly recorded storage is needed during the time the ship is at sea.

However, Boller (26 May 2017) is the only one who thinks, that a system as it was presented will support an uncooperative behavior among colleagues. He thinks, due to the fact that just one employee can handle the system at the same time by declaring the items, the other colleagues will use this time to have a small break instead of preparing the next box. To prevent this situation, he would suggest that the storing process is made by a store man, who will have a positive effect for chefs, so they can spend more time in the kitchen (Boller 26 May 2017).

By answering question three, Romes (29 May 2017), Munoz (26May 2017), Schnitzler (28 May 2017) and Fischer (28 May 2017) were looking critically at the technique which is used to run the storage. In detail, Munoz (26 May 2017) and Schnitzler (28 May 2017) are anxious about the potential risk of a breakdown due to the fact that they think, wherever technology is involved, a high risk of breakdowns is included. However, Munoz (26 May 2017) combines the potential risk of a breakdown with mistakes which are caused by humans.
Romes (29 May 2017) and Fischer (28 May2017) see a limitation in creativity of a chef. To create new courses for a menu, those two chefs collect inspiration by entering a storage and looking at the stored items to get an idea of what can fit together. Furthermore, Romes (29 May 2017) considers the speed of the machines, which can operate too slowly and the chefs lose time while they have to wait for the issuing item.

According to Boller who is afraid of the uncooperative behavior of colleagues as mentioned before, he sees the storing process as a risk to continuous cooling which is caused by too slow declaration of items. This can have a negative impact on the quality of the items (Boller 26 May 2017).

Nevertheless, the chefs are very impressed by the concept and gave also positive feedback and answers to question four. At this point, it was said by every chef that the advantage of fulfilling the fifo strategy is a good innovation. Moreover, all chefs add the fact that the storage is cleaned up and well organized at any time as well as the computer control system gives an exact inventory report at any time which was appreciated.
Furthermore, the recordkeeping system was positively mentioned by Munoz (26 May 2017) and Romes (29 May 2017). They see the recordkeeping system as a way of eliminating the risk of theft because every item, stored or issued, is registered and can be combined with the employee who was asking for it or giving the command to store it.

In addition, the perfect storing positions as well as the fulfillment of the storing condition were appreciated by Munoz (26 May 2017), Schnitzler (28 May 2017), Boller (26 May 2017) and Fischer (28 May 2017).
Romes (29 May 2017) is the only one who looks one step ahead by mentioning the financial savings which can be caused by this system. He sees the potential to reduce staff costs by reducing the staff of the purchasing department as well as saving energy cost.

All chefs are delighted by the inclusion of the HACCP color scheme to the storing system. In case of an employee who is beginning his trainee, it is a good support to teach him that color scheme. (Boller 26 May 2017; Schnitzler 28 May 2017)
The fact that just this certain group of items will be stored in the correct box will have a positive impact on the goods, Fischer (28 May 2017) said. At the current situation it can happen that boxes which were used for meat are used for vegetables the next time (Fischer 28 May 2017).
However, Romes (29 May 2017) and Munoz (26 May 2017) were critically asking if the color scheme is really necessary according to the circumstances, that most of the items are wrapped and nobody can enter the storage area.

Boller (26 May 2017) and Fischer (28 May 2017) see the potential of introducing the concept to the companies they are working for. Boller (26 May 2017) explains that the company has storages which can be entered by machines like lift trucks at the moment and there will be enough space to operate this system. Furthermore, he mentions that he also sees no problems to the financial aspect because of having Red Bull as an investor.

Fischer (28 May 2017) adds, that the smaller the business, the lower is the potential to introduce such a system.
Additionally, Romes (29 May 2017), Schnitzler (28 May 2017) and Munoz (26 May 2017) argue that this system would suit perfectly for hospitals and other food handling industries with high hygiene standards.

Furthermore, all chefs would appreciate this kind of system in the near future because of the simplicity, time saving and hygiene aspects as well as the clear overview about stored and issued items. Aspects mentioned by the interviewee's lead to the assumption, that an introduction of this kind of system is just a question of time according to all chefs. The increasing demands from customers for high quality food, as well as the time saving, cost saving and the supporting aspects for the hotel will result in its introduction (Schnitzler 28 May 2017).

In addition to the chefs, the assistant manager of the Almresi restaurant in Vail, Colorado, Mr. Thoma, was invited for an interview. The questions differ from the questions for chefs due to the fact that a manager focuses on other aspects.
As well as chef Munoz (26 May 2017), the assistant manager of the Almresi restaurant in Vail sees the major weakness of the current storage situation in the attitude of the employees. He adds that employees are often not aware of taking unexpected circumstances into consideration in the ordering process and that some are not counting stored items with care which will create a wrong inventory report. Furthermore, he confirms the chefs in the fact that employees simply do not take the fifo strategy seriously and an inventory reports often take too much time (Thoma 30 May 2017).
With the new system he sees the advantage to be up to date at any second. Additionally he is delighted to reduce the influence of the employee on the storage by having the presented recordkeeping. It is essential to have a full control about the employee and the inventory which represents money. With this system he would be able to have not only a full control about stored items, but also be able to calculate his budget perfectly (Thoma 30 May 2017).
In spite of everything, he sees the daily reports of the system as a weakness due to the fact that it takes too much time to read and compare numbers. He suggests to simplify the reports by introducing a traffic light system which will provide a fast and easy overview about the storage. Furthermore, he views the included technology critically. He sees the weakness that a breakdown will happen without any previous warning, whereas an employee can be observed and a good manager can assume how this employee will react in the near future (Thoma 30 May 2017).

As mentioned before by some chefs, Thoma (30 May 2017) also sees this system as a huge innovation for the industry and the system will eliminate the majority of present mistakes. Agreeing with the chefs, he sees this system in hospital and restaurants which operate with ready cut and convenience products.
However, he points out, that this system would not fit in small restaurants and hotels because he assumes that this system would cost too much for them to be efficient (Thoma 30 May 2017).

The main difference between the experts of the hospitality industry and the experts who currently work (Mr. Busse) and have worked (Mr. Rose) in the engineering industry is the way they acted during the interview. The hospitality industry experts were listening and delighted of seeing a system as the presented, whereas the engineering experts took notes and came up with suggestions how this system will work even more efficiently and what types of machines should be used.

According to both engineering experts, they see this system in the hospitality industry in the near future. As reported by Busse (25 May 2017) there are some aspects which need to change before this system will operate. He recommends eliminating the vertical blinds and installing regular isolating walls with a door which can operate electromagnetically. In his opinion, it would be possible to run a storage as it was presented, but it would not be energetically efficient. Accordingly, the different temperatures from the cold storage and the freezer will mix up and due to the inequality in humidity, icing and blocking of the machines will be the result. Thus, the need of an air curtain is necessary to prevent such events from happening. (Busse 25 May 2017; Biddle Climate Solutions 2017)

To fulfil the cooling conditions, Busse (25 May 2017) recommends to use already existing cooling machines by taking into consideration, that there has to be at least one for each cooling area. Furthermore, he assumes that this storage concept is reasonable for a minimum size of at least 40 square meters. He adds that that this assumption is based on wealthy customers because the automated technology which is used to run the storage system is very expensive.
Moreover, he mentions examples of the industries where they already working with such systems. He names industries like the agriculture industry, pharma industries as well as examples out of the food handling industries (Busse 25 May 2017).
Mr. Rose (27 may 2017) as an expert of the technical aspects sees the system achievable for the hospitality industry. According to Rose (27 May 2017), many aspects need to be clarified during the planning period of such a system. He focuses especially on the acci-

dent prevention regulations, which are very strict for automated systems (Rose 27 May 2017).

Furthermore, he is delighted to see that the human being's impact on the storage facilities is minimized. He sees a huge advantage in a fully closed and protected storage due to the present influences which are caused by employees. Authorized personnel which can enter storages are not taking care of the facilities commonly. Regularly, employees leave the storage with a box or several items in their hand and open and close the door by a kick. In addition, those kicks can damage the storage door which may entail frequent maintenance because the door will not close properly anymore and temperatures my rise. Moreover, if employees clean the cold storages it is also possible that they use the wrong cleaner which could damage the seal (Rose 27 May 2017).
In this case, the hotel has to call the provider of the storage to repair it due to the complex work which needs to be done by experts.

The new system is welcomed by Rose (27 May 2017) despite its weaknesses.
He suggests that the conveyor belt which is part of the presented system would be too expensive and complicated to repair. In case of an abrasion and if the belt needed to be changed, the replacement would be complicated and consume a lot of time. Due to the sluice gates the belt has different lengths which have to be stored in a maintenance storage. He recommends the usage of rolls instead of the rubber conveyor belt. According to his experience with automated transportation systems he suggests rubber-coated rolls to maintain the slip-resistance, which is necessary to transport the boxes to their final position. This will simplify further maintenance and reduce costs for spare parts (Rose 27 May 2017).

Additionally, he recommends to use light sensors within the transport instead of the bar code scanners which are part of the system at the moment. Bar code scanners are only needed at the entrance and in front of the shelves to recognize the issued box. This will also have a positive impact on the costs for that system (Rose 27 May 2017).

The fact that this system includes many different divisions like electrical engineering, automation technology, sanitary engineering and refrigeration technology leads to the issue that this system needs maintenance contracts with different expert companies. It would not be financially efficient for a hotel to hire special personnel for that system, which is needed in a case of a breakdown. Thus, he recommends a combined solution of external and internal technicians. Small maintenance work like changing a roll of the conveyor belt or controlling an electronic engine are tasks which can be fulfilled with hotel internal staff.

However, maintenance work of the automatization technology, sensor technology as well as the refrigeration technology must be controlled and checked by industry experts (Rose 27 May 2017).

In conclusion, Rose (27 May 2017) mentions that the control system was thoughtful in operating the system redundantly, which is essential, whereas the control system cannot be the merchandise management system at the same time. It could be possible to instruct an IT company to write and code such a system, but this will cost unnecessary money. To lower the costs, he suggests a merchandise management system provided by SAP Solutions, a German technology company. Those systems are perfect for the presented system and would lower the cost in acquisition (Rose 27 May 2017).

6 Conclusion

The purpose of this research was to investigate if the presented system is reasonable for the hospitality industry. The bases of the new system are the weaknesses of the industry's current situation, mentioned by hospitality experts like Ninemeier (2012;2013.), Feinstein& Steffanelli (2012), Cooper & Schindler (2014.), Dittmer & Keefe III (2009.) or Hildebrand (2014.) in chapter 2.

With regard to the detected weaknesses of the current storage situation, disregard of storage strategy, wrong temperature for stored items, wrong placement in storage, damaged items, theft, spoilage, lack of control procedures, contamination of storage, inventory for stock control, the author tried to create a storage system which will prevent all those weaknesses. To familiarize himself with weaknesses of the current situation, an additional observation was conducted in Hotel X. The findings were also taken into consideration while creating the new system.

To prevent the weaknesses presented in chapter 2.4, the usage of technology is indispensable. According to chapter 2 all weaknesses were caused by humans and had an impact on the storing situation in the hospitality industry. To minimize the factor human technology is a good approach.

The need for a new system as well as the question if this system is reasonable for the hospitality industry was investigated in qualitative research. The system presented in chapter 3 was commonly appreciated by all interviewees. According to them, there is a need for an improvement of the current situation, which can be solved by a system as presented. All aspects which were developed in chapter 3 were welcomed but also reviewed critical. Suggestions and improvements were recommended and are essential to take into consideration for further studies.

To provide a system which will support chefs in storing and issuing procedures as well as providing managers with detailed inventory reports without mistakes, several changes in the presented system need to be done. To provide a system without mistakes it is essential to contact engineering companies who have the experience in constructing automated systems.

In conclusion the system presented in chapter 3 prevents all weaknesses of the current situation but also introduces problems which need to be resolved.

It is essential to say that the conducted research cannot be generalized to the whole hospitality industry. Further studies need to be done to receive a comprehensive overview about the practicability of such a system. Furthermore, the system was created without consideration ofaspects like profitability, engineering details, physical dimensions, construction costs, as well as amortization of the new system. To receive a reliable result, those aspects need to be included in further studies.

However, even without considering those aspects, the need for a more transparent storage system in the hospitality industry is magnificent.

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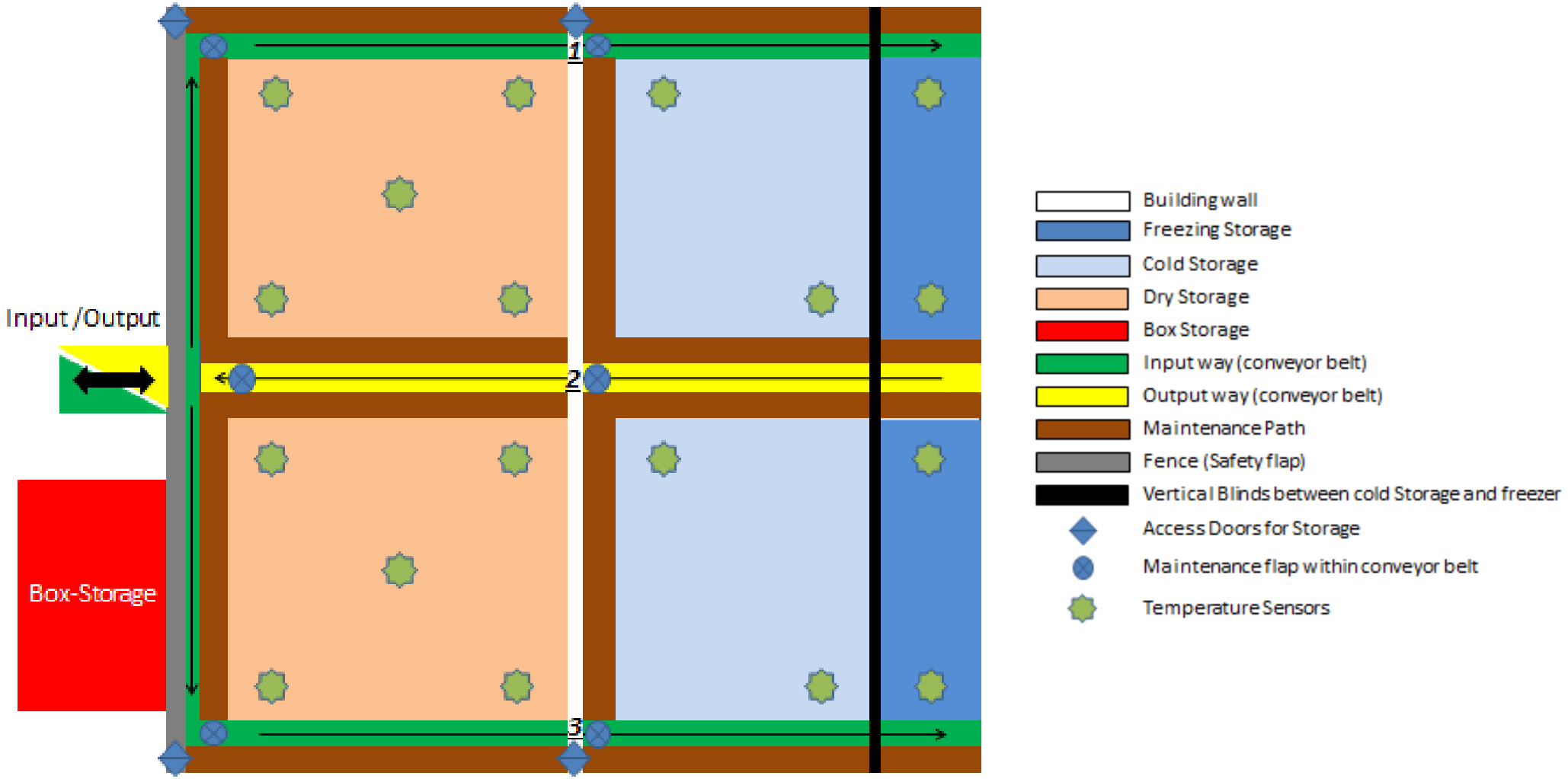
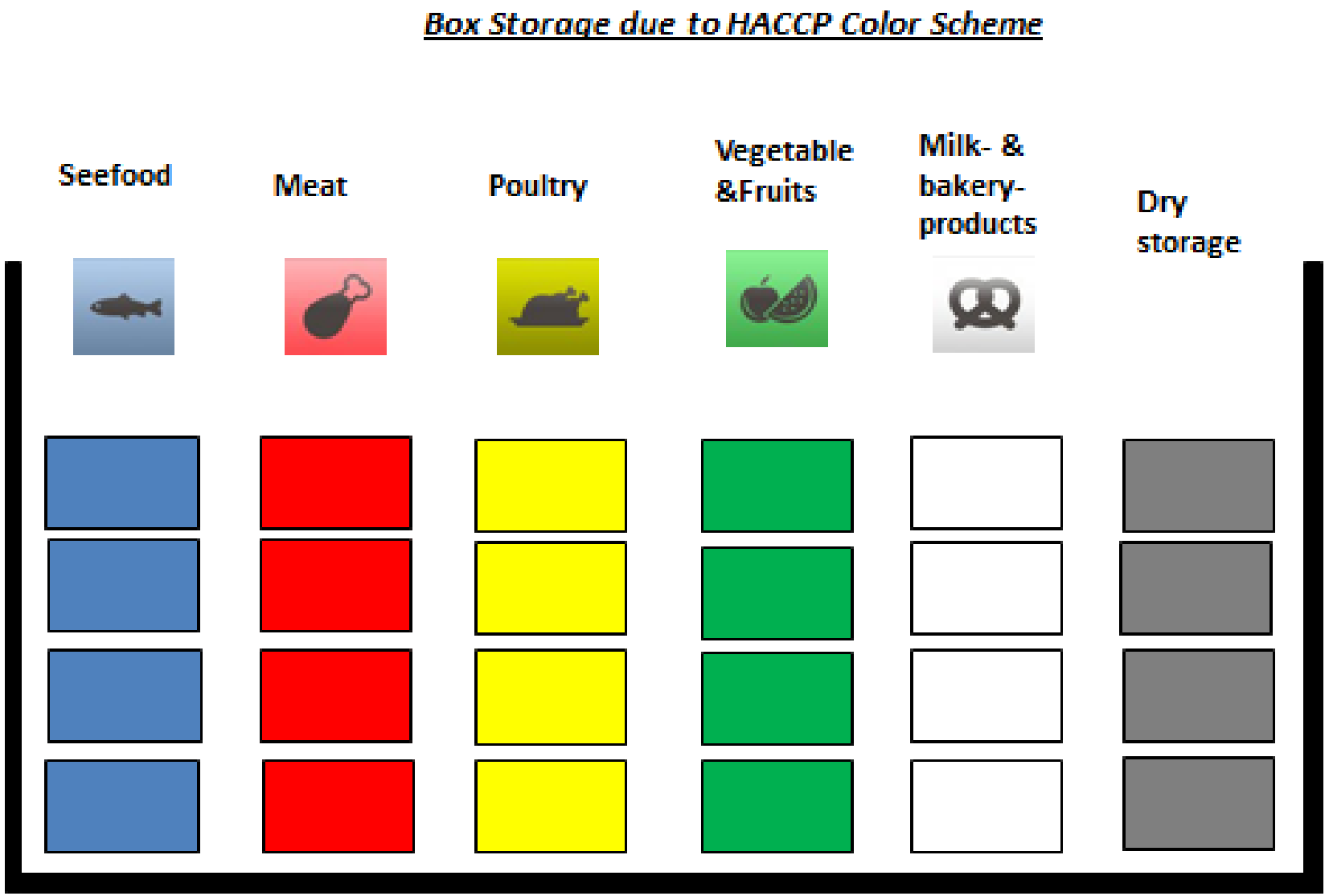
Appendices

Appendix 1 Drawing of the new system



Appendix 2 Box Storage



Appendix 3 Information about Interviewees

Date	Gender	Name	Working experience in years	Current position	Company	Destination
25th of May 2017	Male	Busse, Benjamin	14	Chief executive officer	F.B. Wärrme- Kälte- Schall- + Brandschutz GmbH	Minden, Germany
26th of May 2017	Male	Boller, Stephan	10	Commis de cuisine	Restaurant Ikarus- Hangar 7	Salzburg, Austria
26th of May 2017	Male	Munoz, Damian	8	Junior sus-chef	IL barcaiolo	Rottach-Egern, Germany
27th of May 2017	Male	Rose, Martin	13	Assistant chief engineer	Hotel X	Rottach-Egern, Germany
28th of May 2017	Female	Fischer, Cornelia	13	Chef de partie	Restaurant Überfahrt***	Rottach-Egern, Germany
28th of May 2017	Male	Schnitzler, Marcus	26	Director of staff restaurant	Hotel X	Rottach-Egern, Germany
29th of May 2017	Male	Romes, Kevin	10	Chef de partie	Einstein Hotel St. Gallen	St. Gallen, Switzerland
30th of May 2017	Male	Thoma, Joshua	8	Assistant Manager	Almresi	Vail, Colorado United States of America

Appendix 4 Questions for the interviewees

Questions for chefs:

Question 1	• Which weaknesses can you mention in the current storage systems?
Question 2	• Do you think that the presented system can be supportive for chefs and for their storage routine?
Question 3	• Which weaknesses can you identify in the presented system?
Question 4	• Which advantages the presented system can offer compared to the current storage system?
Question 5	• Will the color scheme be supportive for chefs during their storage routine according to the identification of the product group?
Question 6	• Will the presented system be profitable for the company you are working for?
Question 7	• is this a reasonable system for the hospitality industry ?

Question for food and beverage manager:

Question 1	▪ Which weaknesses can you mention in the current storage systems?
Question 2	▪ Which challenges do you identify at the documentation of inventories?
Question 3	▪ Which aspects within the presented system do you identify as critical?
Question 4	• Which advantages the presented system can offer compared to the current storage system?
Question 5	▪ Will the presented system be profitable for the company you are working for?
Question 6	▪ Is this a reasonable system for the hospitality industry?

Question for engineering expert Mr. Busse:

Question 1	• In your opinion, is the presented system feasible?
Question 2	• Is it possible to separate the refrigerated storage from the cold storage with slatted walls? Will this be efficient?
Question 3	• Is it possible to separate within the cold storage into different cooling zones?
Question 4	• Which cooling system do you can recommend for the cooling (refrigerated and cold storage) of food within the presented concept?
Question 5	• Where the cooling units have to be placed to obtain the perfect cooling (location and amount)?
Question 6	• At which size a cold storage with automation will be useful?
Question 7	• Could you name some examples for still existing systems like the presented one?

Questions for engineering expert Mr. Rose:

Question 1	• In your opinion, is the presented system feasible?
Question 2	• Which advantages the presented system can offer compared to the current storage system?
Question 3	• Which weaknesses can you identify in the presented system?
Question 4	• In your opinion, do you see an advantage in the problem solving procedure as it was presented?
Question 5	• Is there a possibility to maintain this kind of storage with hotel internal technician?
Question 6	• is this a reasonable system for the hospitality industry?