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FINAL THESIS REPORT

eGate Solution for Self-Service Restaurants

Case TAMKOTUKI

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ABSTRACT

Self-service restaurants might often be crowded and lack decent customer flow planning. This has lead to the need of enhanced payment systems and reworked lay-out. This thesis was done for TAMKOTUKI Restaurants.

The aim is to find out what would be the better and improved system that would make self-service dining more convenient, faster and hassle-free. In this thesis the main target is to find out, what would this system be and would it be suitable for TAMKOTUKI.

The starting point for the project was to combine advanced RFID technology and automated payment control. These would create benefit to the diners and restaurants. Literature on the main fields, RFID and queue management, was not immense but sufficient. As RFID still is an evolving technology, there are still quite a few questions up in the air of its future uses.

Establishing an RFID based payment system in a self-service restaurant is not an easy task. However, depending on its scope and flexibility, it is a feasible and beneficial solution. This is especially for restaurants that have a relatively great amount of daily visitors.

A buffet style RFID card based payment solution is introduced on the last pages. This model is recommended for advanced studying for TAMKOTUKI Restaurants. It is rather light on the technology but brings significant benefits.

Key words: RFID, self-service restaurant, queue management, electronic payment

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1 Introduction

In present day the self-service restaurants such as student and personnel restaurants most often work in the so called traditional way. First the diner collects the meal and beverages from various options and pays in the end of the distribution line. This is done by using several different payments methods. This method of collecting and paying for food can be referred to as the selection, payment and consumption (SPC) structure (Gössinger 2005: 2).

The problem lies by the cash, see figure 1. Often the actual paying takes most of the time and makes the queues grow at peak hours. This is usually frustrating for many customers.

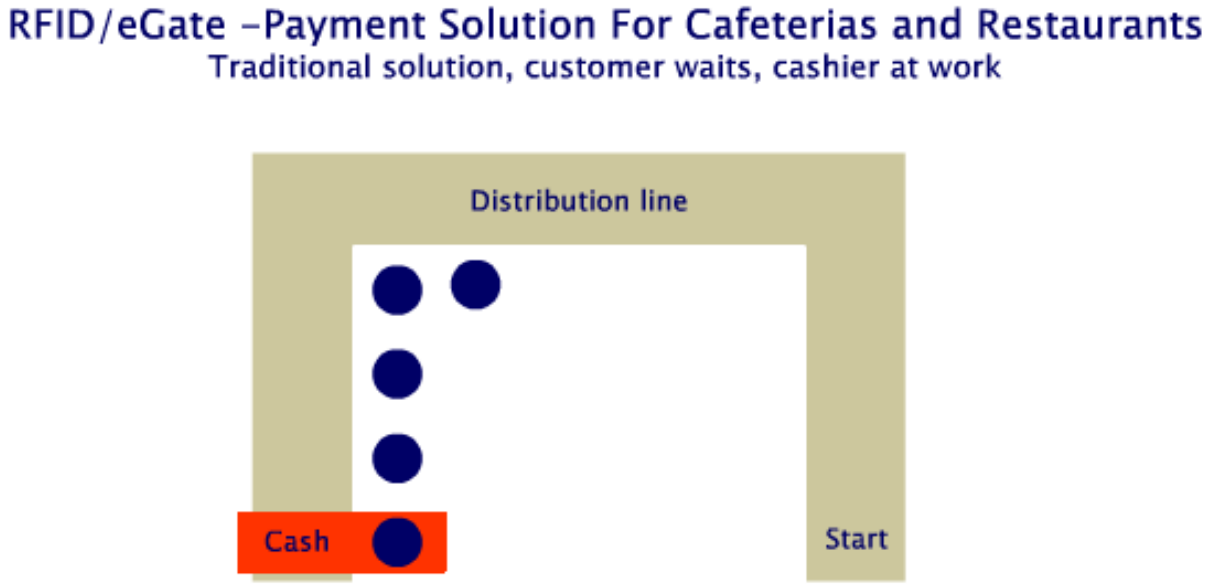

Figure 1 Traditional payment solution

The main aim of this final thesis is to find out how the TAMKOTUKI restaurant operations could be improved by introducing a new method of paying and managing the queues.

1.1 Research Method

As a research method case study was used. In case study there is always a problem to be solved. Case study can be interpreted also as a deep study on a matter, trying to understand the real insight of the situation and organisation the work is being done for. It might also give a picture of why something happened in the way it did. In a case study the researcher normally selects one or few topics which are to be profoundly examined. (GTTP: How to write a case study.)

Case study has long roots. It has been used in Europe and in the United States of America from the early 20th century. In the beginning it was mostly associated with sociology. The method was criticised in the beginning and only later in 1960s case study became widely accepted as a research method. (Tellis 1997: Introduction to Case Study.)

In present, case studies are widely used in the field of business, law and medicine education. In case studies one often has to bind information and knowledge from different areas such as marketing, management, information systems, and operations among others. This makes students aware of interrelatedness of various subjects. (Tellis 1997: Introduction to Case Study.)

1.2 Radio Frequency Identification Technology as the Enabler

In recent decades evolving new technology called Radio Frequency Identification (RFID) has enabled innumerable unseen solutions. As the technology is getting cheaper day by day, we are seeing more RFID based systems in every day life.

RFID especially plays a big role in tracking goods. Most common place to find a vast RFID system would be an immense warehouse or a global package deliver company that handles perhaps hundreds of thousands of packets and other items a day. With this technology these companies can track the exact locations of any packet any time.

In addition, there are a good amount of other ways this technology is used. Many of us use RFID based public transport or building access cards. Cars and trucks are recognised and charged high way tolls with this technology. Even live stock, such as cows and pigs, are controlled with radio frequencies. In this Final thesis RFID also plays a major role as it creates totally new possibilities for payment systems.

1.3 Thesis Structure

Part two “Managing Self-Service Restaurant Queues” explains more about the restaurant functions in order to understand how the restaurant lines are controlled and managed.

Part three “Psychology of Waiting” tells about how customers react on waiting and how this experience can be improved.

As the proposed solution largely relies on RFID technology, it is widely explained in part four “RFID Technology”. This part will include a profound explanation of the history and the technology itself.

Part five is the actual case. In this part the TAMKOTUKI situation is explained, three different payment solutions are introduced and one is selected as the most suitable for TAMKOTUKI.

2 Managing Self-Service Restaurant Queues

Planning and creating a smoothly running self-service restaurant might not be an easy task, especially if there is a great amount of expected daily diners and if the layout area is relatively small.

2.1 Basic Self-Service Restaurant Queue Forms

A diner is involved in three basic processes when eating at a self-service restaurant. For a detailed table see appendix 1. These include

Food selection: choosing dishes and beverages offered at different counters.

Food consumption: selecting a table, consuming the selected food

Payment: paying for the consumed goods at the cashier.

Since only the relationship between food selection and food consumption is fixed, these processes can take various places. To put it all together, paying can be done before, in between or after selection and consuming the goods. However, food selection must always be done before eating (Gössinger 2005: 2).

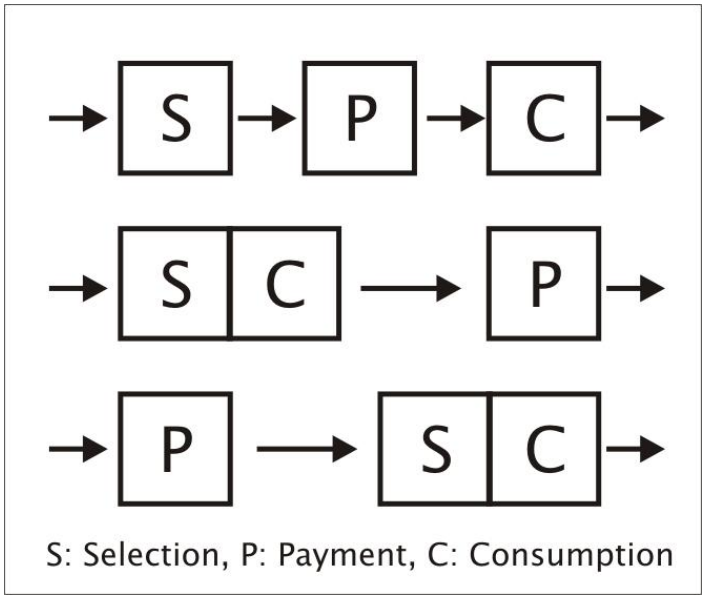

Figure 2.1 Basic structure of self-service restaurant processes (Gössinger 2005: 2)

There are three basic ways of organising the self-service restaurant basic functions, see figure 2.1. First of them is the traditional selection – payment – consumption (SPC). The second one is called selection – consumption – payment (SCP). The last and third one goes by the name of payment – selection – consumption (PSC). All these three models are explained in details in the following subsections.

2.1.1 Scenario 1: Selection – Payment – Consumption (SPC)

This is the so called traditional structure. If a restaurant is organised this way diners will arrive and start selecting food stuff. Most often trays are taken first followed by other items. Diner can select between a set number of choices. After collecting the desired items the diner will pay at the cash. A characterising factor in SPC solution is a single queue at every counter. (Gössinger 2005: 2.)

As the payment process is complete, diner can enjoy the selected meal in the dining area, which is separated from the selection and payment area. As the customers have finished their meal, they can immediately leave the restaurant, or if wished, restart the self-service process. (Gössinger 2005: 2.)

2.1.2 Scenario 2: Selection – Consumption – Payment (SCP)

This structure has seen its start days in recent decades and it can be found only in a limited number of restaurants. Upon the entrance to the restaurant each diner is given some sort of identification, children might be excluded. This can be a piece of paper, a state-of-the-art RFID card or anything in between. As the customers choose food items, they are recorded to the identification method (for instance Vapiano restaurants in Germany with RFID cards, high way resting area restaurants in many countries with paper coupons).

After selection, diners enjoy the meal in a nearby food consumption area. This area is connected to the food selection area and customers can restart the selection process whenever wanted.

As the customers are done with eating, it is time to check out at the cashier. All recorded food stuff is retrieved from the identification method, total sum introduced and final amount paid by the customers. If a customer loses identification, often a set amount of money must be paid. This commonly equals many times the amount generally spent by an individual at the restaurant. (Gössinger 2005: 3, Vapiano restaurant website.)

2.1.3 Scenario 3: Payment – Selection – Consumption (PSC)

These sorts of restaurants are commonly known as buffets. They are many for instance in the Nordic countries, but known everywhere in the world. As entering the restaurant, in between eating, just before leaving or at another event point customers have to pay a lump amount of money for the food selection. Sometimes beverages are included in the price and sometimes not. There are a few variations to this, but the basic idea is the same all over. In this model customers have an unlimited access to the food selection and can eat as much as they wish. However, taking food with for the same price is normally not allowed. (Gössinger 2005: 3)

2.2 Routing Within the Selection Area

In addition to food consumption and payment, food selection has multiple stages and many possible routing options. There are three basic possibilities to organise the selection area, see figure 2.2. In the following, a counter can be interpreted as a part of a longer counter or an independent, free-standing, smaller counter.

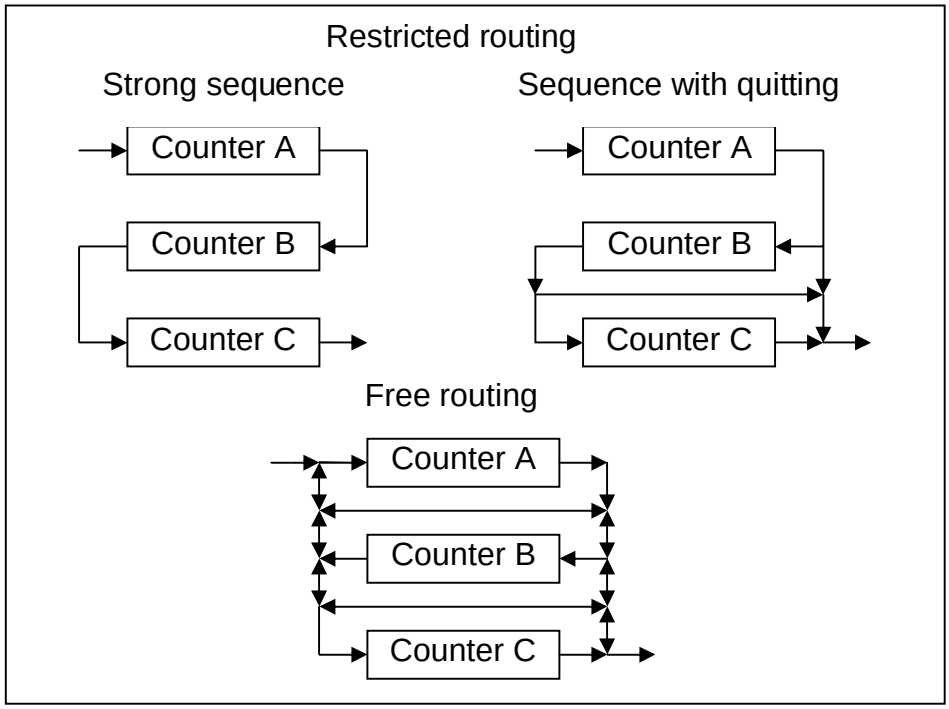

Figure 2.2 Self-Service Restaurant routing options (Gössinger 2005:3)

Free routing. Customers can freely select which counters they visit. The possibilities might include main dish, salad, dessert, beverages counters among others. There is no prearranged order diners must visit the counters. For instance they could first have drinks and the move on to desserts, salad and main dish counters, or vice versa. This could also be done in a mixed order. In this kind of a restaurant counters often are physically separate and do not have to be in any kind of special order.

Restricted routing, sequence with quitting, single queue. Customers can leak from the single queue after having selected the desired items. They can not take the same position again; instead they must start from the beginning if they want to restart the selection process. If the desired item is in the very end of the line of counters, diner must queue all the way before being able to select the wanted product.

Restricted routing, strong sequence, single line. Customers must go through the whole line, even if they do not want to choose anything from the subsequent counters. Often, a cash desk is in the end of this kind of a line. (Gössinger 2005: 4.)

In order to learn more of the queue management methods, see appendix 1.

3 Psychology of Waiting

Waiting and standing in queues seems to be rather unpleasant for most of us. We tend to stand regularly in lines, some many times a day, some perhaps just occasionally. How annoying people find waiting, greatly depends on an individual. For some, standing in a queue just a minute or two might seem like forever. For others it feels nothing. (Carmon et al 1995: 1806.)

In a deliver company advertisement it is said clearly: “Waiting is frustrating, demoralizing, agonizing, aggravating, annoying, time consuming and incredibly expensive." Many have obviously felt the same way. It is important to understand the meaning of waiting-lines, since this can significantly affect the overall evaluation of a service provider. Shorter queues might mean better business. Therefore it is important to find ways of cutting down the time spent in a line. (Maister 2005:1.)

As there are tools for making queues shorter (as the eGate solution presented in this final thesis), waiting cannot totally be deleted, at least for the time being. However, we can influence the experience of waiting. This is an intelligent way of influencing how customers feel about the organisation providing the service. (Maister 2005:1.)

3.1 Law of Service

In his paper Maister introduces law of service. He calls it simple but powerful.

$S = P - E$

Where S stands for satisfaction, P for perception and E for exception. If a customer waits for a certain service level (E) and what one receives (P) is higher, customer is satisfied. If a customer expects more than previously and receives the same, customer is dissatisfied. (Maister 2005: p.1.)

What customers think is naturally their own opinion. The reality might be something different. After all, it is hard to impartially define the absolute truth. However, as customers are the source of income, it is important to gain information on their feelings and actions. Following examples prove that clever business managers understand the importance of customers’ feelings. Sometimes not that dramatic change is needed to make them feel better. (Maister 2005: 2.)

A hotel chain received regularly complaints about the long waiting time for elevators. After an analysis it was decided to install mirrors to the elevator waiting areas. This reduced complaints, since people are naturally keen on checking their personal appearance. However, the actual waiting times did not change. (Maister 2005:2.)

Some popular restaurants are used to promising customers a waiting time in excess in order to keep them happy. Most often people get seated earlier than promised and this is positive sign for the diners. Should a service encounter start with a relatively long wait, it might become nearly impossible to make customers happy again. If a long waiting cannot be avoided, there might be some ways of making the actual waiting process. (Maister 2005: 3.)

These two examples show how the satisfaction level at these service locations was reached. First customers might be unhappy but later after enhancement the perception level rises, which will affect the satisfaction level as well. (Maister 2005: 3.)

3.2 Reworking the Waiting Experience

There are simple tools for making waiting seem shorter and more comfortable if the waiting time itself cannot be influenced. Even the smallest service company can review these statements and improve their customer experience. (Maister 2005: 3.)

“Occupied Time Feels Shorter Than Unoccupied Time. People want to get started.” If you can keep customers busy while they are waiting, might make them happier. Some restaurants give menus to guests waiting to be seated. They feel that the service has begun already. This also makes the service faster as they already know what to order. (Maister 2005: 4.)

There are many restaurants whose managers tell the service staff to pass by a table right after the customers have seated. This makes them feel acknowledged and not forgotten. (Maister 2005: 4.)

"The other line always moves faster.” Many of us certainly have been in a situation in which selecting a line has been necessary. This might have happened for example in a supermarket, bank or airport. Some service providers have introduced a single line waiting system, or even better, an automated queue number system. These two will ensure that all customers get service on the so-called “First in, first out” basis. The anxiety level of customers will not rise, since they are

aware that they will be served equally and as quick as any other will. (Maister 2005: 5.)

"Uncertain Waits Are Longer than Known, Finite Waits." Sometimes it happens: a doctor is late or flight is delayed. In this kind of situations customers will be more confident and will show more understanding if they are told how long the wait will be. Should a patient be told that surgeon is late, one might be nervous and unable to settle down. However, if the patient is told that surgeon will arrive in 45 minutes, the patient will accept the wait after initial annoyance. It is understandable that sometimes it is impossible to tell the exact wait times in a case of delay. In these situations, customers should be let known when and how they will receive further information on the matter. (Maister 2005: 6.)

Appointment systems are in a way queue management methods. Instead of line managed at the service providers premises people can wait at home, work or at another place. These systems suffer from the fact that some people make appointments without showing up. Therefore some organisations have introduced different guarantee methods, such as compulsory credit card information upon making the reservation. (Maister 2005: 6.)

"Unexplained Waits Are Longer than Explained Waits" If a person requesting for a service knows of a special situation or circumstances, one is more likely to accept the wait. If getting sick on the flu time of the year, one might accept the extended wait at the doctor's reception more likely than if the wait happens just in a season without any special disease around. If waiting at the airport for a flight, or even better on boarded, the information of why the departure is delayed will make a significant difference. (Maister 2005: 7.)

Waiting in ignorance creates a feeling of powerlessness. This might lead to visible irritation on the customers' side as they try to reactive their status as paying clients. (Maister 2005: 7.)

"Unfair Waits Are Longer than Equitable Waits" One of the most irritating waits is when one cannot be sure of being treated equally with others. Sometimes somebody might be able to cut in at a queue anywhere. If you arrive at a restaurant and get seated after someone that has arrived later is a major reason for customers to become angry (Sasser et al 1979: 89, Maister 2005: 7.)

In many situations, there is no strict order to who came first or who the last to join was. In many situations, this does not even matter. The

waiting for a train on a platform with a bunch of people might create a lot of nervousness among the people. Instead of being able to relax, they must constantly observe the crowd in order to secure a seat in the fully packed car. (Maister 2005: 8.)

"The More Valuable the Service, the Longer the Customer Will Wait"
The tolerance for standing in line and waiting is often dependent on the value of the service the customer waits. For instance having a lunch on a workday might have a significant impact: one might find it extremely unpleasant to not to have a lunch. Therefore, even long waiting times might be acceptable if other possibilities are not available. However, this is not considered decent service and if other, better service provider was introduced, customer would most likely change there. (Maister 2005: 8.)

3.3 Importance of Queue Management

These examples show that waiting in a line is often frustrating for most of us. There are some tools that might cut the actual waiting time but it is important to understand that psychological experience of waiting can also be managed. Waiting situations are also, if not always, often context related. Therefore, every service manager can see to their lines themselves and consider enhancements.

4 RFID Technology

RFID stands for Radio Frequency Identification and it has long roots. It is a result of work done during many decades. It all comes down to a small chip that has an antenna that goes around it. The chip is actually a transmitter and memory that can contain some simple or more sophisticated information. Often this is a series of numbers, for instance an identification or product number. (Finkenzeller 2003, Shepard 2005.)

In this technology, there are three basic elements: transponders that are widely known as RFID chips or tags, readers and underlying computer application including database that actually make everything run in the desired way. (Finkenzeller 2003, Shepard 2005.)

4.1 RFID History

4.1.1 Barcodes

Barcode is the first step for product identification, which RFID also represents. There was a great need for instance grocery retailers already in the 1920s to estimate their inventories automatically. A new system to do this was urgently needed. This only happened much later as barcodes had become widely accepted technology. (Finkenzeller 2003, Shepard 2005.)

In a basic RFID-chip same kind of information is available as is in a barcode: product number, nothing more, and nothing less. It is the intelligent background system that holds all the vital information on logistics and inventories. (Finkenzeller 2003, Shepard 2005.)

The first barcode reader was immense; it was the same size as two washing machines together. Of course, this was not a vital solution but it was a promising start for IBM engineers. Barcodes made a major breakthrough in 1980s as laser scanners became more efficient and affordable. (Finkenzeller 2003, Shepard 2005.)

During the development days, there were two different barcode solutions, circular and linear. The linear one took the first place. There are a few variations of this version. Most commonly used are the American ones that are known as Universal Product Code (UPC),

Europeans as European Article Numbering (EAN), Japaneses as Japanese Article Numbering (JAN) and finally International Article Numbering (IAN). Most often, these are compatible among themselves. However, there are other bar codes in the market as well (Finkenzeller 2003: 3, Shepard 2005: 27).

Barcodes revolutionized paying, tracking and storing products, this might be called as mechanized inventory control. With barcodes it was easy to manage large and complex stocks. However, barcodes were designed to work in an environment, where a product would need to pass a barcode reader. This was enough for retail environment, such as supermarkets and certain assembly lines. (Finkenzeller 2003, Shepard 2005.)

New applications were rising and these would require identification system with greater reading distance and the possibility of not having a visual contact. Barcodes also face a variety of problems that make it difficult for scanners to accurately read them. These are application depended and include for instance dirt, intense sunlight and scratches in the barcode. These factors helped the RFID technology to develop. (Shepard 2005:12-30.)

4.1.2 The Development of Radar

As many other civil solutions, RFID technology has its roots in military identifications systems. These technologies are based on an array of innovations that began in the 1940s. Especially the Second World War gave a great impact on the development processes. (Finkenzeller 2003, Shepard 2005.)

What radar (radio detecting and ranging) have in common with RFID technology, is that they both use radio waves. When a radio signal from radar reflects from a target, it is much alike when an RFID tag emits a signal after having been searched by an RFID reader Shepard 2005: 42).

4.2 Emerging of RFID Technology

4.2.1 1960s

In 1960s a collection of important innovations and researches were made. These include such as modern computers, lasers and integrated circuits. Significant studies made on RFID include “Remotely Activated Radio Frequency Powered Devices (1963)” by

Robert Richardson and “Interrogator-Responder Identification System (1967)” by J.P. Vinding. Another important seminal paper was introduced in 1975 by Freyman, Depp and Koelle with a title “Short-Range Radio-Telemetry for Electronic Identification Using modulated Backscatter”. (Finkenzeller 2003, Shepard 2005.)

Companies whose main point was to detect shoplifters were founded at those times. Such enterprises as Checkpoint and Sensormatic were pioneers in the field of radio frequency based product identification. These companies created a 1-bit RFID-tag, which made it possible to detect a product that carried such a tag. These tags are deactivated at the time of purchase and so secure a non-alert departure for the customers. Otherwise, an alarm would sound at the exit gates. (Shepard 2005: 47.)

4.2.2 1970s

In 1970s, commercial applications started to appear, thanks to the many earlier innovations and researches. The Los Alamos Scientific Laboratory, which was situated in New Mexico, also played a significant role in making RFID solutions commercially feasible. In 1970s the first real RFID tag was developed. A patent request for a transponder was made. (Finkenzeller 2003, Shepard 2005.)

Among other such companies as Philips and General Electrics (GE) developed a car tracking system, which helped the New York and New Jersey local authorities to easily collect toll payments from road users. Other applications that changed the way supply chain was monitored were also offered (Shepard 2005: 48)

4.2.3 From 1980s to the New Millennium

The last decades of the second millennium were time of RFID systems to grow and become stable. Now that the end users also knew what could be achieved with this new technology, markets stabilized. The major customers for these systems were railroads and container associations. RFID had largely helped to track the movements of expensive train cars, shipping containers and pallets (Shepard 2005: 49).

RFID has become an everyday matter; we face solutions everywhere. For instance public transport providers widely use radio frequency based payment solutions, ski resorts control the access to the lifts. Entrance to home, work places, and universities are under RFID

control. Besides these applications, the main users still are in industry as described in previous chapter. (Finkenzeller 2003, Shepard 2005.)

4.3 Fundamentals of RFID

As discussed earlier Radio Frequency Identification Systems have three basic elements. These are readers, transponders, which are often called RFID tags and software, which typically includes a database. The software combined with the database makes everything run in the desired way. This is the underlying system that processes information gathered from various tags. (Finkenzeller 2003, Shepard 2005.)

There are two different types of transponders; they are either passive or active.

An RFID tag comprises of a processor, a memory and an antenna/coil, see figure 4.3. Chip processes information and it has a memory to which information is stored. Most often an identification number is stored into the memory of an RFID chip (Shepard 2005: 55).

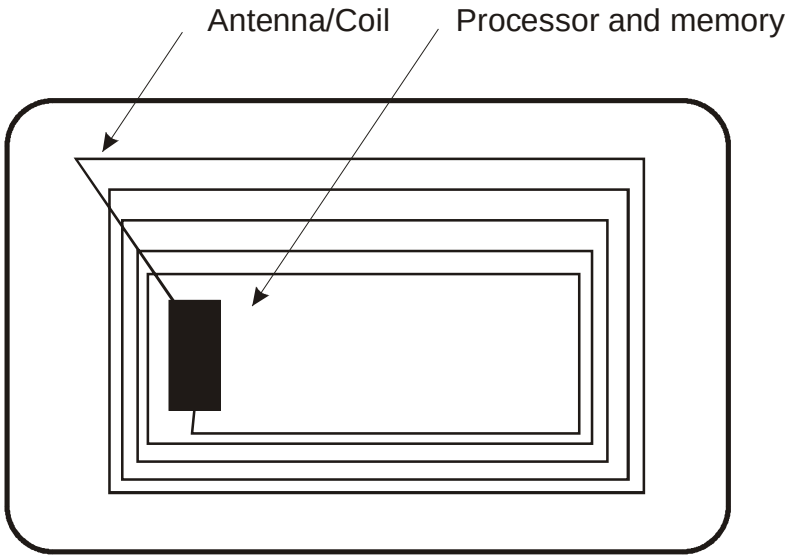

Figure 4.3 Anatomy of an RFID Tag

4.3.1 Passive Transponders

Passive tags do not have a power supply of their own. They only rely on the power they get from the reader. As the reader tries to find tags, it creates an electrical field. Passive chips use this field to derivate power, and this is enough for them to send an existential signal back to the reader. (Finkenzeller 2003, Shepard 2005.)

Since the transponder does not have its own energy source, the reading distance is greatly shorter than with the active tags. However, this does have some advantages. As the reading distance is short it is more obvious that the reader somehow could be accidentally be used in error. They are also relatively small in size, which helps the affixation of such tags, also to items that do not have a lot of surface. As they do not have a battery of their own, they are virtually everlasting devices. One can also consider them lightweight. (Shepard 2005: 57.)

Figure 4.3.1 Passive RFID transponder (TechFreep 2008)

4.3.2 Active Transponders

Active tags on the other hand do have an internal battery. As they have own energy for transmitting signal, the reading distance is greatly bigger; this could up to some 30 meters. Since they have an internal energy source, they also are greater in size, see figure 4.3.2. This sets a few restrictions on their use and they are most often used

in different environments than their passive counterparts. For instance, these include automated high way toll-paying systems and tracking large items in a warehouse, such as a product pallet. (Finkenzeller 2003, Shepard 2005.)

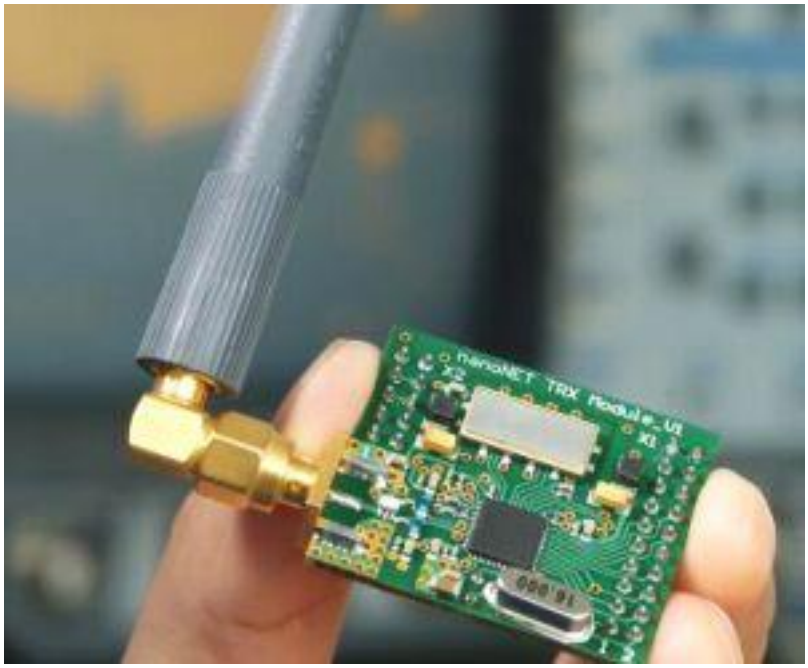

Figure 4.1.2 Active transponder (ScienceProg 2008)

To determine which transponders should be used in an application depends on its future purpose. Passive transponders are typically used in applications where a large amount of them is required. The application also needs close proximity between the reader and transponders. A good example of such a system is a future retail application for instance at a super market. Passive tags are remarkably cheaper than active ones and therefore it would be possible to tag each item in a store. (Finkenzeller 2003, Shepard 2005.)

Active tags are often chosen for situations where they will be needed in smaller amounts and with a greater reading distance. These contain normally big items such as ship containers (Shepard 2005: 59).

4.3.3 Readers

The second important part of any RFID based systems is the reader. For physical appearance see figure 4.3.3. These will energize the

passive transponders and receive information from both the active and the passive tags. In some cases, readers may change the data stored in the tag memory. (Finkenzeller 2003, Shepard 2005.)

Readers have two important responsibilities. First, they activate tags that are in their area of control and make them send signals back. Second, they transmit the signal information to the background system that will then process the information. Often readers are attached to some sort of processor that collects the data before passing the data to the database. (Shepard 2005: 113.)

Figure 4.3.3 RFID Reader (GAO RFID Inc. 2008)

4.3.4 Operating Frequencies

Readers and transponders operate in a variety of different frequencies. These range from low frequency RFID devices (30 to 300 KHz) to high frequency (3 to 30 MHz), to ultra high frequencies (300 MHz to 1 GHz) and to microwaves (1 to 6 GHz). See table 4.3.4 for details. (Finkenzeller 2003, Shepard 2005.)

Operating frequency	Advantage	Liabilities	Applications
Low frequency 30 to 300 KHz	Widely deployed, broad global frequency deployment, metal interferes minimally	Read ranges limited to less than 1.5 meters	Animal tracking, container tracking, antitheft systems
High frequency 3 to 30 MHz	Widely deployed, broad global frequency deployment, minimally affected by moisture	Read range limited to less than 1.5 meters, metal poses serious interference problems	Library asset tracking, access control, baggage tracking, retail product tracking
Ultra high frequency, 300 MHz to 1 GHz	Widely deployed, read range is significantly greater than other standards	Adversely affected by moisture, adjacent tags cause detuning	Pallet, container tracking, vehicle tracking
Microwave, 1 to 6 GHz	Read range is significantly greater than other standards	Not widely deployed, complex implementation	Vehicle access control

Table 4.3.4 Common use of RFID frequencies (Shepard 2005: 168)

Lower frequency systems require minimal operating power and are less expensive than their high frequency counterparts. Low-end devices can transmit signals up to 1.5 meters, are not sensitive to orientation, and normally can be read trough metallic overlays.

High frequency devices require more power and are more expensive. They support greater reading distances and data transmission rates. These devices might have to be oriented to the right direction in order to gain connection. Metal surfaces might also become a problem when devices are trying to get contact. (Shepard 2005: 61.)

4.3.5 Software

There are many different applications that can be used together with RFID technology. For instance at a future supermarket a cash system integrated with a database holding information of all the items in the store would be used. This kind of system will be rather complex and developing such software might turn out to be a demanding task. In addition, other systems will be used. These would include for instance data mining, Knowledge management, Customer Relationship Management (CRM) and Enterprise Resource Planning (ERP). (Finkenzeller 2003, Shepard 2005.)

These systems will create many sort of information to company management and operations. The key is that with RFID technology many steps can be done automatically and in real time. For instance, a warehouse inventory could be done on time automatically in a matter of some tens of seconds. No manual input is needed. Right after, results and reports could be printed out from the cooperating system. However, RFID tracking can be attached to many smaller systems than previously described industrial software (Shepard 2005: 114-123).

4.4 Benefits of RFID

RFID technology acts as a superb aid to other systems. Many previously hand made tasks are now automated. They are run through quickly, efficiently and most often very error free. Expressively it must be noted that an RFID system is nothing without another system it feeds information to.

5 Case TAMKOTUKI

5.1 TAMKOTUKI Company Profile

TAMKOTUKI is the company that operates two student and one personnel restaurants in the Tampere Polytechnic University. It also offers the services of a book store to students and public. The firm offers catering services to a vast variety of customers. The latest addition to the TAMKOTUKI portfolio is Wäkipyörä recruiting services. (TAMKOTUKI website.)

TAMKOTUKI is owned by the student body of Tampere Polytechnic University and Insinöörioppilastalon kannatusyhdistys ry. The general manager at the moment is Kati Kalsola, the company board has five members. The company was first established in 1965. The aim of TAMKOTUKI is to support the student society with decent services and affordable prices. (TAMKOTUKI website.)

5.2 Current Restaurants

At the moment TAMKOTUKI has three different restaurants. The main restaurant serves diners with three different lines and with one additional coffee & pastries line. The personnel restaurant serves the Tampere Polytechnic University staff. Full lunch is served in these restaurants including meal, bread, salad and one glass of beverage other than water.

The distribution line layout is designed so that diners first take the tray and then cutlery, beverages, plates, main meal, pay for their meal, take bread and salad. During each day there are from three to five different meal options. A special salad buffet is prepared in the afternoon. This service caters for the needs of late diners.

In addition to this the so-called Info-café serves diners with a smaller and lighter selection. This would normally include salad, soup and beverage. (TAMKOTUKI website.)

5.2.1 TAMKOTUKI RFID Payment Card

Together with the student body of Tampere Polytechnic University TAMKOTUKI and its suppliers have developed a new RFID-based payment card. The RFID-chip is combined to the student card, which all student body members receive.

The aim of the new card payment method is that paying would significantly be faster and easier. A student can load ten lunches a time to the card at a discounted price. Only the card will hold information on how many lunches are still left. The lunches on the card should be considered as cash. Should the card be lost, the lunches are lost as well. There is no way of retrieving them. (TAMKOTUKI Website.)

TAMKOTUKI restaurant is an optional place to plan the implementation of one of the eGate concepts. This is because the restaurant area already has a suitable area for the possible new concept.

5.3 eGate/RFID Solution

eGate and RFID solution is a sophisticated access control system that will allow only paying customer to enter the meal distribution area.

In this final thesis three possible solutions are presented. These are examples, as these all could be somewhat combined.

- The first one is the eGate concept
- The second one is the eGate concept combined with intelligent RFID-tracking technology. This one will later be called the eGate/RFID concept
- The third one is the eGate concept combined with an RFID-based payment card. This one will later be called the eGate/RFID payment card concept

5.3.1 eGate

eGate is a part of the access control system. There are a few options how the gate itself would look like, but the basic idea is simple. The gate would have either tripod poles or sliding doors securing the entry. The gate functions are connected to the payment module and as it orders, the gate will open and close. A display informing the users and a payment module are also attached to the gate. For exemplar physical appearance see figure 5.3.1.

There are two types of gates, entry and exit gates. Exit gates do not have payment module or a display. They will only secure proper exit of the customers.

Figure 5.3.1 eGate in action (Gunnebo International 2008)

5.3.2 Payment module and EMV

Payment module is a part of the access control system. This module is in charge of proceeding customer's payment transaction. This can be done by using several methods. For instance by using EMV-compatible cards (such as any bank or credit card: Visa/Visa Electron, MasterCard etc.) or another specific method such as a company based RFID card that will be billed directly to one's salary.

Europay, Mastercard and Visa together developed a payment standard that would make transaction more secure. This is called EMV and the system uses standard cards with chips installed inside that are not RFID chips. (EMVco website.)

5.4 eGate Concept

eGate concept has two basic elements. These are the gate-module and the payment module. One or several gate modules are installed

in the beginning of a distribution line as well as in the end of the line, see figure 5.4. As a customer wants to have a meal at a restaurant, one enters the eGate-area. At the gate the eGate screen will inform the price of the meal that is offered at the moment. The diner would use a desired payment method, which can be for instance an EMV-card or a company based RFID card.

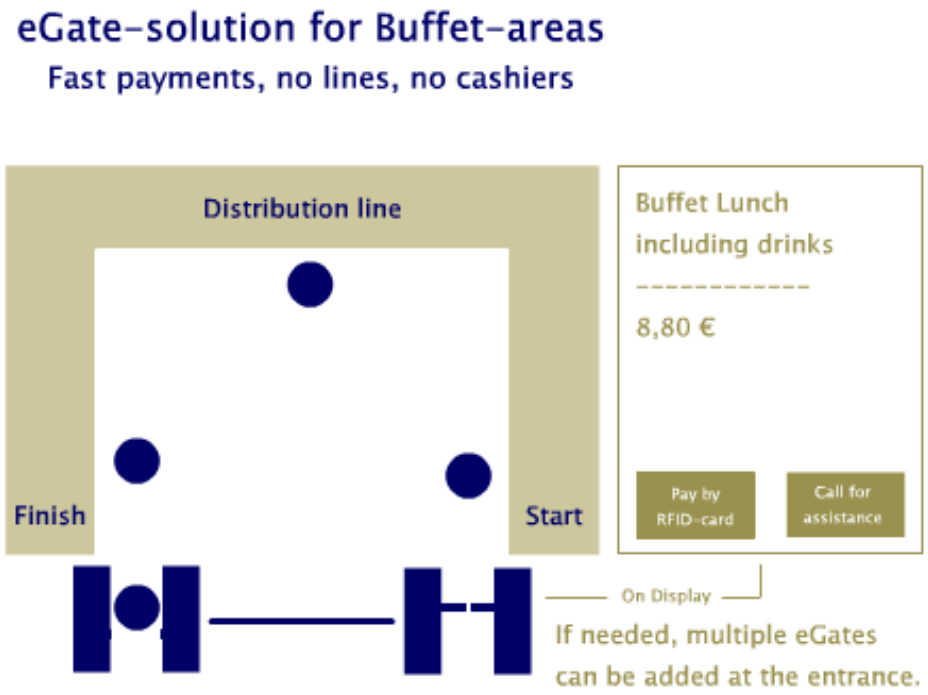

Figure 5.4 eGate concept

As the payment has been accepted the payment module would send a signal to the gate module to open the gate. Then the diner would enter the distribution are in order to collect desired items.

The main idea is that a buffet style meal, where all drinks and food are included, is offered. However, a person can enter the distribution line with one payment only once.

After a diner has collected the desired items, one can leave the distribution area by using the exit gates.

5.4.1 Hardware and Software

eGate and payment module make up the basic hardware. The payment module will be connected to the existing payment system that already exists.

In order the gate system to function, software is needed. This system would normally be linked to the existing master payment system software and running on the same server, if possible. However, it would be possible to use it as a stand alone version as well. If the software is not able to run on an existing device or it is wished to work as stand alone, a specific computer/server is needed.

The software would have following features and it would operate the gate and payment modules.

- Connecting and discussing with the master payment system, which would accept card payments
- Commanding the gate module

Configuring these two systems might take some effort and some problems might be encountered.

5.5 eGate/RFID Concept

The main idea of this concept is automated paying and the ability to pay only for the collected items.

eGate/RFID concept has some joint basic elements with the eGate concept. There are entrance and exit gates; however, paying would take place at the exit gates, see figure 5.5. In addition to this, this system has a sophisticated RFID-tracking system that will know which items were collected.

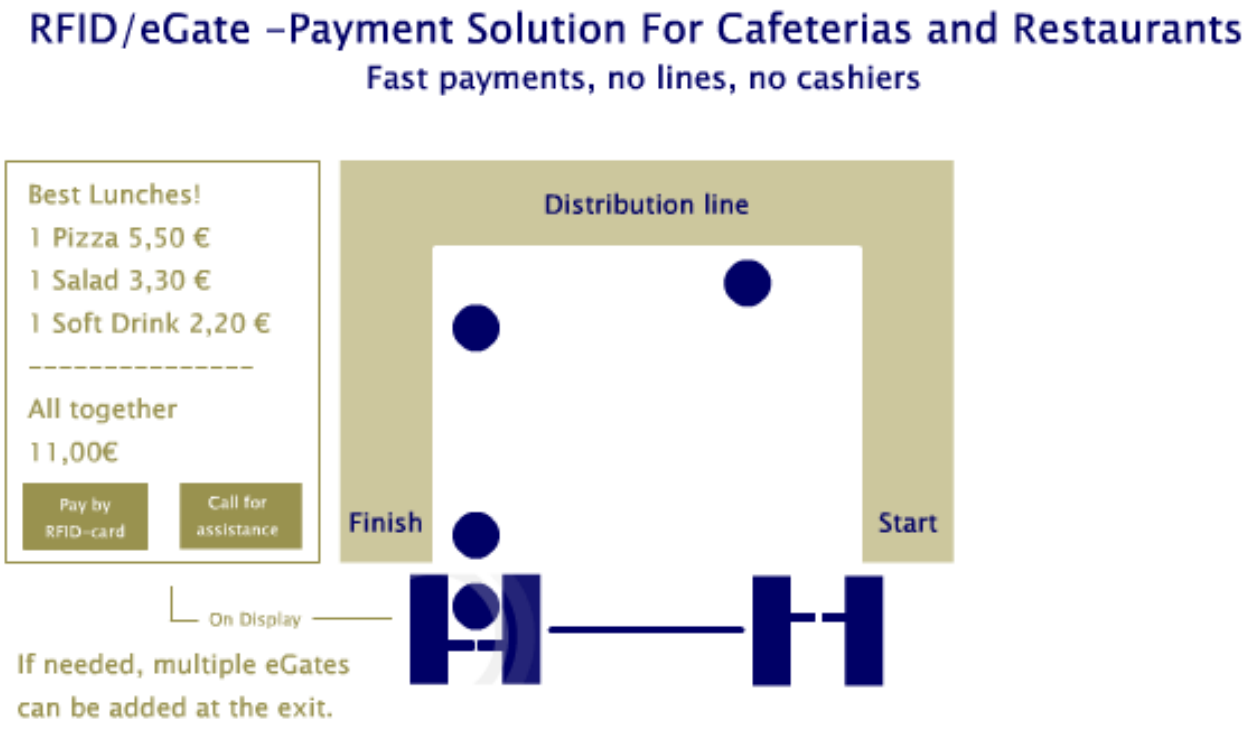

Figure 5.5 eGate/RFID Payment solution

Customers would enter the distribution area by one way entrance gates. Diners are free to collect any items. All the dishes would have an RFID-chip installed. As the customers go through any possible distribution line, the tracking system would know which plate has passed and where. This would make it possible to have meals and items with different prices.

As the customer enters the exit gate area, the RFID-readers would automatically notify the items collected. All items on the tray would be shown on the exit gate display as well as the final price. The diner is asked to pay the amount. This can be done by using normally several methods, such as debt/credit cards or even an RFID card. After the payment has been accepted, the gate would open and diner can exit the distribution area.

5.5.1 Hardware and Software

eGate/RFID concept would have same kind of hardware as the eGate concept; In addition to this there would be RFID-chips installed in all dishes and RFID-readers by each distribution line as well as the exit gates. Most obviously, an additional server/computer is needed.

The eGate/RFID concept software is significantly more demanding than in the eGate concept. The system must take care of a variety of more advanced functions. In addition to the ones needed for eGate concept are

- Tracking RFID chips
- Having a database for all the RFID enabled dishes and combining the information with correct prices

5.6 eGate/RFID Payment Card Concept

The main idea of this concept is the same as in the eGate concept with the addition that paying would only happen with an RFID based payment card. The main benefit of this concept is that payment transaction would take only a very short moment. This process and opening the gate would only take less than a second.

The entrance would happen through an eGate. By the gate the customer is asked to pay with an organisation based RFID card. The diner would take one's RFID card to the reader, which would then reduce one meal or value from the card. This can happen automatically or after the customer has accepted the transaction request shown on the entrance gate display. After the payment has taken place the gate would open and let the diner to collect desired items. In the end the customer exits by using the one way gate.

5.6.1 Hardware and Software

An RFID-reader and a display informing the customers are needed in addition to the eGates themselves.

This solution is the simplest when it comes to the software. Basically what is needed is the communication between the already existing cash system. However, additional software might be needed, in order these two systems to function well together.

5.7 Benefits of the New Concepts

eGate and RFID put together is an intelligent system that will significantly better the dining experience at any participating restaurant. It aims to offer fast and reliable way of paying. It benefits both the diner and the restaurant offering the new system.

Diners will benefit of faster paying and less queues, which will leave more time on enjoying the meal. As cashiers are no longer needed, restaurant will benefit of diminished need of personnel bond to the cash function.

The most affective benefits of the concepts are in the quicker customer service and the liberated workforce. These can also generate notable savings.

5.7.1 Customer Orientation

After the system has been installed the customers will spend less time in queues. This means more time eating or doing something more worthwhile. Diners will most likely come back to a restaurant that has been quick in serving them.

5.7.2 Savings and Liberation of Workforce

As no more cashiers are needed, this workforce can either be liberated or used in a better way. For instance the former cashiers can now take better care of the distribution line, welcome customers, assist people needing special attention and others as well. However, most obviously there must be some sort of support person, which knows what to do in possible problem situations.

If a cashier can totally be liberated from one's duties, notable savings can be generated. As a rule of thumb this amount will come up to 1,6 times the salary. This calculation is based on the fact that employers must pay other fees in addition to the salary. These are among others social security and retirement fees and count up to some 60% of the salary.

The savings can for instance be used in making the company to do better result or improving the quality of meals.

5.8 General Problems Concerning eGate and RFID Concepts

Always when a new system takes its place, it cannot be taken for granted that everything will run smoothly and without problems. Some obvious problems have arisen. These vary from the overall changes to the traditional restaurant concept to the dead RFID-chips.

5.8.1 Overall Changes to the Traditional Restaurant Concept

The new system will have an impact to the way diners normally have a meal. There are some changes that will take place in the new system.

As the distribution area must be closed, all food and other items must be within. Therefore for instance the bread or beverage areas must be within the closed area as well, unless these are openly distributed.

Organising such a closed area might be somewhat problematic, since the traditional space might not be big or flexible enough.

As the area is closed a separate service gate might be needed, depending on the structure of the previous distribution and kitchen area.

5.8.2 Student Identification

In Finland students are entitled to a significant discount on meals in designated restaurants. Normally, the restaurants that are entitled to give discount are in or nearby universities. Students can use the discount once per day.

However, these restaurants are also open for the university personnel and the public. Due to this fact there is a need for the identification of students that are allowed to have discount. The identification can be done in some possible ways.

If an RFID-chip is installed within the student card, it can be used for the identification. As a student arrives at an eGate, one would first show the student card to the RFID card reader. A discounted price would be shown in the payment module display. If no student identification is shown, normal price would be displayed. This system requires the background support from the student database. However, only the students of such a university where this system is installed would get the discount. Student card can work as a payment card as well.

The payment card is used as identification. As a student in the autumn or whenever starts one’s studies at a university, one would have to go a place where payment card sixteen digits series is connected to the student profile. This payment card has to be in the name of the student. This service could be outsourced for instance to the university’s student office or could be done at the restaurant.

5.8.3 Cash Payments

Even though card and electronic payments are on the increasing side there is a good amount of people who still want to use cash as their first method of payment.

The eGate payment module would not accept cash, even though it would technically be possible. This is due to the fact that paying by cash would take simply more time. However, if a company wants to accept cash payments, it is possible.

This can be done by using similar vending machines as for instance in parking halls. One would show a possible discount card and then pay by using cash. The machine would then issue an RFID based card with meals or value. A deposit for the RFID card should be paid. This is, however, a complex and an expensive system. The benefits of using a new payment system might be lost if additional cash payments are needed.

5.8.4 Dead RFID Chips

In the eGate/RFID concept each dish would have an RFID chip installed. It is unlikely but possible that these chips would break. It is crucial that all the chips are working, since the billing is only based on them.

In order to make this sure, a special device checking the RFID chips at certain intervals should be prepared. This is somewhat complex but an unavoidable task if this system is chosen.

The RFID-chips in the payment or student cards can also break. Depending on the background system the unused value or amount of meals can or cannot be restored. If the card itself is physically numbered it is easy to retrieve the lost amount of money.

5.8.5 Customers' Negative Orientation

Some customers might be opponent to the new concept. Some may think that people get unemployed or the service has become impersonal due to the new system. This tends to be somewhat normal in all societies and as time passes by people will start noticing the benefits such as smoother and quicker service.

According to a Swedish study many people embraced self service automats in library and grocery store, even in spite of their impersonal character. After a period of adaptation they found the machines are easy and quicker to use. (Solomon et al 2006: 309.)

5.9 The Best Concept for TAMKOTUKI: eGate/RFID Payment Card

eGate/RFID-payment card concept was chosen for TAMKOTUKI. This based largely on the fact that TAMKOTUKI had already in use an RFID card that could easily be combined with the possible new system.

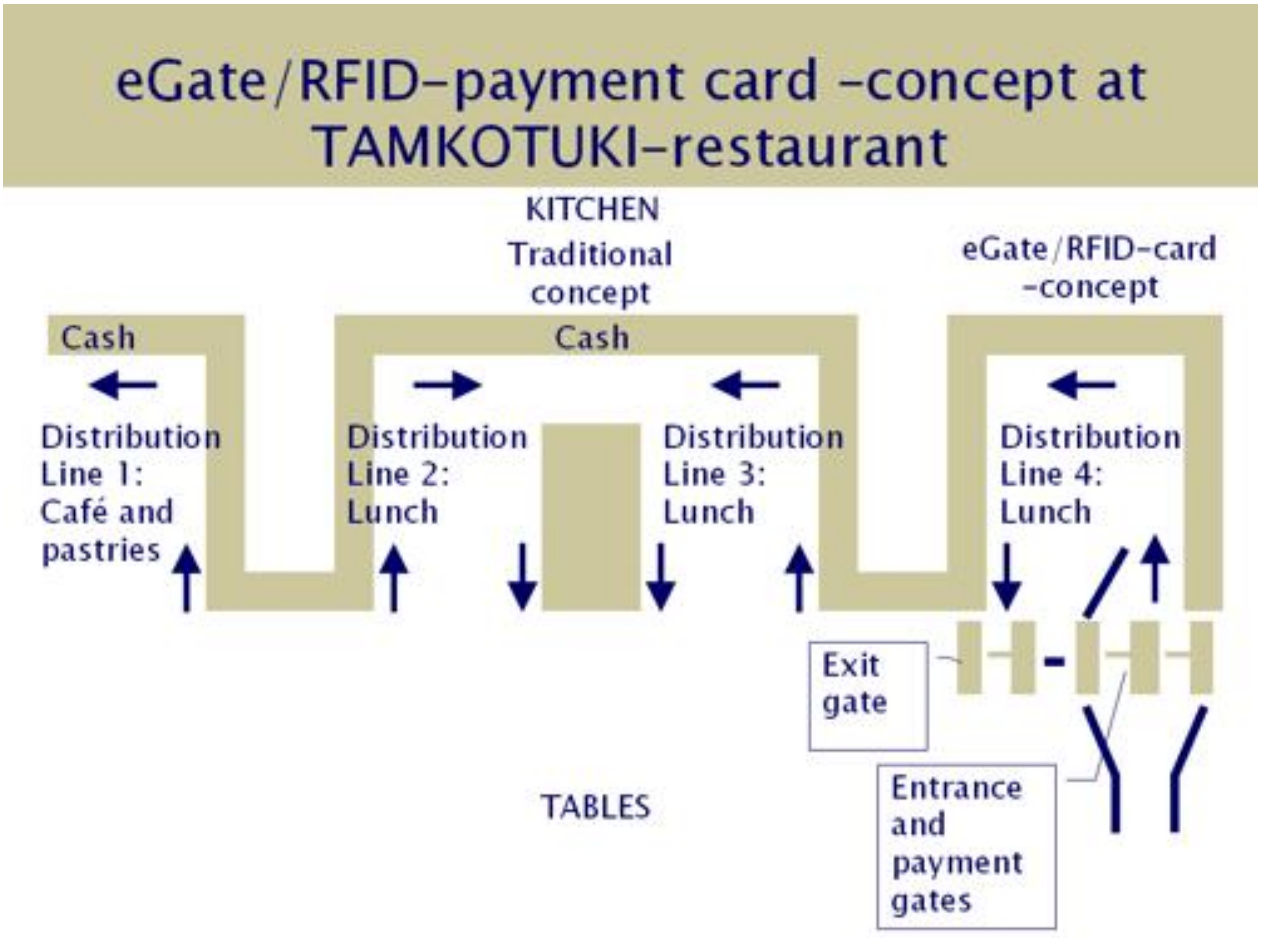

Figure 5.9 eGate/RFID card -solution for TAMKOTUKI-restaurant

In the new concept three of the four distribution lines in the TAMKOTUKI-restaurant would be left as they are. The fourth one would be transformed to the eGate/RIFD card concept, see figure 5.9.

Two access eGates would be installed at the beginning of the distribution line. This would allow faster entrance. However, only one queue should be organized, so that the diners would avoid the situation of one queue being slower than the other one. Two gates would also secure the function ability of the system, should other one of the gates malfunction.

The distribution line would only be able to have buffet concept in use. Therefore dishes that have same pricing could be on sale in this line. This concept could only include items that are included in the price (buffet). For instance no extra soft drinks or desserts could be on display, unless they already go with the price.

5.9.1 Concept Basic Functions

As diners want to enter the distribution line, they form a single queue in front of the eGates. By the gates they distribute into two lines.

Before the gates, the customers are asked to take their RFID card and hold it in their hand. As they are by the gate, they are able to read the price of the meal on the eGate display. They are asked to pay the amount by taking the RFID card to the reader and simultaneously pressing a button, in order the payment will be accepted.

The gate will be opened and after the diner has entered, closed again. Now the customer is ready to collect desired items.

As the diner is ready to exit the distribution area, one will go to the exit gate, which will automatically enter everybody to leave, but no one to enter.

5.9.2 Waiting experience

In order to make the waiting experience as pleasant as possible for the customers, special signs telling the approximate waiting time would be drawn. These could be on the floor or on special stands created for this purpose. In addition, a one line waiting system would be introduced. This would ensure that diners would not feel that the other queue is moving faster. In addition, screens showing dishes of

the day by the distribution line entrance would be placed. This would keep customers busy and cut down selection time.

5.9.3 Benefits of the Selected Solution

The eGate/RFID concepts were born with the customers' and company's best benefit in mind. Therefore the design has been customer oriented from the very beginning.

Freed workforce. When the fourth distribution line is moved to the new system, some workforce will be freed. Normally the fourth line is open from 10.30 till 13.30. The three hours when somebody was standing at cash and taking care of the distribution line, can now totally be used in care taking and other tasks.

Rapidity. Customers will enjoy the smoothness and rapidity of paying and the short over all time of getting a meal. This will affect the customer satisfaction and the willingness of people eating at the TAMKOTUKI-restaurants.

Increased income. Freed workforce and rapidity may increase income. First, it might be possible to let go some of the workforce or for them to work fewer hours. Second, more people might want to eat at TAMKOTUKI-restaurant, since the process runs smoothly.

These two factors together or separately may make a difference in the TAMKOTUKI-budget.

5.10 Costs and Training

Even though the hardware and software investments are not immense, a good amount of capital most be invested in order to acquire sufficient devices and computer programs to run the new system.

The overall costs for the new concept described here would count up to some 30 000 – 40 000 euros.

5.10.1 Software and Hardware

Software and the integration to the main cash system would take a good half of the budget with some 20 000 euros. However, the software needed is not complex. It has to be able to communicate

with the main cash system, accept payments, open and close the gate.

Hardware, mounting and shipping will take up to some 15 000 euros. Each gate costs around 3 000 euros and RFID-readers some 500 euros each. Some sort of fences is needed to close the area.

5.10.2 Personnel and Education

As the system is designed to function with minimum maintenance, it should be free of daily intervention. The personnel would be given a comprehensive training session about the new system. Also practical training and problem solving situations would be provided.

An induction time of some weeks would take place. A trained person from the vendor would be present for a few days to address possible problem situations.

6 Conclusions

In this final thesis three possible new operating models are introduced in order to make the TAMKOTUKI main restaurant queuing faster and more pleasant for the customers. The recommendation for the new solution for TAMKOTUKI is the eGate/RFID payment card solution.

In the new system one of the four main food distribution lines at the TAMKOTUKI main restaurant would be transformed into a new eGate/RFID model. In this model diners, that is, the students of the university, would enter the closed distribution area by paying a lump amount of money at the automated turnstile eGate with the already existing Student Union RFID card. Payment would only be possible with this card. In exchange, they would get food and drinks from the buffet. The whole process of paying and controlling would happen automatically and in a period of maximum one second.

The new model would make a significant positive change at the TAMKOTUKI main restaurant. It would cut down waiting time and the need of workforce. On the other hand, liberated workers could be used in other beneficial ways such as in ensuring that the distribution area is in top-notch condition. The other overall benefits include improved service and more comfortable waiting.

In addition, TAMKOTUKI might want to make sure that the customers' waiting experience is as good as possible. Therefore, wherever it is possible one queue concept should be introduced. This means that the "The other line always moves faster" syndrome would not take place. It would also make sense to mark approximate waiting times on the floor or on the wall, if possible. These would tell the customers how long the waiting time still is. To make the selection process quicker and the waiting time more comfortable TAMKOTUKI might show photos of the dishes of the day on screens before customers enter the distribution area. This would give diners something to do while waiting and reduce selection time at the food counter. Queue management is an important part of a successful restaurant, since customers find it unpleasant to wait.

The eGate concept could be introduced with a relatively small investment. This would include new eGates, software, hardware, and installation of them. The total amount of one distribution line would count up to some 40 000 euros. Additional salary costs might arise if a project manager is needed for planning and controlling the process

as a whole. Payback time would be acceptable three to four years, if some of the workforce could be let go.

If these recommendations were put into action they would create a faster and better lunch experience at the TAMKOTUKI main restaurant. In addition, this might create a consulting possibility for TAMKOTUKI as other companies might want to adopt the new model.

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8 Appendices

Appendix 1

Queue	Criterion	Occurrence		
Food selection	Number of queues	single		multiple
	Number of parallel servers per queue	single		multiple
	Arrangements of counters	in line	u-shaped	circular
	Type of customer's routing	free routing	restricted routing	
			sequence with quitting	strong sequence
Payment	Number of queues	single		multiple
	Number of parallel servers per queue	single		multiple
	Arrangement of cash desks	centralised		distributed
	Existence of specialized servers	yes		no
Food consumption	Number of queues	single		multiple
	Number of parallel servers per queue	single		multiple
	Way of getting a seat	"free choice"		"wait to be seated"
	Existence of length of stay restrictions	yes		no

Appendix 1. Design parameters of waiting queues in self-service restaurants (Gössinger 2005: 4)