Multidisciplinary project
2nd semester

Danish Crown

Case description

Computer Science programme

2nd semester multidisciplinary project

1 Introduction

This document contains the project description for the multidisciplinary project in the 2nd semester of the Computer Science programme at Business Academy Aarhus. The document describes both the case and the formal requirements for the Business and IT (BIT) part of the project. As the work with the project progresses, two other descriptions of formal requirements will follow for the other courses in this semester: Software Development (SD) and Programming (PRO), and Databases and Operative Systems (DAOS).

You will be working on this project in groups, formed by the teachers – see Fronter for Groups.

1.1 Purpose of the project

The purpose of the project is

- That the students complete a full systems development process from analysis to programming and testing

- That the students, in a realistic setting, get hands on experience with the skills they have acquired

- That the students can consider the system, that is to be developed, in a business context

1.2 General conditions for the project

1.2.1 Problem statement

The background of the project is a description of Danish Crown and in particular the challenges concerning production and loading of products. A core part is an overview of the focus and targets for the individual iterations for the project and a description of the minimum documentation requirements.

The project outcome is a running program and its documentation in relation to company management, requirements, analysis, design and programming and a description of important parts of the development process.

The submitted project report must be divided into three sections; one on BIT, one with SD and PRO and one on DAOS. For the exam, these three reports will be considered as one single report.

1.2.2 Theory and method

It is decided in advance, which methods and techniques are to be used. Hence, it is not required that the students explain these choices theoretically.

1.2.3 Submission

The project must be submitted to WiseFlow no later than Thursday 21th of April at 12:00 noon.

The submitted project must comprise:

- Project report and source code uploaded to wiseflow in PDF format. The report shall consist of three sections
    - BIT section
    - SD/PRO section
    - DAOS section
- State clearly in the rapport where each section starts and ends.
- Include Java source code, for both PRO and DAOS, in the report as appendixes, see below on how to format the source code.
- Hand in the project report with source code, as the main hand-in in WiseFlow.
- Besides the report, hand-in the following as extra material in WiseFlow.
    - JAR file with Java source code, PRO project
    - Runnable JAR file, PRO project
    - SQL source code, DAOS project

The total project report (exclusive of appendices) can be no more than 60 pages.

The pages of both the project report and the source code document must be consecutively numbered and they must have separate tables of contents.

The source code document must contain all Java code - including the GUI code. Each class/interface must start on a new page using the name of the class/interface as the headline. The Java source code must be copied from Eclipse with the colour codes intact. The font must be Courier New with 8 points in size. Tabulations must be 0.5 cm.

1.2.4 Tutoring of the groups

A subject-specific tutor throughout the project (the tutors are the teachers of the four course subjects) will offer guidance when asked.

1.2.5 Study guidance

The group will meet with the relevant academic tutor for a number of guidance sessions, either during the scheduled class lectures or as per arrangement with the tutor.

Guidance for a class is equivalent to the class lectures scheduled for the project period.

Guidance sessions must be arranged well in advance and preferably at one day's notice. The students must state the topic(s) of the guidance session. (For example, an explanation of specific aspects of the problem to be addressed or a discussion of the method applied.)

The tutor is to inspire the students and offer them input on how to approach the assignment, ideally by offering examples, but it is not the tutor's responsibility to solve the assignment. The tutor cannot award advance approval of the report or parts of it.

The tutor can also ask groups about the status of the project. As a minimum, the group must be in touch with a tutor at least once a week.

1.2.6 Trouble shooting

Besides guidance, a group may be in acute need of assistance to solve a specific problem. Then the group can of course contact the tutor so they do not waste several days but not until the group has tried to solve the problem on its own, or perhaps by the assistance of other groups.

1.2.7 Project work in the 2nd semester of the Computer Science programme.

You should be aware that the main idea of the project is to give you an opportunity to demonstrate that you can apply the knowledge acquired during the first two semesters. Bearing this in mind, you may at times be facing the dilemma that when you must choose between doing something in the easiest possible way or in a less simple way the latter approach may improve the overall impression of your report.

2 Danish Crown

2.1.1 History

Danish Crown is a merger of slaughterhouses that produces and sells meat all over the world. The first cooperative slaughterhouse was founded in Horsens, Denmark, in 1887. The first year the slaughterhouse slaughtered 23.400 pigs. Over the next 50 years, a large number of slaughterhouses were established in Danish towns. In 1960, the slaughterhouses began to see the benefits of working together, in terms of product development, sales, marketing etc. This has led to numerous mergers over the last 50 years. Today, Danish Crown is the largest meat processing company in Europe and the second largest in the world. Furthermore, Danish Crown has the world's largest production of pork in addition to a considerable production of beef.

2.1.2 Organisation

Danish Crown is a limited liability company. The owners are the shareholders. There are today about 9.000 of these shareholders in Danish Crown. You can become a shareholder if you deliver meat to Danish Crown.

Shareholders in Danish Crown are guaranteed:

- Competitive prices
- Safe pick-up
- Personal service
- Extended programme for special production series
- Professional advisory service

The parent company Danish Crown totals about 10.500 employees whereas the entire group totals about 23.500 employees.

The company headquarters is located in Randers, Denmark, where administration and the general management of the parent company take place. The slaughter divisions are scattered across Denmark with an additional two divisions in Germany. The company also has subsidiaries in the rest of the world. For example in the USA, the company has nine departments with 1.400 employees.

You can find more information about the organisation if you use on this URL:

http://www.danishcrown.com/Danish-Crown/Organisation.aspx

2.1.3 Danish Crown in Horsens

Danish Crown's largest, state-of-the-art slaughterhouse is situated in Horsens, Denmark. This slaughterhouse has about 1.300 employees. Approximately 20.000 pigs are cut and boned on this location every day, which totals 100.000 pigs a week. The Horsens slaughterhouse also holds departments for supplier contact, inbound

transportation and settlement. A centralised salary department can also be found here. In the following, we will mainly focus on the challenges of making the slaughterhouse efficient and competitive. Danish Crown targets markets where large quantities of meat are eaten but where the competition of selling the meat is tough.

2.1.4 Quality

To Danish Crown the key competitive factor is quality. The Horsens slaughterhouse is not in full control of the end-to-end value chain, since the pig farmers breed the pigs. Because of the ownership structure of Danish Crown, where the shareholders are also pig farmers and cattle farmers, the farmers have a considerable interest in animal welfare and quality. In order to be a pig supplier you must live up to certain standards. Danish Crown has its own 'Code of Practice' which among others comprises the ethical approach to pig production. Likewise it describes the guidelines for food safety, protection against infections etc. A pig farmer must comply with these guidelines in order to deliver pigs to Danish Crown.

Use the URL to read more about the Danish Crown 'Code of Practice':

http://www.danishcrown.com/B2B/Code-of-Practice.aspx

Furthermore, the pigs are categorized and there are different guidelines for the breeding of each category.

Many parameters can be used to measure the quality of a pig. The following is a list of examples:

- appetising appearance
- little fat, both in terms of fat cap and marbling
- regular and fine-grained marbling
- regular fat cap (easily cut off after frying)
- fat cap of a milky white or light pink colour vs. grey, brown or yellowish colour
- no blood in neither fat nor meat
- meat of a uniform pink or dark pink colour vs. whitish grey, reddish brown, yellowish or pale colour
- firm texture vs. a loose, stringy or jellyish texture, applies to both fat cap and meat
- slightly humid appearance without being soggy
- regular shape and thickness.

Of course, each consumer has his own subjective quality standards, just as the parameters may change from one country to the other. All in all, the above are only examples of the parameters that Danish Crown considers.

2.1.5 The production process

The Horsens slaughterhouse plays a direct role in the final quality of the pork products from the moment the pig arrives at the facility. Before being slaughtered, the pigs are held in the stall area. How long they are held there depends on when Danish Crown can initiate the slaughtering process. While waiting the pigs stay in a

stall. When slaughtered the pigs are transferred to the chill room where they are held for about 24 hours. From the chill room the pigs are transferred to the cutting department where they are hung up before being cut, boned and packaged.

The Danish Crown website offers a visit to a slaughterhouse showing the entire production process (using the url below you get access to a guided tour in the virtual slaughterhouse. Adobe Flash is required):

http://www.danishcrown.com/Danish-Crown/At-the-slaughterhouse.aspx

Alternatively, try one of the other links listed on the webpage above. They contain lots of information about the production process in Horsens.

2.1.6 Quality in the production process

Every day about 100 trucks carrying about 200 pigs each arrive at the Horsens slaughterhouse. Already from the pigs' arrival at the slaughterhouse the company makes every effort to preserve the highest possible quality. For this purpose the pigs are held in stalls together with pigs they are already familiar with. This makes them calm and feel safe. If the pigs are to stay the night before being slaughtered, they are given the necessary food and rest. However, the planners try to avoid pigs staying the night, which is costly since the animal needs food and proper care. When the slaughter line is ready to receive the pigs, they are taken there through pathways. The design of the pathways ensures that the pigs walk upward, which helps to keep them calm. Having been slaughtered, the pigs are transferred to the chill room where they mature at a specific temperature for up to 24 hours. The planners are faced with a challenge in order to ensure that the pigs are held in the chill room for the optimum period of time. On the one hand the meat needs to mature, on the other it should not be held for too long, since the stay in the chill room beyond a specific number of hours does not contribute to the processing of the product.

During the entire production process the question of food safety is a major concern. In this context, the producer must comply with the statutory requirements. Danish Crown conducts its internal control procedures in all processes according to the HACCP principles. As a result of this, all employees have passed courses in hygiene and the Danish Veterinary and Food Administration inspects the production process. Some customers, for example from Japan, lay down very specific instructions for the pork products they purchase. As a consequence, there are often visits from Japan to Danish Crown to verify that the company lives up to the specific instructions that apply to pork exported to Japan.

The production facility at the Horsens slaughterhouse is characterised by a high degree of automation. Most of the products need to be processed in more than one production facility. In the event of long-term interruptions of the production, the production is distributed among other facilities, if necessary by introducing overtime or weekend work.

The pig production takes place continuously all through the day. The slaughterhouse is cleaned for every work shift in order live up to the requirements for food safety. In order to ensure this continuity, it is critical that the production is not interrupted; however, mechanic interruptions and breakdowns of the operation

are daily events. Danish Crown prefers to avoid long-term breakdowns since these can lead to overcrowding at the farms.

2.1.7 Environment

Water and wastewater are important resources for the slaughtering of the pigs and processing of the meat products. The rooms are cleaned using cold water whereas hot water is used to clean the production rooms and for disinfection and scalding of the pigs and boiling of the products. Water evaporates in connection with cooling but most of the water ends up as wastewater.

As can be seen, water is an essential factor in the production and for this purpose efforts are made to reduce the water consumption and improve the quality of the wastewater.

2.1.8 Employees and payment

Wages are also an important management parameter for Danish Crown. The costs involved in meat production continue to include large sums for wages although the trend is towards increasingly automated slaughterhouses. For the Danish meat producers, this poses a particular challenge since the wages for Danish workers in the production are very high compared to similar wages in other parts of the world.

Production workers in general have considerable focus on the wage. This means that the employees often want to carry out the functions in the production line that offer the best pay. However, this is not quite in harmony with the strict provisions of the working environment legislation that provides how personnel working with slaughterhouse production processes are allowed to work. Slaughterhouse work typically involves uniform, physical, manual processes that are very taxing to the body. To alleviate this Danish Crown is constantly in the process of identifying and minimising the loads to which the workers are exposed. In addition the production is noisy, so constant efforts are made to minimise the noise hazards to the workers.

2.2 Danish Crown are facing challenges

2.2.1 Wages

The wage costs of producing meat in Denmark are the reason why the slaughterhouse in principle is closed on weekends. The costs of paying slaughterhouse workers to work weekends are simply too high to make it profitable. The Horsens production is carried out in two shifts, although there are plenty of pigs in Denmark to produce pork products all around the clock at the slaughterhouse. The reason why production is only a two shift process is the wage costs incurred by night work and that the cleaning procedures are lengthy and make a three shift process difficult.

2.2.2 Flexible orders

Over the past ten to fifteen years, the customers have requested their orders to be more and more flexible. One parameter where the customer wants flexibility is the question of quantity. A customer may not always

want a number of products sufficient to fill a truck. This means that Danish Crown may need to load several orders for different customers on the same truck. If a truck holds orders for several customers, the driver takes the truck to a central collection point where it is reloaded. A customer may also order many different types of products in many different quantities; for example a customer may order half a leg of pork and four pallets of front ends. Especially when it comes to fresh-food, the orders also involve the aspect of time. To Southern European customers, durability is absolutely vital. Road transport by truck typically lasts several days to destinations in Southern Europe, and bearing this in mind it is of course essential to optimise transport time already from the moment the order is produced by Danish Crown.

Another example of how different transport conditions and regulations can affect the customer's purchase pattern concerns the English market. Here the carrier chose for years to transport the purchased products by road and below the English Channel. This meant that a typical order size would be 21.5 tons since this was the quantity trucks passing the English Channel were allowed to carry. Today, goods to England are mostly carried by sea, because a truck taking that route can carry 25.5 tons. This has led to a change of the typical order size, which is of 25.5 tons now a day.

2.2.3 The quality of the products sets the price.

The quality are determined based on the type, weight and meat percentage of the pig, among others.

Pricing generally takes place on a weekly basis.

Like all other companies, Danish Crown survives by getting a good price for its products. Each order is priced individually with the individual customer. Although each pig is "a pig in its own right", the difference from one pig type to the other is not so significant that a supplier can expect prices that are significantly different from the general prices of the market.

Generally, the price of pork fluctuates from one year to the next according to how much money the consumers can spend on meat. Of course the actual price of pork is also critical. If pork is expensive compared to beef, the trend will be towards a decline in consumption. Another parameter that can influence the price is for example EU legislation, use this url:

http://www.guardian.co.uk/business/2012/aug/12/price-of-bacon-to-soar

2.2.4 Waste

To the slaughterhouse it is essential to let as little of the pig's meat as possible go to waste. Of course, in the actual slaughtering process there will be some meat that is not cut exactly right.

Use the url below to get an idea of how to create value from the by-products from the meat production:

http://www.danishcrown.com/Danish-Crown/Climate-change-strategy/Improvements/Byproducts-are-reutilised.aspx

Since waste is so very difficult to manage, the IT department at Danish Crown has developed systems that can calculate the quantities of the expected and actual waste. These systems help Danish Crown keep waste

to a minimum. Likewise, the system also helps the customer's final delivery to be as close as possible to what was expected. As it happens, the data from the system also provides information on the exact content produced for every single order.

2.2.5 Production management

Generally, all Danish Crown slaughterhouses have a maximum capacity for the number of pigs that the production facilities can handle on a daily, weekly, monthly and annual basis. Danish Crown makes long-term plans for the number of pigs that the company can sell in a year. The planning is based on the degree to which the consumers want to eat pork, the sales of previous years etc.

With the high number of slaughterhouses, Danish Crown can organise which slaughterhouse to deal with which orders. The planning typically starts a few days/weeks before the order is implemented. The planning is based on historical orders and sales prognoses.

The detail planning lies with the individual slaughterhouses. The Horsens slaughterhouse plans how to organise individual orders. Orders are typically planned the day before they are implemented. When the production planning processes individual orders, there are clear expectations of when the order can be implemented. But even when the order has been processed it is still highly uncertain when it is ready for loading onto the waiting trucks. Production is regularly interrupted, and also the staffing of especially butchers at each production facility impacts on the production time.

It is vital to Danish Crown to ensure as efficient a production flow as possible. The customers expect production to last between one and two days from the time when the order is placed until the order is implemented and thereby packed and ready for delivery by truck. To achieve this, the slaughterhouse must always see to it that the supply of pigs to the slaughterhouse is sufficiently large. In the words of Thomas Lassen, planner: *"Usually, it is not a problem to have enough supplies for the production. Most days it feels as if we have a bunch of pigs right on our backs. Otherwise, we would not be able to fulfil the requests from our customers. What is important is to get the pigs through the system as fast as possible. Once a pig has entered Danish Crown, it should preferably be slaughtered that very day, otherwise it needs 'to stay the night' at the slaughterhouse which means expenses for food, care and stalls."*

Danish Crown plans for the long-term perspective, between six and twelve months, based on the production of previous years, sales prognoses and the general trends of the market for slaughtered meat. Planning from a monthly and a weekly perspective has a different character.

Thanks to the production structure with a high number of slaughterhouses within a limited geographic area, Danish Crown can adjust the capacity of each slaughterhouse upward or downward for short-term planning purposes. It is absolutely critical for animal welfare to have a fast and ready plan if production is interrupted. This means that at a relatively short notice a production process can move from the slaughterhouse in Blans, Southern Jutland, to the slaughterhouse in Horsens or the other way round.

For support of the overall planning, Danish Crown has introduced the ERP system SAP. According to the structure of SAP, the system starts by receiving order data, such as type of product, quantity, time of delivery

etc. The data usually comes from Danish Crown's sales departments. The system then calculates the main line of the production; i.e., it calculates the type of pig to be slaughtered, its size and the fat percentage etc.

The calculations concern what it takes for the customers to get the final orders that they placed. The calculations are transmitted to each production facility so that they know what to produce. This is known as making 'hard' process calculations. In other words, planning in a 'hard' way means that SAP generates a production order that is transmitted simultaneously to the different production facilities where they produce what is expected.

This way of planning poses certain challenges because the system has no eyes and ears. The system cannot see the reality and SAP cannot 'figure it out'. For example the system is unable to see specifically how things are in each production facility. Nor does the SAP system know about specific breakdowns of machinery and the waste that the production generates. A pig as such is not a standard commodity although many pigs are of course very similar to each other. In order to make the planning and the production as efficient as possible each pig is marked upon arrival to the slaughterhouse. The pigs are also weighed and measured, fat percentages are recorded etc.

In the ideal world, the planning would mean that the finished meat products would be ready for loading in the right quantities and at the time when the trucks and their trailers are ready for loading. However, this is a rare sight because of the many factors that need to fall into place before this 'dream scenario' arises. The problem of loading the orders onto the trucks at the exact moment when the meat carriers wish to fill their lorries will be discussed below.

Another aspect that the planning needs to take into consideration is that for many orders the products need to be born at an early stage of the production process. What this means is that the processes to which the orders are linked must be defined at an early stage. For example the customers may decide that the pork legs (hams) are to be cut in a specific way or that the meat must observe a specific fat percentage etc.

2.2.6 Loading of goods

Basically, the meat carriers of course want the shortest possible transport time for the meat products. Danish Crown has customers in Southern Europe to whom the goods are transported by truck. It is essential for them that transport time is minimised because of the short durability of fresh meat. However, this is not the only factor that impacts on the optimal freight procedure. In view of the EU's very strict regulations for driving time and rest time periods, in many cases it can be an advantage to introduce a break for the driver the moment he arrives at Danish Crown Horsens.

In the vicinity of 550-600 trucks are loaded each week with three types of goods; 1) boxed goods; 2) palletised goods, either fresh or frozen; and 3) hanging goods. Equivalent to a total of about 8.000 tons a week. Loading takes place from 25 loading ramps.

When the driver arrives at Horsens, he therefore usually enters the slaughterhouse premises. He passes a gatekeeper and 'hands over' the truck trailer. He then drives the tractor unit to an area where he can rest and wait for the trailer to be loaded with the right goods. When the trailer has been loaded with the right

goods, Danish Crown notifies the driver through the gatekeeper that the trailer is now ready for dispatch. During the loading procedure, the gatekeeper is in touch with Danish Crown staff who is told when the trailer is fully loaded. When the trucks arrive at and depart from the Horsens facility, they are weighed both when going in and going out. Due to weight limits for the trucks the orders cannot always be met exactly.

Loading orders onto trailers also pose a management challenge to Danish Crown. It is the carriers' responsibility to ensure that the trucks arrive on time and in the right number and with the right size of trailers to the Horsens facility. Sometimes, orders are so large that several trailers are required for one single order. Since a truck may be delayed now and again, the trucks do not always arrive at the times that the carriers have given to Danish Crown. Planning the contents of each vehicle and the order in which they are loaded is made even more difficult by this situation. The size of the trailers also vary. As a result of this, the carrier also needs to consider which parts of an order should be placed in which trailer. Sometimes an order is for less than the capacity of a trailer. Since it is 'expensive' to drive around with a truck that is not full, carriers usually want a truck to take several orders for several different customers. What happens in practice is that the trucks – after having been loaded at the Danish Crown facility – drives to a central collection point where the cargo is reloaded and the vehicle continues its journey towards the various customer destinations.

For trailers there is another point which is that not all types of goods can be carried in the same trailer. Goods packed in cardboard cannot be carried together with fresh goods.

The actual loading of the trailers is carried out from the 25 loading ramps at the Danish Crown facility. The different types of products/transport devices are loaded from different ramps, 1) 'boxed goods', which are packaged in blue plastic tubs; 2) palletised goods, and 3) and hanging goods, the so-called 'Christmas trees'.

This section closes with the words of Elo Bromer, IT manager, about the challenges that Danish Crown is facing in the context of information technology if the company is to retain its position as the world's leading supplier of meat. "*Overall, the challenge is to work with and create computer system that can support the increased flexibility and dynamics that we have been facing over the past decade in particular. Today, customers have very high expectations of their meat suppliers.*"

3 BIT requirements

- A brief presentation of and reflection on your project establishment and development, including team cooperation, roles, personality and work split and the use of project planning during the work with the project.

- Break down the workload and document the planning and development of the project.

Based on partly on the issues described here for Danish Crown, partly on information you find yourself and from the company visit, the group is to produce the following:

- A description of the company, including a description of the company logistics, and an in-depth analysis of the challenges of the production and the loading of goods. The analysis must include rich pictures.

- A business case suggesting one or more solutions to prioritized problems. At least one of the suggestions must be an IT-solution. You must use tools to visualize the problematic business processes that you have chosen to address. Describe the demands for the solution and discuss which effect(s) introducing the solution would have.

- A general discussion of the implementation of the solution.