University College Nordjylland

Project

System Development, Programming and Business

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Computer science

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1. Abstract

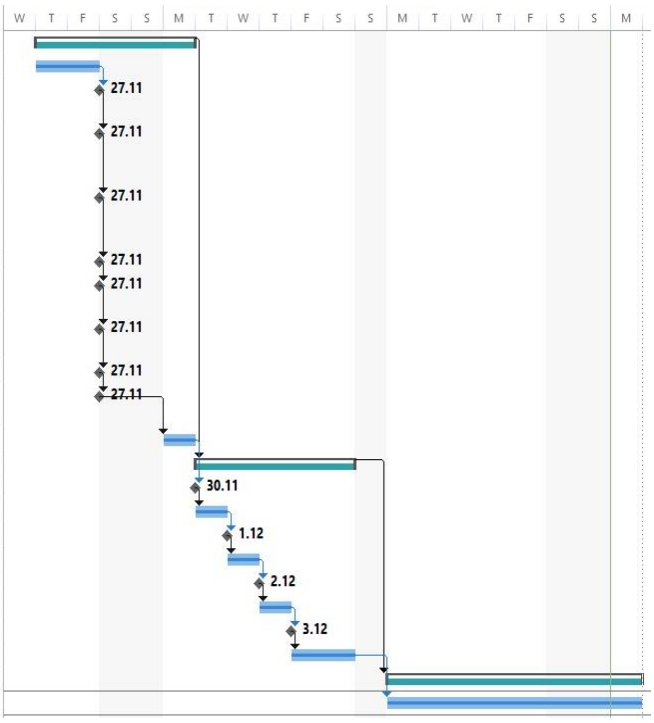
We have found some problems and drawbacks in work flow at Vestbjerg Byggecenter. In addition we have made business analysis with which we have concluded that the company is going to make profit. We have used UML for making diagrams and Java for implementing software tools due to which we have improved activity as*: Rent out machine, Send out request for stock, Order goods, Make sale*.

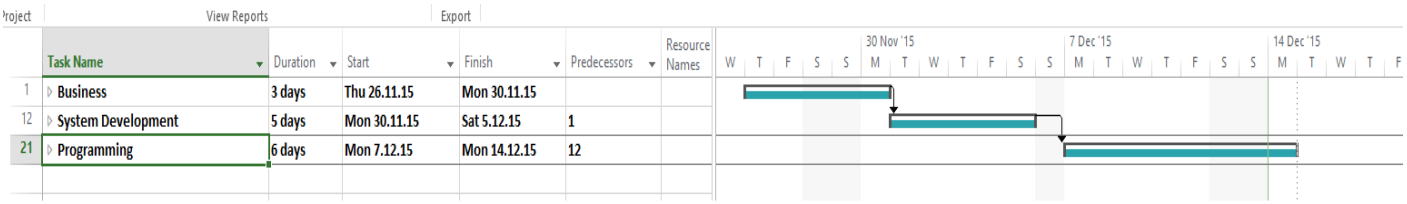
2. Introduction

The purpose of this project is to create a new system which can handle and continue the competitive power of the firm. The system must make sales statistics over the customers, products and contractors, and also statistics over each co-worker. The system should enable one to make registration from offer until the product is invoiced, but there should also be opportunity for making offers, place an order, confirmation of order, dispatch note, delivery note, and invoice. The new software should be easier to work with.

3. Project plan

	Task Name	Duration	Start	Finish	Predecessors	Resource Names
1	**Business**	**3 days**	**Thu 26.11.15**	**Mon 30.11.15**		
2	Construct a project plan	2 days	Thu 26.11.15	Fri 27.11.15		
3	Evaluation of organisational structure and problems	0 days	Fri 27.11.15	Fri 27.11.15	2	
4	Organisational culture and description of the managers behaviour	0 days	Fri 27.11.15	Fri 27.11.15	3	
5	Make an analysis of the project stakeholders and their expectations to a new system	0 days	Fri 27.11.15	Fri 27.11.15	4	
6	Make a SWOT analysis	0 days	Fri 27.11.15	Fri 27.11.15	5	
7	Find/formulate vision/mission of the company	0 days	Fri 27.11.15	Fri 27.11.15	6	
8	Formulate strategic goals for the company to achieve.	0 days	Fri 27.11.15	Fri 27.11.15	7	
9	Evaluation of your group process	0 days	Fri 27.11.15	Fri 27.11.15	8	
10	Description of the organisational structure	0 days	Fri 27.11.15	Fri 27.11.15	9	
11	business case	1 day	Mon 30.11.15	Mon 30.11.15	10	
12	**System Development**	**5 days**	**Mon 30.11.15**	**Sat 5.12.15**	**1**	
13	System definition	0 days	Mon 30.11.15	Mon 30.11.15	11	
14	Event tables	1 day	Tue 1.12.15	Tue 1.12.15	13	
15	Use case	0 days	Tue 1.12.15	Tue 1.12.15	14	
16	Domain Model	1 day	Wed 2.12.15	Wed 2.12.15	15	
17	Use Case fully dressed	0 days	Wed 2.12.15	Wed 2.12.15	16	
18	System Sequence Diagram	1 day?	Thu 3.12.15	Thu 3.12.15	17	
19	Interaction Diagram	0 days	Thu 3.12.15	Thu 3.12.15	18	
20	Design Class Diagram	2 days	Fri 4.12.15	Sat 5.12.15	19	
21	**Programming**	**6 days**	**Mon 7.12.15**	**Mon 14.12.15**	**12**	
22	programming	6 days	Mon 7.12.15	Mon 14.12.15	20	

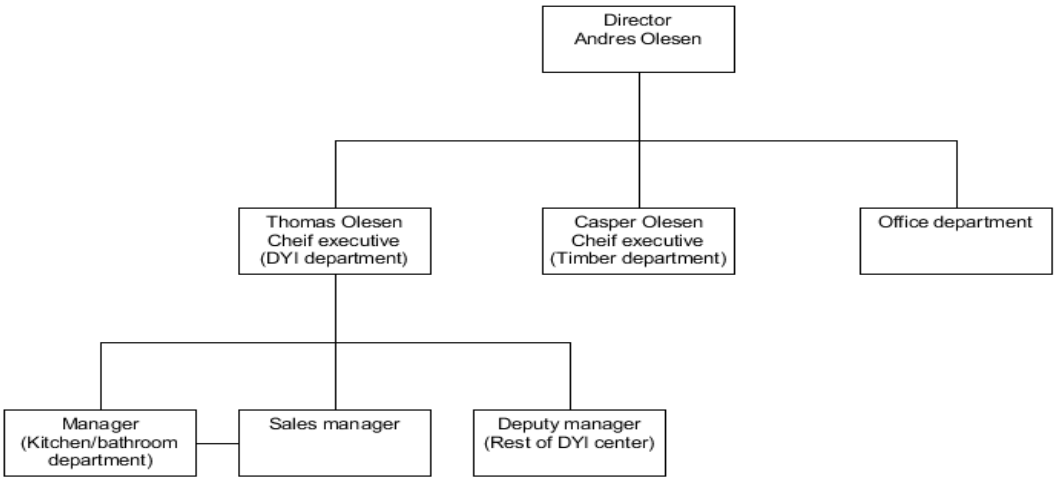




We have made project plan to schedule our time during the project. We have started with Business part at 26.11.15 and we have finished it within 3 days period. After that we continued with System development part for a 5 days period. The last part that we have made was Programming which last 6 days.

4. Description of organisational structure

The organisational structure in Vestjerbg Byggercenter represents the typical functional structrure. The founder and director is Andres Olesen. The 33-employess-company has three main departments - the Office department, the Timber department which is led by Casper Olesen, who is son of Andres and the DYI department led by Thomas Olesen, also son of Andres.In the Timber department Casper is in charge of 8 employees and all of them are serving customers. In the office department there are 4 people who are in charge of registration of vouchers, calculation wages and debid-credit operation. In the DYI department Thomas is the chief executive and he is in charge of the Kitchen/Bathroom manager. Thomas is also in charge of the Sales manager the who is responsible for both the DYI department and the Kitchen/Bathroom department. Thomas also has a deputy manager under his charge who is responsible for the rest of the DYI department.



4.1 Evaluation of organizational structure

The functional structure of Vestbjerg Byggecenter fit its goals and culture. With the current size

of 33 employees this is the best structure for the company. The main advantage of the choosen structure is that the company is led by very experienced person who adequately understands the situations. A disadvantage for the company is that with this type of structure the process of decision making is taking longer. This means that the communication between departments is weak and there might lead to desynchronized process of work. The main disadvantage, however is that with the presents of both Andres sons in the managment it is very hard for an employee to climb the ladder to the top. An employee might be given various challenging and demanding tasks but not being able to progress will demotivate him.

4.2 Style of leadership

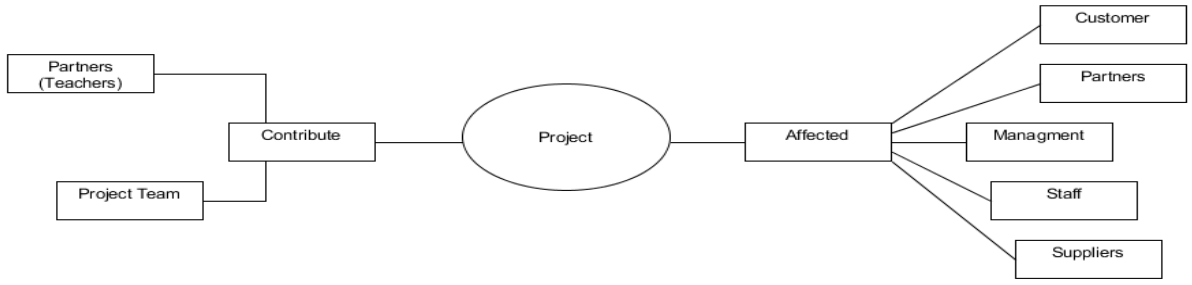
After studying the structural view of Vestbjerg Byggecenter we concluded that the model is Role culture. The CEO is Andres Olesen with his sons Thomas and Casper right bellow him in the structural view. This specifies one of the main characteristics of the Role culture as there is small group of senior managers. In addition, the work is very rational and predictable which is also a sign of Role culture.

Andres Olesen is a bit old-fashioned. He wants people to give their best so he tries to motivate them as much as he can. Although, he keeps good relationship with every employee he is very demanding and may be critical if not satisfied from an employee. Moreover, he wants from an employee to be positive especially to customers. Due to his friendly behaviour the company has gained a lot of loyal employees.

Thomas Olesen is more like HR manager. He cares about every employee in the company and helps it to achieve its goals. He is making yearly interviews with the employees so he can find out if they are appreciated and satisfied with their work. He tries to create a friendly environment and arrange events for the employees in order to create a society which is in close collaboration.

Casper Olesen is very much as his brother Thomas, but he has a little bit more controlling style of leadership. He is focused on the industry and the marked and want every employee in his department to solve its tasks as good as possible.

4.3 Stakeholders map



After carefully analyzing the project stakeholders we concluded that there are two main types of stakeholders - those which are going to contribute to the project and those which are going to be affected when the project is completed. As to how they are going to be affected by the project we placed them on different distance from the project. Our project team expect that

the system we are going to make is going to affect the whole work process in Vestbjerg Byggecenter as it will boost the company sales and its competitiveness on the market. We believe that our partners expectations are pretty much as ours - to provide Vestbjerg Byggecenter with fully functional system. The expectations from the managment of the Vestbjerg Byggecenter are that the system will be able to keep statistics over customers, employees and suppliers. In additon, that it will increase the regular customers and products offered. The expectations of the staff towards the new system are that it will allow them to provide better and faster customer service and it will ease their work to some point. For the suppliers expectations to be fulfilled the system will automatically send request for a particular stock when it reaches it minimum. The partners of Vestbjerg Byggecenter think that with the new project the company will achieve expansion which will also affect them as it will connect the stock of Vestbjerg Byggecenter to the XL - byg chain website.

4.4 Stakeholders interestest and behavior

Stakeholder	Their goals	Behavior expected	Positive or negative to changes	Likely reaction
Partners(Teacher)	To help achieve the task	-	-	-
Project team	To contribute achieving the vision of the company	-	-	├
Management	Expanding the company influence	Optimistic about the new IT system	Positive	Pleased with the work that the IT system can do
Customers	Easiness when using the company services	Supportive	Positive	Promote the company because of its good service
Staff	Easiness when serving customers	Likely to appreciate the new system	Positive	Appreciate the new system
Suppliers	Better distribution of stock	Respecting the decision for new system	Positive	Positive as it will make the process of supplying easier
Partners(Company)	Expanding the XL - byg chain brand recognition	Looking forward to complete the project	Positive	Better relationship

By the information we gathered we created the table which is showing that everyone who is affected from the new system finds some positive affect on him which means they will be optimistic to the changes that the new system will bring.

4.5 Strengthes Weakness Opportunities Threads

Strengths	Weaknesses
Managment desire for new system Loyal,dedicated employees Well-recognized brand to customers	Staff levels Employees not used to the new system
Opportunities	**Threats**
Making company more competative Expansion Keeping statistics Improving the customers service	Employee resistance about using new software IT not cordinated

We made a SWOT analysis which gave us awareness of what can be beneficial and what harmful when doing the project.

We concluded that the main strength we can use is that the management has a high desire about a new system. The loyalty and dedication of the employees would be another benefit as they trust the managment decision making. The brand recognition of Vestbjerg Byggecenter would made sure that the customers will not be affected negative by the changes.

The main weakness of the project is that the company is divided into different staff levels and it might be hard for implementing those levels. Considering the fact that the employees are used to an old system, they might find it hard to get used to the new system.

With our project we offer many opportunities for Vestbjerg Byggecenter. With the IT system we are going to produce the company will become more competitive in the market and it wil be able to expand. In addition, the system will be able to keep statistics which is desired by the managment. Furthermore, it will help in improving the customer service.

The external threats that may occur are that there might be employee resistance about using the new software as they are used with another system and might find it hard to adapt. The system also might be not coordinated and result in mistakes which is not desirable.

Goals for the company to achieve

Considering the vision and mission of Vestbjerg Byggecenter to provide everything necessary for people who like to do it themselves we can conclude that the company goals would be to improve it customer services, expand its customers and number of products offering, as well as keeping statistics over the most important information.

Business case

Executive summary

In Vestbjerg Byggecenter there are weaknesses which whit this project could be eliminated.The

aim of out projects is to improve work process in Byggecenter and contribute to the vission and mission of the company. With the brand new system our expectations are the company would be one step closer to achieving its goals and also would gain both tangibles and intangibles benefits. The tangibles benefits are: more customers, bigger profit, and more products in the stock. The intangibles benefits are: better customer service, better work organization, and boost of the brand recognition. Finally, the project has to be started because at 4th year the company will have returned its investment as well achieve profits from new system.

Problems

The first problem we found was that currently the workers do not know the exact location of a particular product. There are two places - DIY center and the timber department, where the product might be found and the employee should check both to find the desired product.

The second issue the company has is that they lack a system to keep track on the machines they offer for renting. Currently a manual system is being used.

Another problem we found out is that in the kitchen and bathroom department a specific kitchen cannot be displayed from a number of items which form the delivery of the kitchen.

At present time the company cannot print sale tags and cannot display them on different products and shelves.

Analysis of the situation

The present situation in Vestbjerg Byggecenter is due to the fact that the currently used computer system which doesn't allow the company to cope with its tasks efficiently. We can assume that if the company continue to work with the current system they will meet difficulties and won’t be able to achieve an expansion. Furthermore, the company might become uncompetitive with companies from the same branch and lose customers.

Suggestions for eliminating the problems

The new system we are going to develop will be able to keep track of the products' location and their quantity in stock.

In addition, the system will be capable of controlling the renting out and recall of the larger tools which are possible to be rented.

As well the software will allow displaying a kitchen or a bathroom as number of items, and not as a single item which can be bought. This will allow a customer to buy a specific product from a kitchen or bathroom and not the whole kitchen.

To improve the inventory control in the company we are going to develop a bar code reader.

Another beneficial improvement for the company will be that with our program will be responsible for not allowing customers to exceed 20 percent discount.

Moreover, we will provide the staff with the options of registering new customers, products and information about the contractors, but only the management is going to set the prices and discounts.

Furthermore, the system will keep track on the sales over each customer, product, contractor, and co-worker and make statistics.

We are going to provide the opportunity of registering an offer until the product is invoiced, but also the advantage of making, placing, confirming an order.

There will be a minimum and maximum number of items in stock on which the system will keep track and send request to the contractor when the stock it is at the defined minimum, but also will not allow an item to exceed the desired maximum.

The system will give a huge benefit in the cooperating with companies in the same branch as it will connect its data, including prices and stock, with the XL-byg website, as Vestbjerg Byggecenter is part of the XL-byg chain, and will allow online customers to check if the products they want are available.

Cost and benefits

When doing the cost and benefits analysis we took under consideration as much as possible facts about the company and the business. The inflation with which we calculate the NPV is based on real inflation predictions for the next 4 years. The inflation for the Denmark is predicted to be maximum 1% per year.

Costs

	Current Year (CY)	CY +1	CY +2	CY +3	
Costs					
Hardware	75 000,00 DKK				
Hardware maintanance	5 000,00 DKK	5 000,00 DKK	5 000,00 DKK	5 000,00 DKK	
Software	80 000,00 DKK				
Software support	7 000,00 DKK	7 000,00 DKK	7 000,00 DKK	7 000,00 DKK	
Total Costs (Future Value)	167 000,00 DKK	12 000,00 DKK	12 000,00 DKK	12 000,00 DKK	
Total Costs (Present Value)	**167 000,00 DKK**	**11 881,19 DKK**	**11 763,55 DKK**	**11 647,08 DKK**	**202 291,82 DKK**

The costs of the new IT system for Vestbjerg Byggecenter for 4 years are estimated as the hardware and software will initially cost 75 000 DKK and 80 000 DKK respectively. We also calculated that there will be 5 000 DKK for the hardware maintenance and 7 000 DKK for the software support per year. At present time the project will cost 167 000 DKK. On the other hand, the NPV for the project will be 202 000 DKK after 4 years.

Benefits

	Current Year (CY)	CY +1	CY +2	CY +3	
Benefits					
Profit from shops	20 000,00 DKK	34 000,00 DKK	50 000,00 DKK	65 000,00 DKK	
Profit from XL-byg chain websit	12 500,00 DKK	20 300,00 DKK	26 000,00 DKK	32 000,00 DKK	
Total Benefits (Future Value)	32 500,00 DKK	54 300,00 DKK	76 000,00 DKK	97 000,00 DKK	
Total Benefits (Present Value)	**32 500,00 DKK**	**53 762,38 DKK**	**74 502,50 DKK**	**94 147,24 DKK**	**254 912,12 DKK**
Present Value Discout Rate	**1%**				

Profit

With our system in Vestbjerg Byggecenter we are going raise the sales in all departments of the center. Connecting its data with XL-byg chain website will give the company a new way of profit - e-commerce. We calculated that our project will definitely raise the sales in Vestbjerg Byggecenter by roughly 1.5% for the first year and 1% for each year afterwards. Assuming that and the inflation the necessary time for the investment to return its money is 4 years.

Cost Benefit Analysis	
Total PV Benefits	254 912,12 DKK
Total PV Costs	202 291,82 DKK
NET BENEFIT	52 620,30 DKK

The picture above shows the profit due to our system. Of course, these are roughly calculations which are only showing the tangible benefits for the company. The new system will definitely have intangible benefits such as faster customer service, better environment of working for the employees and easiness for the management when looking at the statistics.

Recommendation

We would recommend the project to be started as soon as possible as it will have enormous improvement in the way of work in Vestbjerg Byggecenter. It will bring both tangible and intangible benefits for the company. The only risks arise if the employees find it hard to work with the new system, but considering their long time in the company, we can conclude that this risk is minimum.

Conclusion

Finally, we can say that the current way of cope with work task in Vestbjerg Byggecenter is quite irrelevant and a new IT system will manage to help the company in its work. We can say that the company will welcome a new system as both management and staff are tired of the old system and some of the manual processes. A new system in Vestbjerg Byggecenter will provide everything necessary for the company to achieve its goals.

Evaluation of the group process

Doing the business part of our project we learned the importance of that part before starting up with a project. We now know that if someone has an idea he should support it with a business case to prove that his idea is worthy and will have benefits when completing it. The hardest thing of the business part was to make the right decision about the company structure, style of leadership and etc. We also found it hard to agree on the model of the organizational structure. All in all, we managed to agree and we believe that we have made the right decisions.

System vision

Functionality:	Customer, product, staff registration. Making sales, offers, requests. Keeping statistics over company employees, products, contractors.
Application:	Support for registering orders, arranging deliveries, handling payments.
Conditions:	Staff and management have low level of experience with computers. User-friendly system.
Technology:	PC's connected to server. Web interface wanted later for e-commerce.
Objects	Customers, staff, products, contractors, payments.
Responsibility:	Efficient tool for order and payment handling. Responsible for customer, product, staff, contractor registration, reading, updating.

Event Table

The next event table is showing some of the main events in Vestjeberg Byggecenter and what steps employees do to complete the work process.

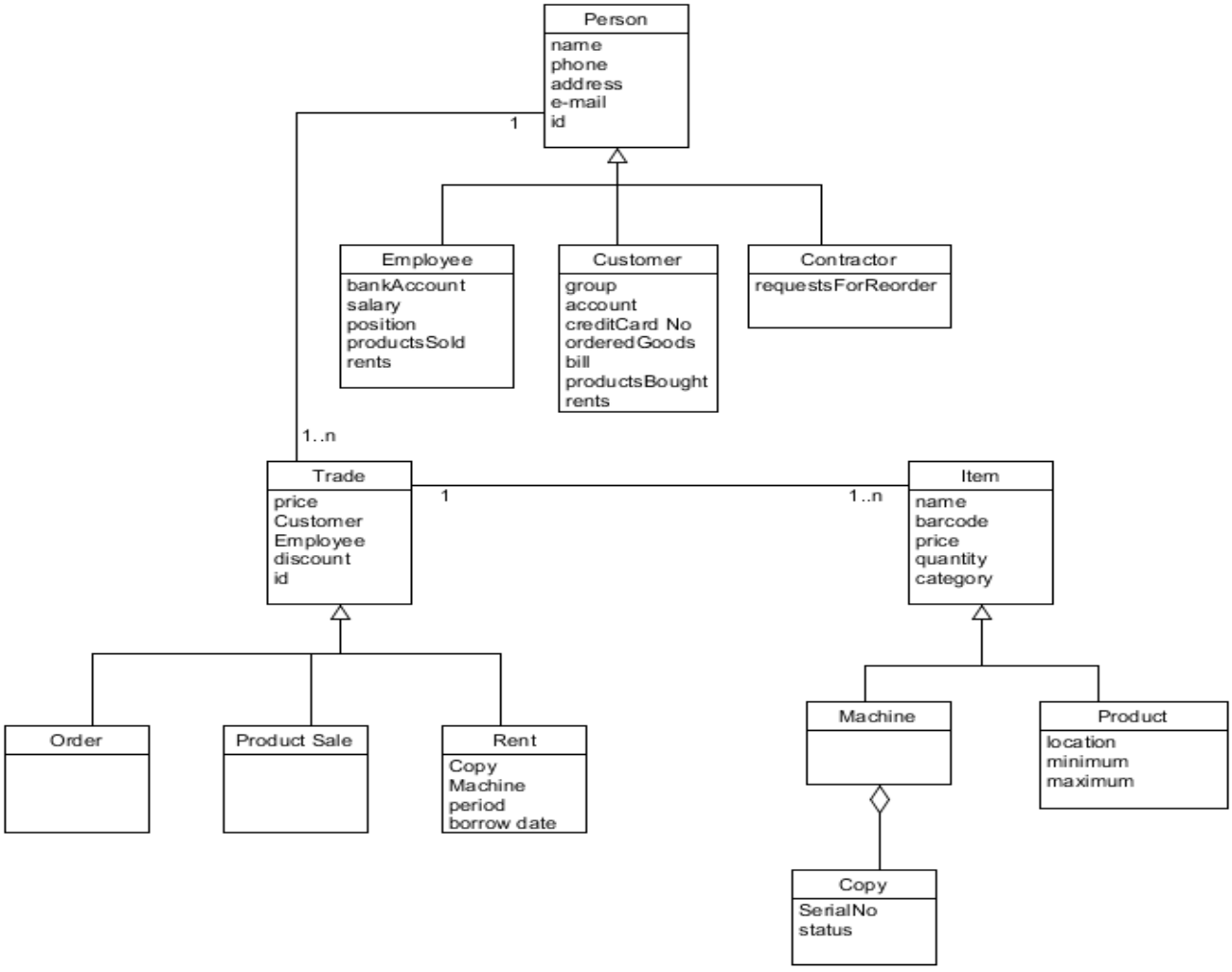
Event – "AS IS"	Activity	Steps in activity	Actor
Customer wants to rent out a machine	Rent out a machine	Write the desire machine into the order form Adding customer information Specifying time period Send copy of the order form to the warehouse and bookkeeping	Employee
Employee send out request for returning out a machine	Recall of a machine	Compare details from the contract of renting Send out reminder if the time period is exceed	Employee
Management send out a request for stock	Request stock	Write the desired products into order form Specifying quantity Send to order to contractor	Management
Customer order goods	Order goods	Write the desire products into the order form Adding customer information Send copy of the order form to the warehouse and bookkeeping	Employee
Customer buy products	Make sale	Add all the products in the sale Ask customer for payment Complete sale	Employee

And this event table is showing the new way of employees doing up with their tasks using the new system. `

Event – "TO BE"	Activity	Steps in activity	Actor
Customer wants to rent out a machine	Rent out a machine	• Adding customer and machine information • Specifying time period in the system.	Employee
Sending out request for returning out a machine	Send out reminder	• The system checks whether the returning date is exceeded. • Send out request if the limit is exceeded	System
Sending out request for stock	Request stock	• The system checks whether stock amount meets the minimum border. • The system requests the management to set amount of reorder. • The system check inventory whether ordered amount exceed maximum amount for the current product. • The system send request for reorder to contractor.	System, Management
Customer order goods by phone or personal	Order goods	• The employee chose desired products in the system • Delivery note is saved in the system.	Employee, System

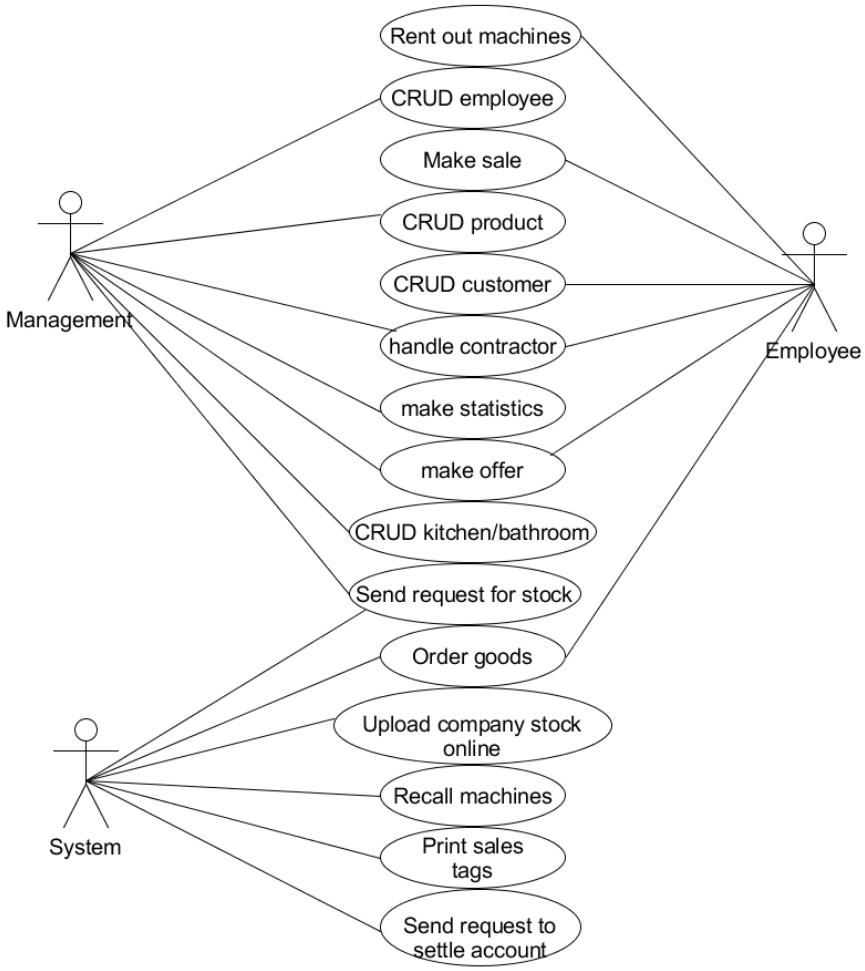
		• The customer gives his id to the guys handling the stock to pick up the goods by himself. • They check which are ordered goods on this account in the system and give the stock. • The system generates on invoice that is sent to customer's email.	
Customer buy products	Make sale	• Get the goods registered when the customer leaves the shop. • The Employee register all goods in the system. • The system Calculate the sum. • The customer makes a payment.	Employee, System

Domain Model



In our domain model we has three super classes which are: Person, Trade and Item. The Person class has three subclasses: Employee, Customer and Contractor. Person class is related with the class Trade in relation *one to many.* The super class Trade has three subclasses which are: Order, Product Sale and Rent. The Trade class is related with the super class Item in relation *one to many*. The class Item has two subclasses which are Machine and Product. The Machine class and Copy class shows Aggregation(Machine Has- A Copy).

Use Case diagram



We identified 3 key actors in the new system – Management, Employee and the System. The management is mainly responsible for creating new employees, products, handle contractors, make statistics over different groups in the company. The management is also responsible for confirming an offer which was created by an employee. The management is also involved in the process of sending request for stock where they have to write the desired amount they want from a specific product. The system is mainly responsible for handling events like ordering goods, recalling machines, and sending requests. Employee main tasks are to make sales, offers and rent out machines.

Brief description Use Case: Rent out a machine
The employee adds customer and machine information in the system as well as specifying time period in the system.
Brief description Use Case: **Send out reminder**
The system checks whether the returning date is exceeded. If the limit is exceeded the system send out request to the customer exceeded the time.
Brief description Use Case: **Request stock**
The system checks whether stock amount meets the minimum border. If the minimum is reached the system request the management to set amount of reorder. Then the system check inventory in order not the ordered amount to exceed maximum amount for the current product. Then system send request for reorder to contractor.
Brief description Use Case: **Order goods**
The employee choose desired products in the system and delivery note is saved in the system. If the customer desire to pick up the goods by himself give his id to the guys handling the stock otherwise the goods are send by truck. The guys check which are ordered goods on this account in the system and give the stock. The system also generates on invoice that is sent to customer email.
Brief description Use Case: **Make sale**
Get the goods registered when the customer leaves the shop. The Employee register all goods in the system. Then calculate the sum. The customer pays cash/credit card. If the customer is a registered can pay via a bill. If the customer buy from the timber yard can pay only by cash/credit card.
Brief description Use Case: handle contractor
Contractor arrives with products requested by management. Employee accepts the products, and update contractor information in the system.
Brief description Use Case: make statistics
Management want to see statistics over customer, products, employee or contractors. They enter the system and choose the specified category. The system returns the statistics over the group.
Brief description Use Case: Upload company stock online
System uploads the company stock and price online to the XL-byg website.
Brief description Use Case: Print sales tag
Employee wants to print sales tag. He types the name of the product and the price. The system then prints sales tag with those attributes.
Brief description Use Case: Send request to settle account
System checks if every customer account has settle his account. If there are people which haven't the system sends them a request to do that.

When doing the Use Case descriptions, we decided not to include the CRUD use cases because it is a basic process where you always have to CRUD something.

Use Case prioritizing

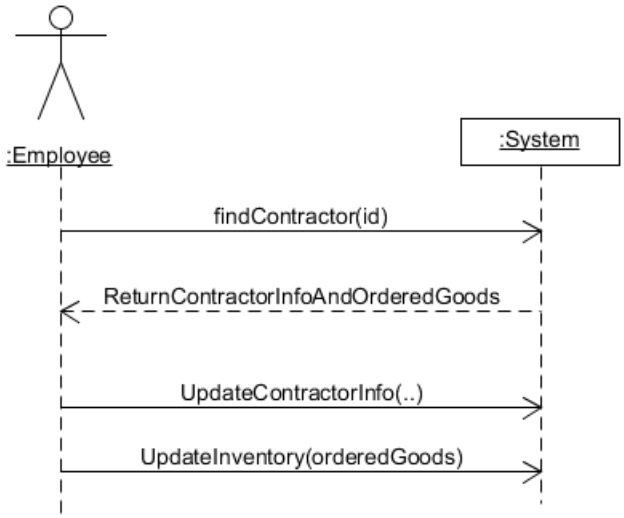
After carefully considering the use cases we identified and studying their business value we concluded that the most important use case is **Make Sale** and the second most important is **Order Goods** because that is what shops do mainly – they are making sales and ordering new goods so again they can make a sale.

Fully Dressed Use Case Make Sale

Use case name	Make sale	
Primary Actor	Employee	
Pre-conditions	Employee and products are registered in the system	
Post-conditions	Products are sold and customer is served. The system update stock, employee and customer information, if he is registered. The system prints out invoice.	
Frequency	100	
Scope	A system which can be used for product registration and selling.	
Level	"functionality"	
Stakeholders and interests	Management, employee, customer, contractor.	
Special requirements	Good usability and proven reliability	
Main Success Scenario (Flow of events)	**Actor(action)**	**System(response)**
	1. Customer walks with products.	
	2. Employee mark a product	3. The system returns the product information and price
	4. Employee repeats step 2 until every product is registered	
	5. Employee mark the sale as finished	6. The system returns the total price and ask if customer is registered
	7. Employee tells the customer the total price and ask for payment	
	8. The customer choose payment option and the employee mark the sale as paid	9. The system update its stock,employee and customer information.
Alternative flows	2a. Product is not registered in the system 6a. If customer is not registered, employee offer the customer to register him. 6b. Customer is not register and doesn't want to register 7a. Customer can pay via bill only if he is registered 7b. The customer can pay only cash or with credit card in the timber yard department 9a. The system cannot update customer information because customer is not registered.	

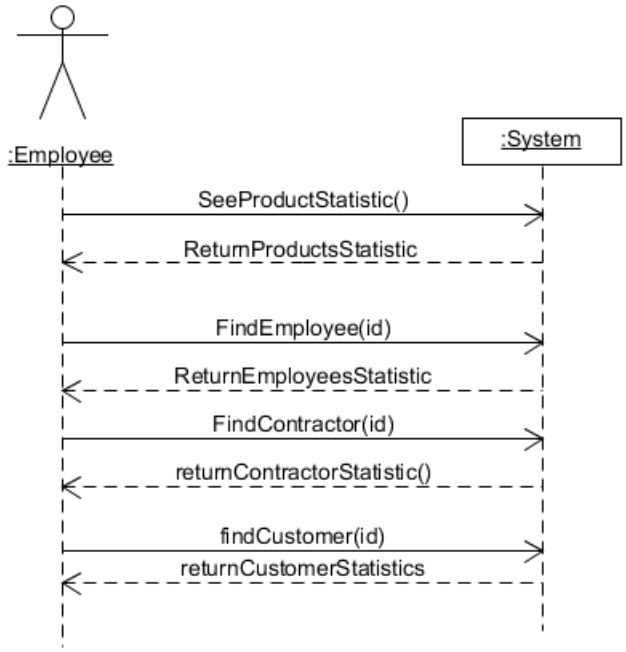
The fully dressed use case describes the way of dealing with a Use Case in very detailed way, specifying what should be true of the begging of the process and what should be completed at the end.

Handle contractor SSD



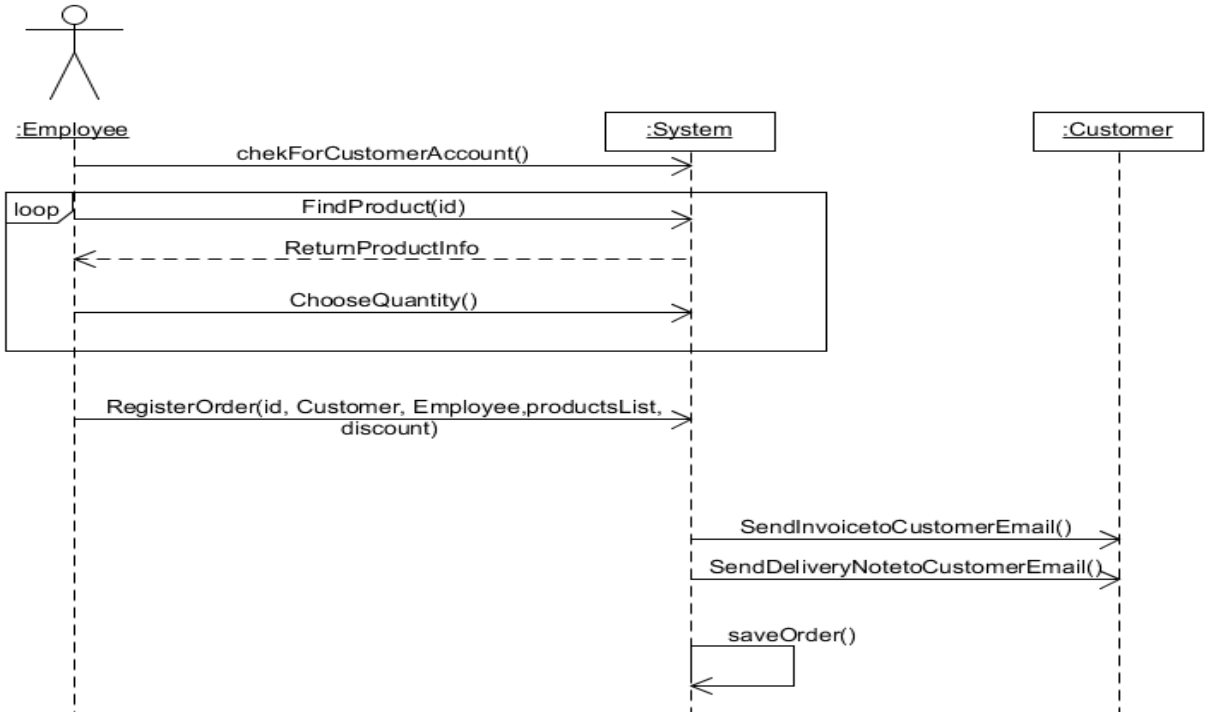
The employee requests contractor's id. The system returns an answer with the contractor info and ordered goods. Then the employee can update the info and the inventory.

Make statistics SSD



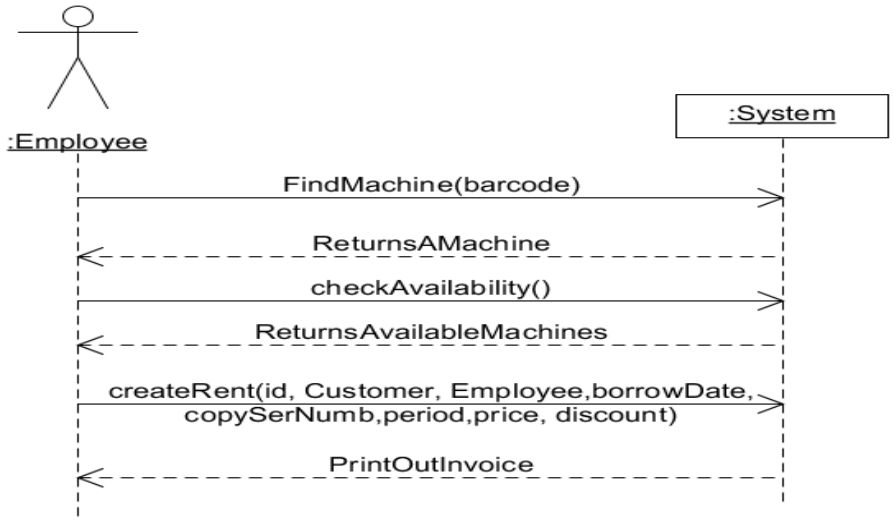
The employee requests information about a product, other employees, contractors and customer. The system returns an answer.

Order goods SSD



While there is a category of a product the employee finds the product, then the system returns all products from this category, then the employee chooses particular product barcode and quantity. After that the employee checks for customer account and creates an order. Then the system sends invoice to the customer email and a delivery note. Then finally saves the order.

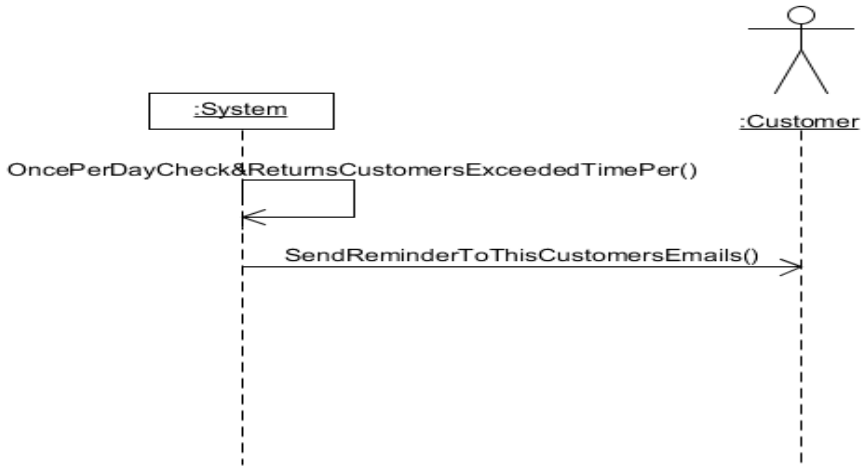
Rent out SSD



The employee request a specific category for machines. The system returns all machines of this category. Then the employee checks for availability and the system returns the available

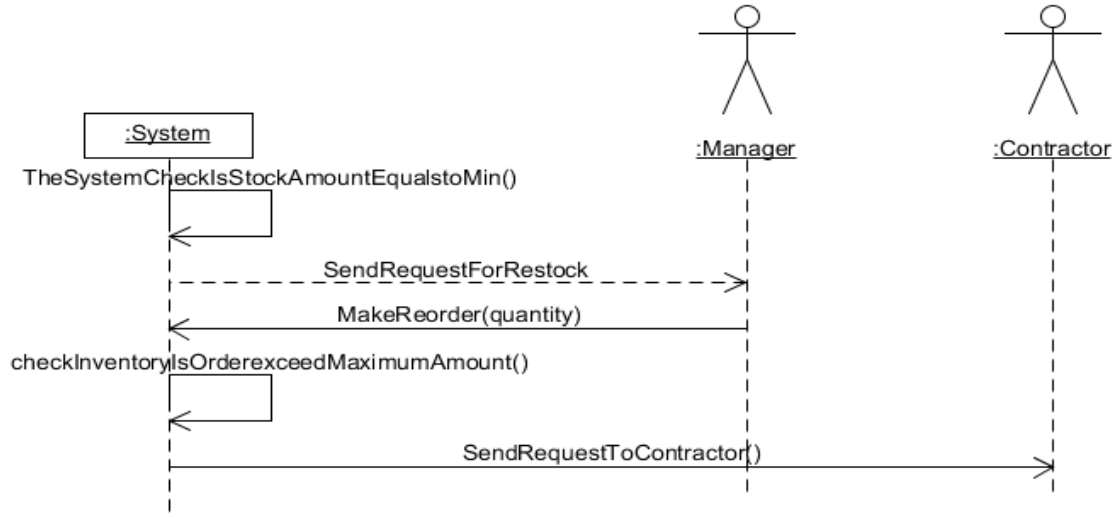
machines by a serial number. After that the employee creates a rent condition and the system returns a print out invoice.

Send out reminder SSD



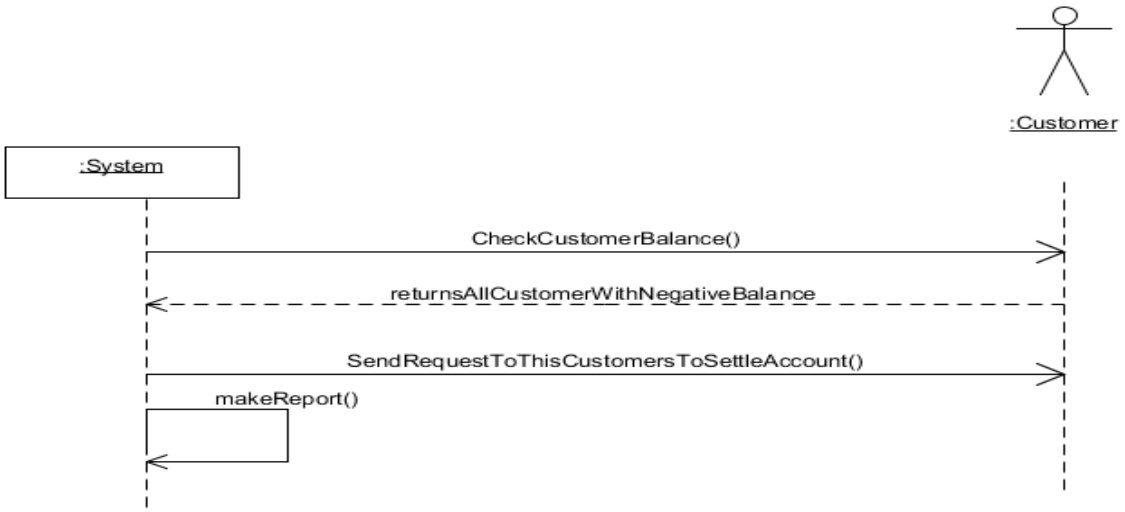
The system checks once per day and returns customers exceeded time then sends a reminder with an e-mail.

Send request for stock SSD



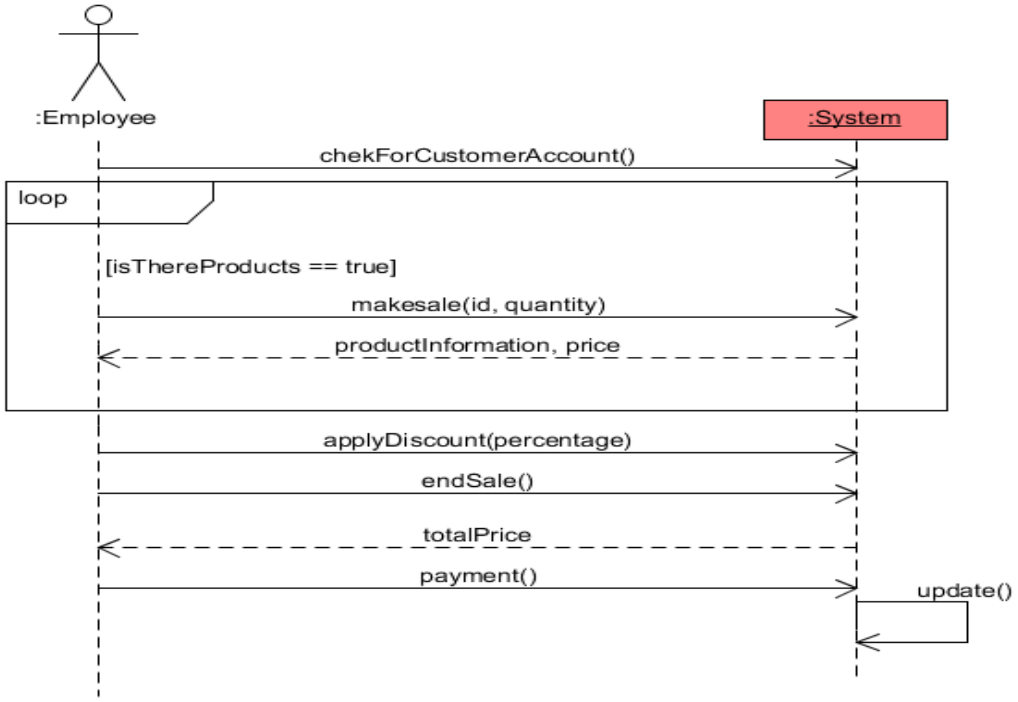
The system checks the stock amount after that sends a response to the manager and a request for a reorder. Then the system checks if the maximum amount is reached in the inventory the system sends a new request to the manager. Then sends a request to the contractor.

Settle account SSD



At the end of the month the system checks all customer accounts, then returns all customers with obligation, after that sends a request to the customer to settle account. Then the system makes a report.

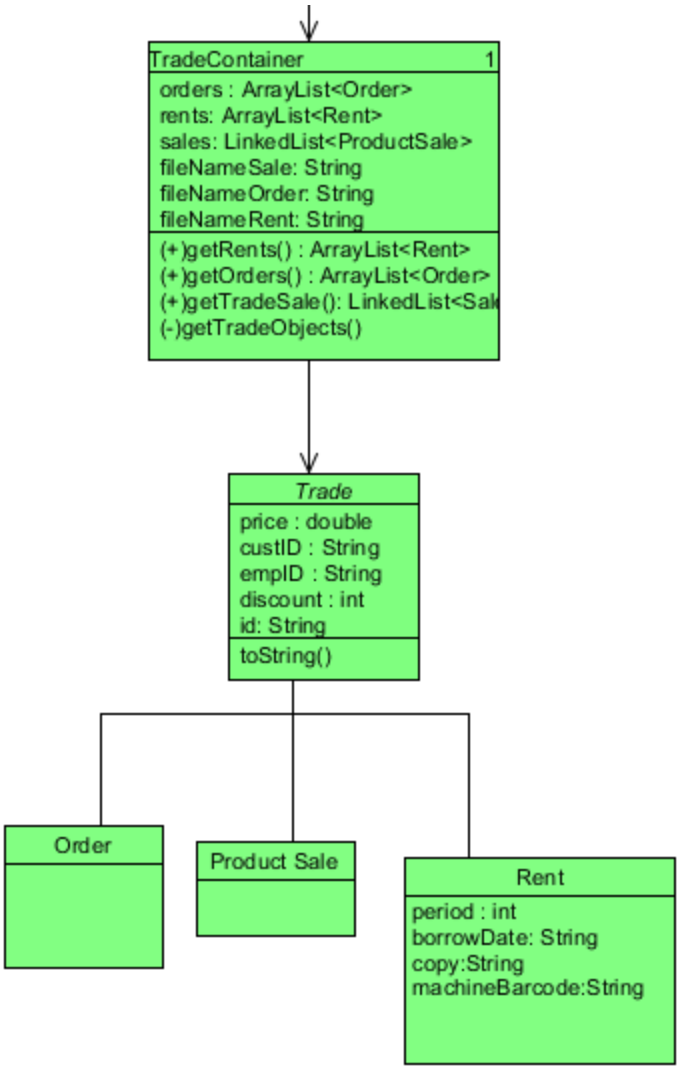
Make sale SSD



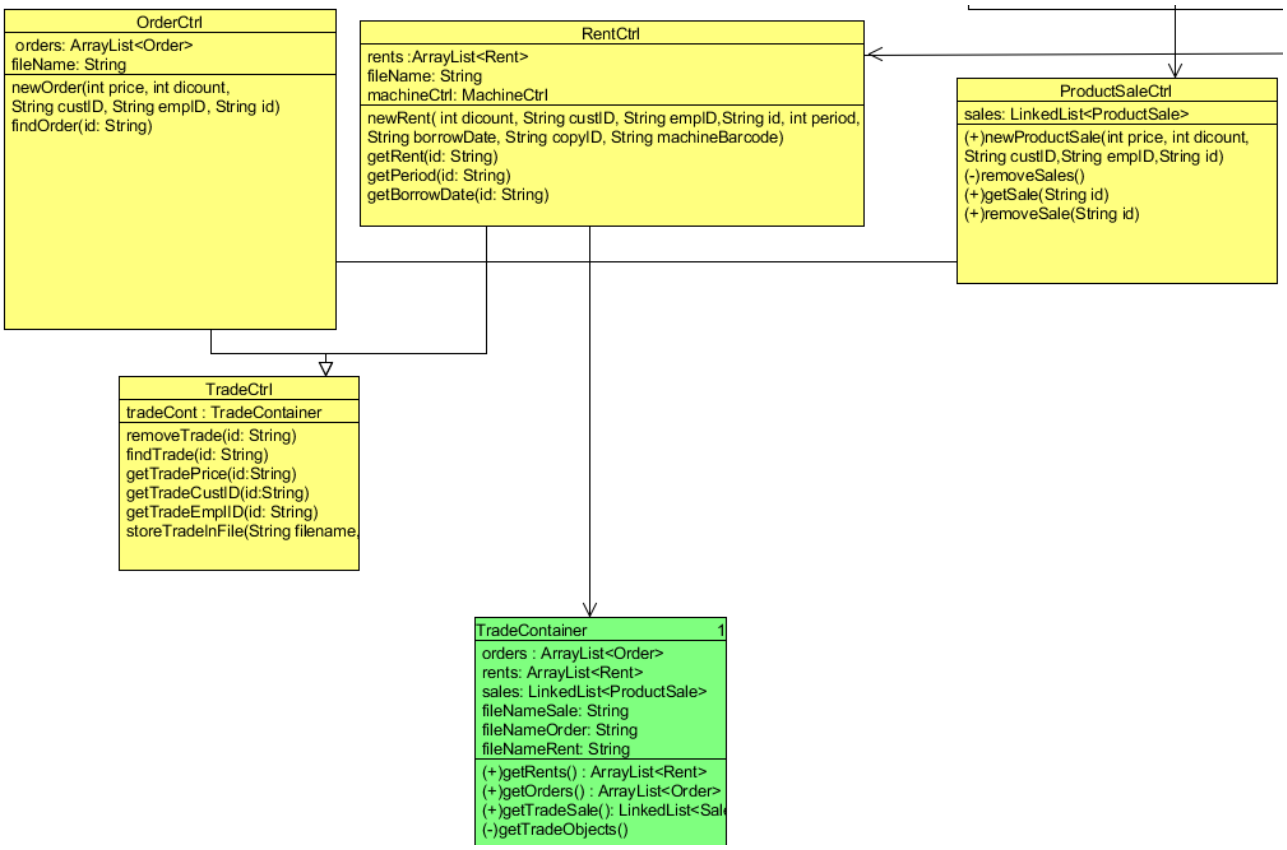
While the product is available the employee marks the id and quantity of the product, after that the system returns information and price. Then the employee checks for customer account,

make discount and end the sale. The system returns a total price for the sale. The employee makes the payment and after that the system updates.

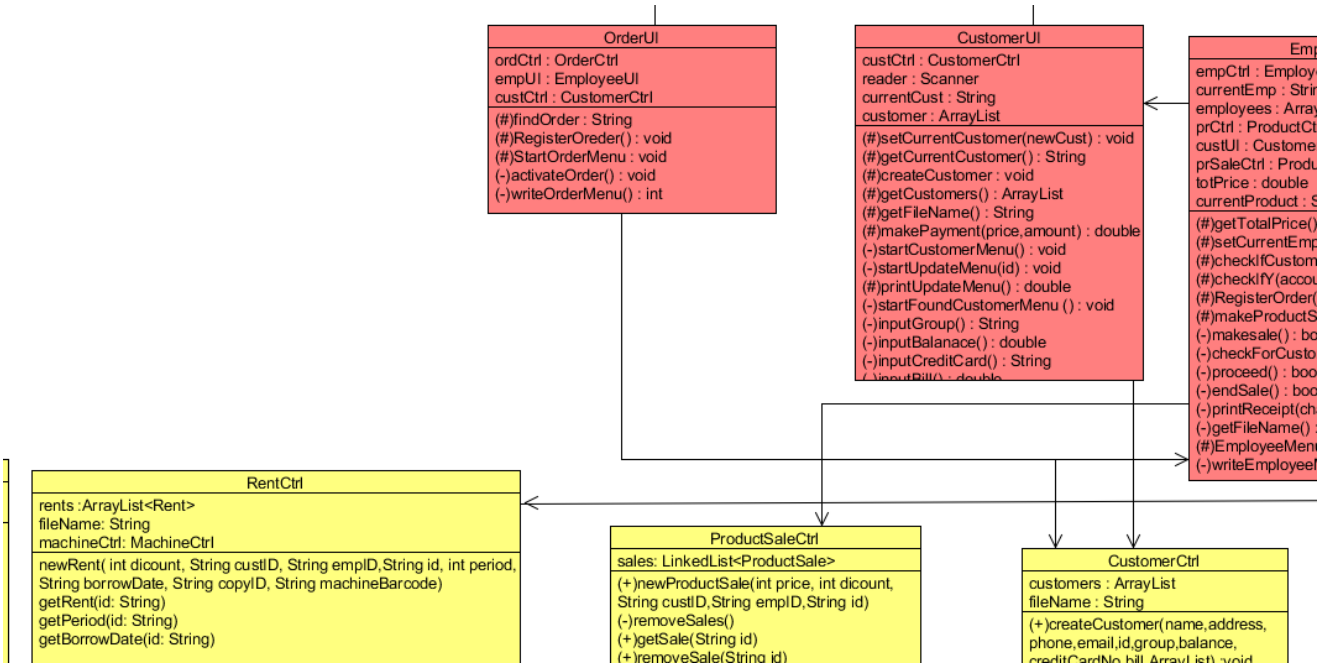
Design Class Diagram

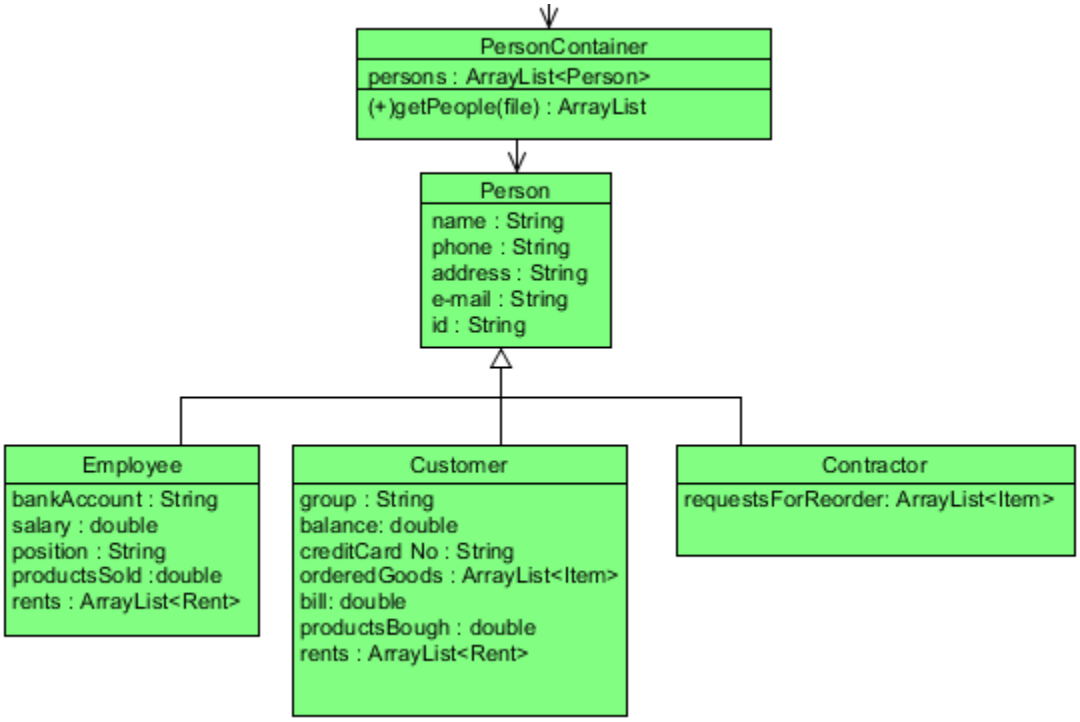


Here we show the Model Layer part of Trade Container and as it can be seen it is singleton and it is used to hold every subclass of the abstract class Trade. We used inheritance so we can avoid code duplication and make the code easier to maintain.



Here is the Trade Controller together with its subclasses Order Controller and Rent Controller. As it can be seen only the Trade Controller is using the Trade Container instead of both classes.

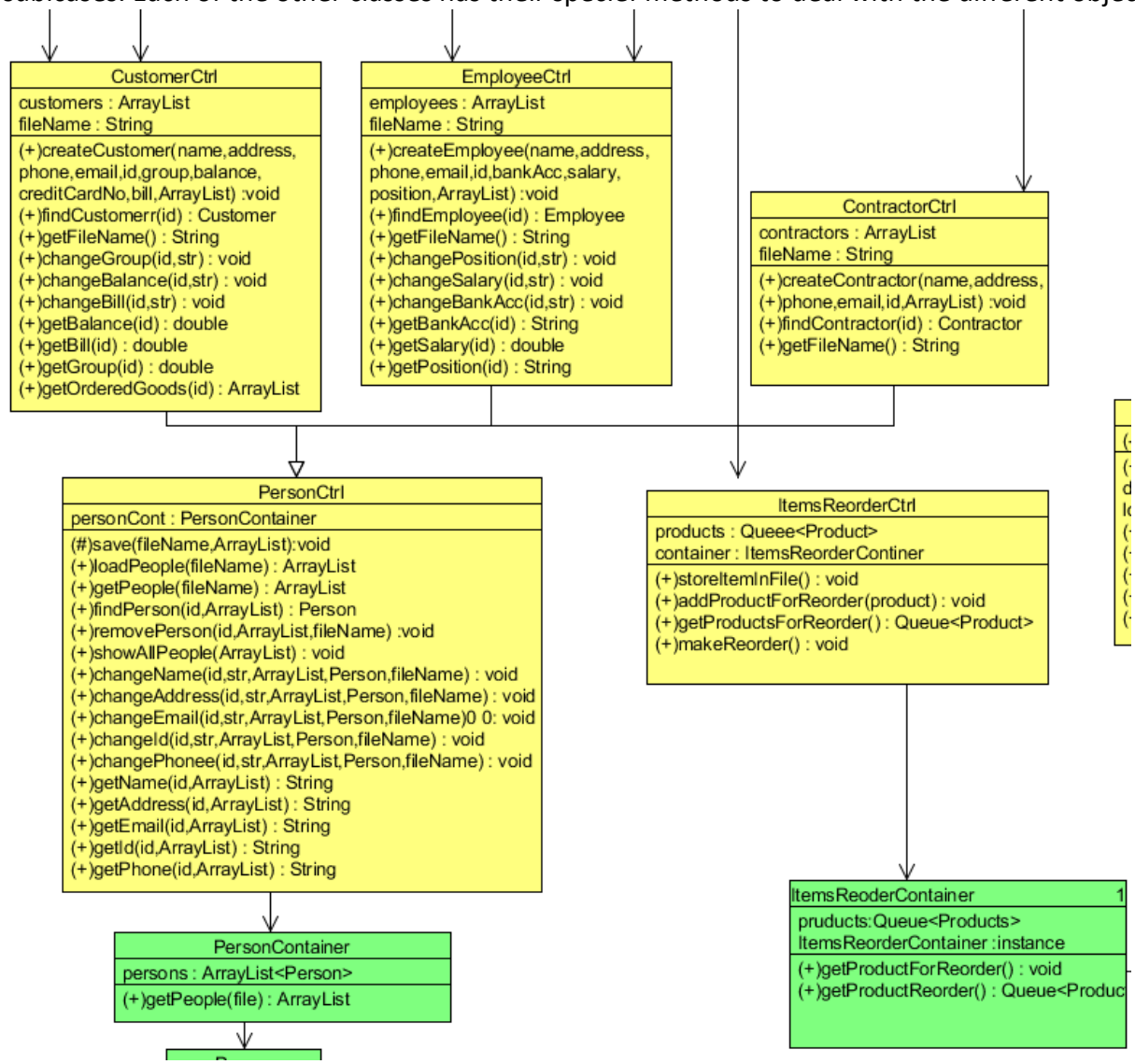




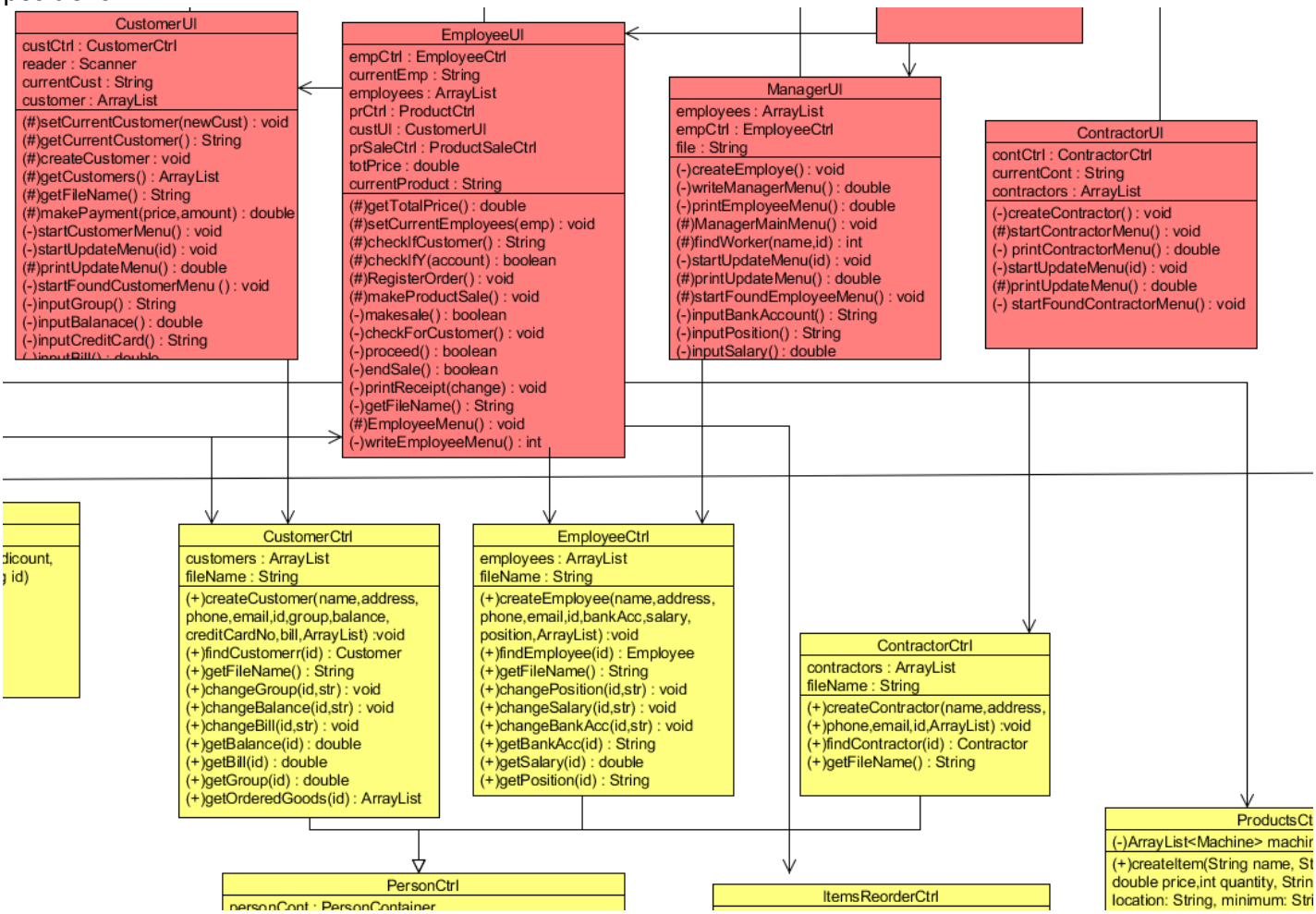
Here is the Model Layer of the Person Container and the classes that are hold in it. Here the Person superclass is not abstract and in the Container only a single method is used to get a specified collection of objects which is required. This is achieved by passing different filename to the method.

Here is the part of the Control Layer which is dealing with manipulating the Person's subclasses. We use one big superclass called PersonCtrl so that every method in this class is usable in its

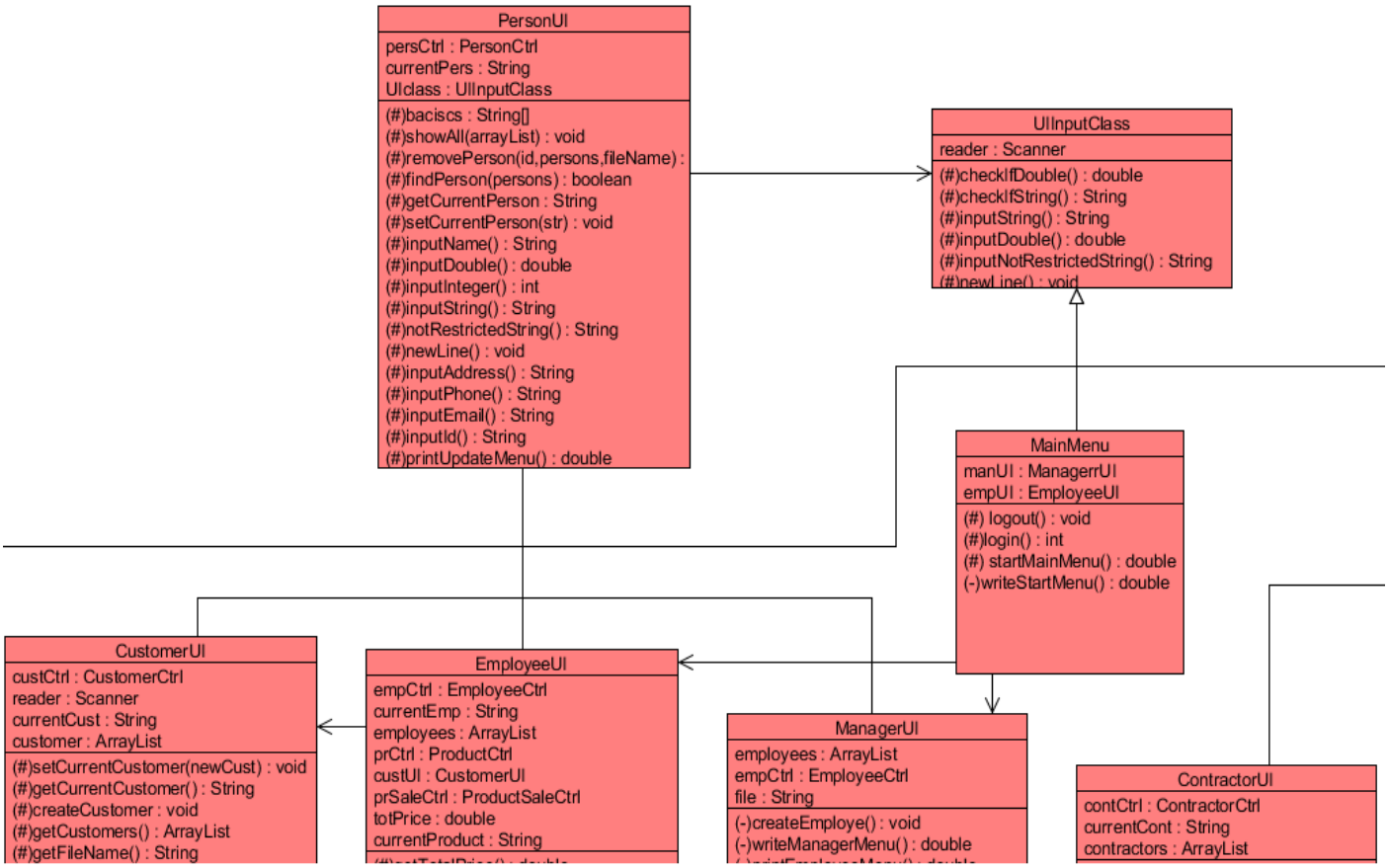
sublcases. Each of the other classes has their specief methods to deal with the different objects.



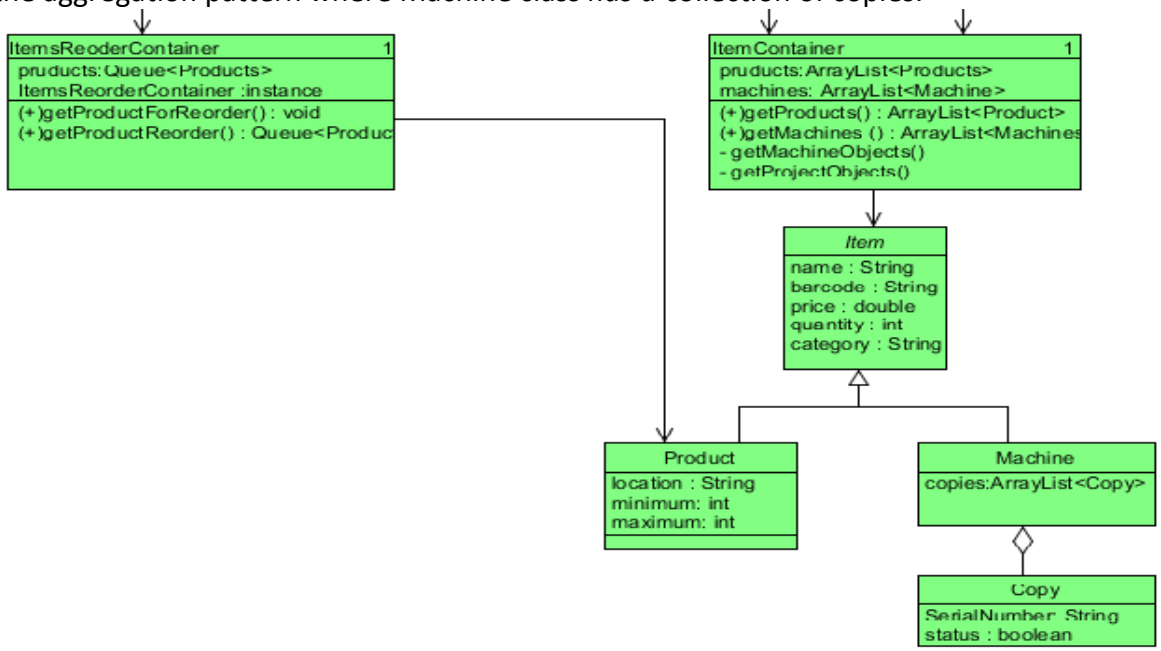
Here we have the UI Layer with all classes needed to achieve a proper text interface of the Person Controller. We devided the employee UI into 2 parts EmployeeUI and ManagerUI because there will be a difference with the menus acessable by employees with different positions.



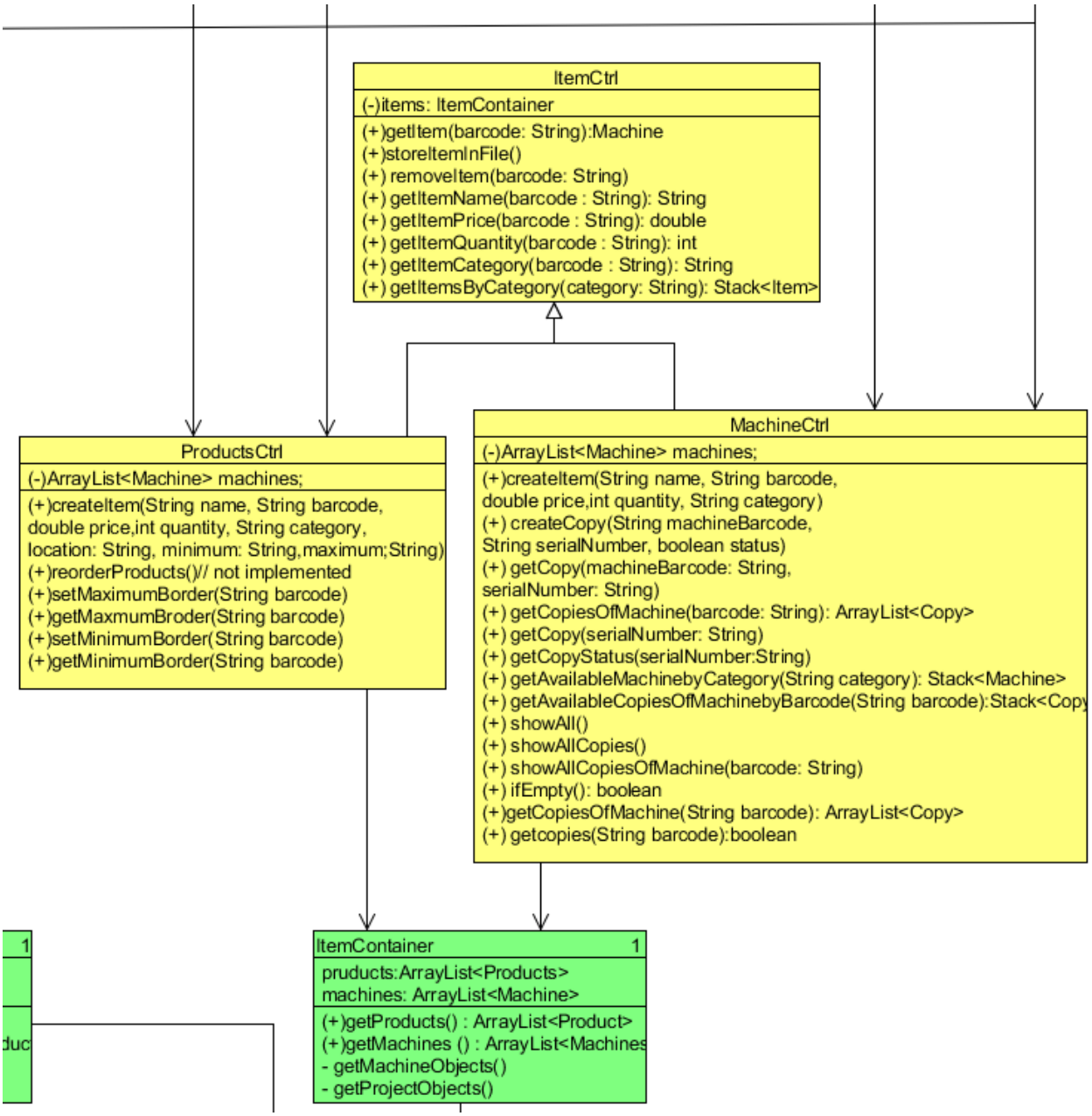
Here we have the UIInputClass which is a superclass used by all UI classes to provide a validation of the data the user is inputing during different processes and to prevent the program of crashing if an incorrect value is provided.program of crashing if an incorrect value is provided.



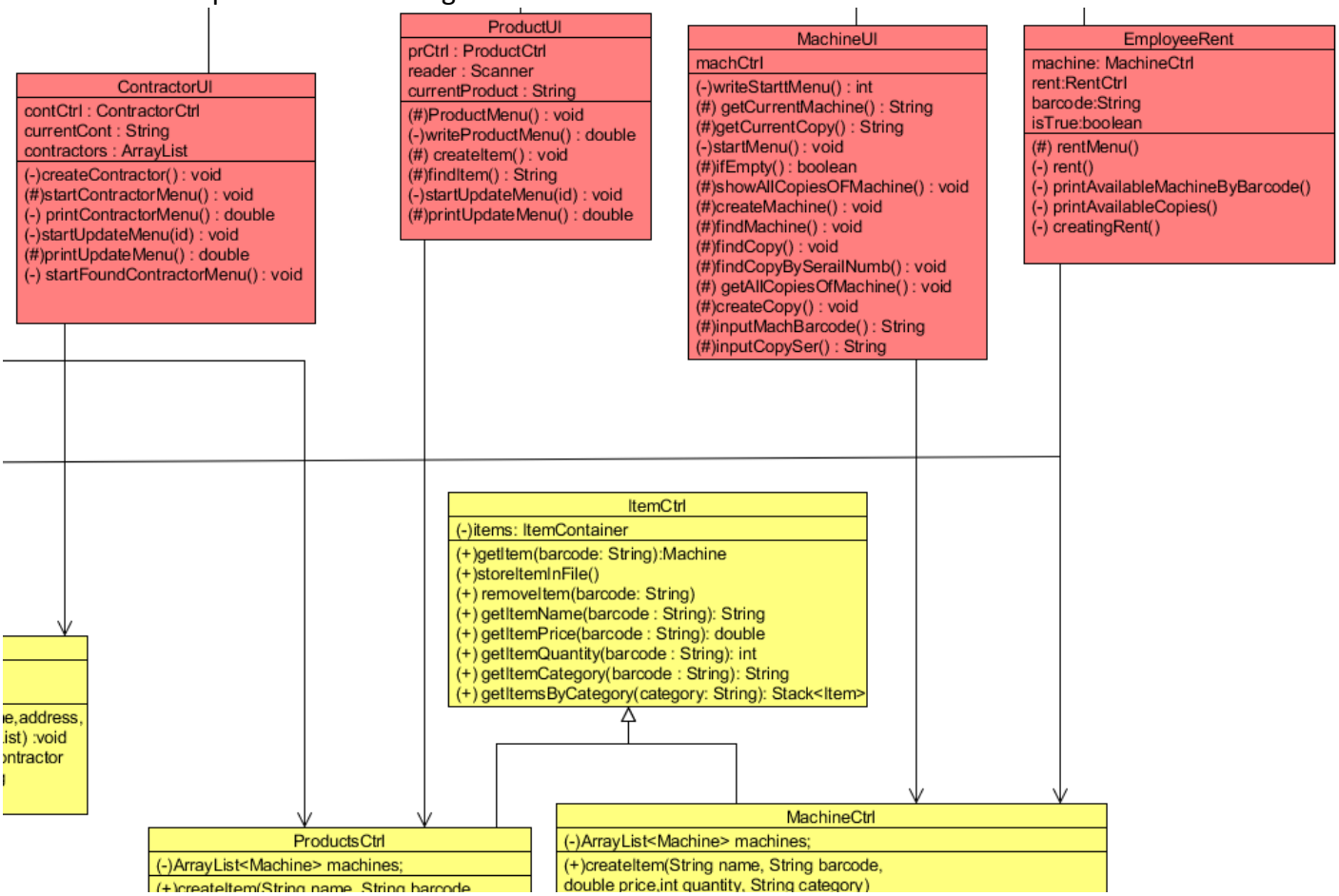
Here is the Model Layer of the Item class and its subclasses. We used two different containers, one to Store all products and machines in the company and another one which is holding all the products which quantity is under the desired minimum. Both are singletons. Here we also use the aggregation pattern where Machine class *has a* collection of copies.



The ItemCtrl is the superclass which both ProductsCtrl and MachineCtrl extends. He is used to provide basic methods for both classes.



This is the UI part responsible for handling the product and machine controllers as well as the class which is responsible for renting a machine.



Team Contract

The purpose of this team working agreement is to outline expectations about the project.

The working relations and group structure among the members are:

1.Communication

2.Decision making

3.Responsibility

4.Participation

5.Leadership

Conclusion

We have tried to demonstrate understanding of the layered architecture (user interface layer – application logic layer – domain layer) and to be able to create it. We used because we needed to separate the different parts of the program in different layers. So now 1 layer is responsible a specified task. In addition, we designed the distribution of responsibilities for controller classes and domain classes using interaction diagrams (UML). We were able to implement use cases according to design, to assemble parts of a system to a whole system, to implement domain classes, to implement container classes many of which adopted the singleton pattern because we needed only one instance of the class to be created and used by every class so there are no losses of data during different processes. We also used the aggregation pattern because we needed a relationship "*has a".* Our team also created a super classes which can be used to avoid code duplications and also make the program easier to maintain. When using the super classes we also needed abstract classes because it was important not to have instances of theses super classes. Another thing that we used is the *interface* so that every of the subclasses should implement the methods in the interface and make use of them. We created different type of collections for different parts of the program where some are more effective than others. We managed to handle the domain objects and to implement different types of structures between objects and to test every class individually.

As a conclusion, our tries to create a system were successful