Assessment – case study *Equipment Storage System* – 2018-2019

0 = did not cooperate in that assignment
1 = passive cooperation (no active cooperation in discussions, modelling). Only read solutions of other members
2 = active cooperation in discussions, modelling, use of Visual Paradigm

Student names (family name + first name)
Group Nr: 4
ST1: name student 1: Loppe Kobe
ST2: name student 2: Stroobants Thibault
ST3: name student 3: Trossaert Jaron
ST4: name student 4: Van Meervenne Bart

		Max score	Score	ST1	ST2	ST3	ST4
Assignment 1	Scope and vision Business analysis	4		2	2	2	2
Assignment 2	Requirement analysis Use case approach	4		2	2	2	2
Assignment 3	Logical analysis Flow of events	4		2	2	2	2
Assignment 4	Technical analysis Use case realisation	4		2	2	2	2
Assignment 5	Requirement & logical analysis User story approach (agile)	4		2	2	2	2
Total group score		20					
% time allocation per student				25	25	25	25
Student score		20					

Which parts of the assignment are not finished or partly finished?
Assignment 1
Assignment 2
Assignment 3
Assignment 4
Assignment 5

Student 1: Loppe Kobe
Tasks performed
Assignment 1 • Business problems & opportunities: problem statement matrix • Stakeholders profile • Activity table • Overall activity diagram – business use case current situation
Assignment 2 • Event response list • Use case diagram • Context diagram
Assignment 3 • System sequence diagram check-out equipment • Activity diagram • Refactored use case diagram • Package diagram
Assignment 4 • Physical ER Model
Assignment 5 • Two user stories

Student 2: Stroobants Thibault
Tasks performed
Assignment 1 • List of PIECES • Business risks
Assignment 2 • Business class diagram • List of business rules
Assignment 3 • Refactored use case diagram
Assignment 4 • MVC sequence diagram • Design class diagram
Assignment 5 • Two user stories

Student 3: Trossaert Jaron
Every week, Jaron also made corrections and improvements for all the texts, diagrams, assignments. He also put all the assignments together in one cohesive document.

Assignment 1
- List of PIECES
- Vision statement
- Overall activity diagram – business use case current situation
- Activity table

Assignment 2
- List of quality attributes
- List of business rules
- Event response list

Assignment 3
- Flow of events for use case check-out
- Flow of events for use case check-in

Assignment 4
- Operation contracts

Assignment 5
- User story map
- Two user stories

Student 4: Van Meervenne Bart
Tasks performed
Assignment 1   • Users characteristics   • List of PIECES   • Business Objectives
Assignment 2   • Business class diagram   • Event response list   • MOSCOW-ranking   • List of quality attributes
Assignment 3   • Domain class diagram   • State chart diagram
Assignment 4   • Operation contracts
Assignment 5   • Two user stories

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1. **Scope and vision / business analysis**

1.1 Scope and vision document

1.1.1 Business problems and opportunities: problem statement matrix

Brief Statements of Problem, Opportunity, or Directive	Urgency	Visibility	Priority or Rank
It is impossible to see an up-to-date account of what equipment employees currently have in their possession. There is no clear overview of the equipment on loan at any given moment, because all loans are still indicated on a piece of (check-in/-out) paper and are not yet automated. Thus, a better information system that allows employees to register their check-outs themselves should be created.	ASAP	High	1
So far, the information system does not track the exact available quantity of any given kind of equipment. To check whether equipment is available, the current solution is for equipment depot staff to simply go look, physically, at the tools themselves.	1 month	High	2
If an employee damages or loses equipment, the incident and the cost price for the company will be marked on the check-in/-out paper. Additionally, a replacement will be ordered. Since there is a lack of automation, it may be difficult to get an exact overview of the costs caused by damage and loss.	2 months	High	3
When the equipment depot staff make a purchase, there is a waiting time between the actual purchase and the equipment delivery. A supervisor or employee may call the equipment depot staff to check the purchase status. Until right now, the equipment depot staff keep all that information in a log, but it does not work well. There should be a more practical way to check the order status.	4 months	Med	4
The current system is not able to place restrictions on certain equipment, which means that all employees can take every kind of equipment home. Thus, there should be a check-out restriction for employees that do not possess a certain skill needed for handling the equipment in question.	6 months	Med	5
There is some confusion about the exact meaning of the 'equip-ID'. Trackable (and expensive) equipment requires a serial number, but other non-trackable tools just have a numeric ID that is shared among every piece of that type. Also, not every ID has been linked to some piece of equipment. The equipment depot staff know most IDs by heart, which might lead to errors and data inconsistency.	6 months	Med	6
So far, there is no way to track the location of a specific piece of checked out equipment. The company should be able to integrate this missing functionality into the new information system.	6 months or later	Low	7

1.1.2 Detailed problem analysis with PIECES

1.1.2.1 Problem 1

Problem	It is impossible to see an up-to-date account of what equipment employees currently have in their possession. This means that there is no clear overview of the equipment on loan at any given moment.
Pieces category (ies)	Information (Stored data): • Data is not well organized • Data is not flexible • Data is difficult to access
Analysis	This is a failure because no control is imposed on the equipment on loan. GB Manufacturing discovered that a lot of equipment was lost, stolen or damaged during the most recent years, causing an estimated loss of € 50 000 worth in equipment every year.
Possible causes	• Loans are still indicated on a piece of paper (check-in/-out paper) and are not yet automated. • Because of the growth of GB Manufacturing, the current system has become inefficient and difficult to manage. In other words, the current system has become obsolete.
Possible solutions	A better information system should be created, which allows employees to register the equipment they want to check out themselves.

1.1.2.2 Problem 2

Problem	The current system is not able to place restrictions on certain equipment, which means that all employees can currently take every kind of equipment home.
Pieces category (ies)	Information (Outputs): • Lack of necessary information • Lack of relevant information Control (Too little security): • Ethics are breached, information (and equipment) accessed by unauthorized people Efficiency: • People waste materials and supplies
Analysis	Employees without the proper skills needed to handle certain equipment could possibly get hurt if they check out such items. Not knowing how to operate the equipment is simply dangerous.
Possible causes	• Integration of an employee's skill classification into the current information system is missing. Lack of such a feature means every employee can check out every piece of equipment, in theory. • Currently, the GB Manufacturing equipment depot staff eyeball the skill classification of employees, which often results in inappropriate equipment check-outs.
Possible solutions	There should be a check-out restriction on equipment for employees who do not possess a certain skill needed for handling the equipment in question. Furthermore, many pieces of equipment could still be safely used by employees with any skill classification.

1.1.2.3 Problem 3

Problem	The information system does not track the exact available quantity of any given kind of equipment. To check whether equipment is available, the current solution is for equipment depot staff to simply go look (physically) at the tools in the depot.
Pieces category (ies)	Information (Outputs): • Lack of necessary information Efficiency: • Effort required for tasks is excessive
Analysis	The equipment depot staff have to manually check the quantity of any given equipment to know whether or not they can check out any of the needed equipment. This is an enormous waste of time and effort for the staff.
Possible causes	• There is currently no way to take stock of the equipment to easily check the quantity of certain pieces. Therefore, the staff must go and check this manually.
Possible solutions	There should be some sort of (digitized) inventory of all the equipment available in the depot. This will save a lot of time and effort for the depot staff, since they do not have to manually go and check the quantity every time a piece of equipment is requested.

1.1.2.4 Problem 4

Problem	If an employee loses/damages equipment, it will be written on their check-in/-out paper and a new piece of equipment will be ordered as a replacement. However, there currently is no exact overview of reports within the company for all loss and damage costs, due to the lack of automatization; a glaring omission created by the many entries that have to be noted down manually.
Pieces category (ies)	Efficiency: • Effort required for tasks is excessive • Materials required for tasks is excessive Information (Outputs): • Lack of relevant information • Information that is not accurate Information (Stored data): • Data is not well organized • Data is not secure to accident or vandalism
Analysis	The equipment depot staff need to manually record every lost or damaged piece of equipment in the existing files of an employee. It is virtually impossible for them to create overviews of about 200 employees, as to maintain records of who lost/damaged which piece of equipment, who damaged the most equipment, etc.
Possible causes	• Lost/damaged equipment records are written on the check-in/-out paper which makes it difficult to link all the lost/damaged equipment for only one employee • Due to the growth to around 200 employees, all the data became unstructured • The data might be inconsistent because of the large number of check-ins and check-outs.
Possible solutions	An automated information system. With this system, it needs to be possible to add a notice for a piece of equipment that has been either lost or stolen or damaged. This system must also be able to generate an overview of lost/stolen/damaged equipment per employee as well as overall statistics regarding the most reckless employees and such.

1.1.3   Business Objectives

BO-1:
Reduce the worth of stolen, damaged or lost equipment by 35% within a few months and by 50% within a year.

BO-2:
Increase the time spent on-site for the maintenance employees by 40 minutes a day, by making check-ins and check-outs more efficient.

BO-3:
Reduce the waiting lines at the depot check-in/check-out during peak hours and other busy periods of the day by 50%.

BO-4:
The ability to get an overview of which employee checked in or checked out which piece of equipment.

BO-5:
The ability to get an overview for every checked-out tool that shows if it is trackable, the employee who checked it out, and its location if possible.

BO-6:
Reduce the effort and time all the employees of the company need to put into entering data.

BO-7:
Reduce the number of employees who check out equipment they are not qualified to use by 25%.

1.1.4   Vision statement

For maintenance employees who want equipment that is necessary to complete their jobs, the Equipment Storage System (ESS) is an Internet-based application that will accept equipment check-outs requested by those employees. It also provides features created to make equipment-related operations easier and more (cost-)efficient for the appropriate users within the company. This all results in less work overhead for the employees on one hand, and less severe equipment losses and repairs for the company on the other hand; increasing employee morale as well as company profit.

Unlike the current manual check-out process, employees who use the ESS will not have to go to the depot to check the tool availability, and skill classification of needed equipment.

People of the company that are higher up in the chain-of-command will also benefit from the new ESS. Updating or inquiring about the skill classifications of employees under the care of their respective supervisors will be made easier for those supervisors, with faster request response times and more accurate data. Furthermore, relations with the Safety Committee will be more stable or even improve if the related information system is made more reliable than before. Supervisors who order new equipment will additionally be made happy with seeing their orders brought to completion in a timelier fashion than with the system currently in place. Worth mentioning is that the equipment depot staff also gain a great deal from an improved equipment ordering system, when they need to order items because of tool loss or damage by an employee.

Speaking of the equipment depot staff, improvements will be made to their current web ordering and manual check-in/-out processes as well. Records will be kept of which employees have checked out what sorts of equipment and how many, by which date they need to be returned to the depot, the employees' history with equipment loss/damage as well as their skill classification. All these valuable employee facts will be safely stored and maintained within the ESS, as is the case for equipment data such as their ID, quantity, availability and skill classification.

All in all, the ESS will enhance the company on almost each and every front. Happier employees will get done what they need to do more efficiently, less costs and losses will take place in terms of company profit and healthier relationships with external groups such as the supplier and the Safety Committee will come to be. A safer work environment will be assured, and company violations such as unauthorized use of work resources - previously caused by check-outs of skill-inappropriate equipment, or by keeping equipment as a result of no control over overdue check-outs - will decrease a lot, hopefully to (almost) zero incidents. Developing the application will take a decent amount of effort, time and money, but it will most certainly be worth it.

1.1.5 Business risks

RI-1:
The employees might not use the ESS the way it is supposed to be used. For example, if they would check out the equipment incorrectly, the error might go unnoticed and the overall losses might actually increase instead of decrease. On the other hand, if errors would occur, the equipment depot staff might need to put more work into fixing the error than they would have when they were still using the old system.

RI-2:
There could be downtime of the new system, which would cause the workflow to significantly drop, since the staff will be relying on the new system rather than the old ways of handling the operations. This would lead to more overhead than there would have been if the new system had not been implemented. Another consequence of system downtime would be that the equipment depot staff can't check the skill classification of certain equipment and certain employees. This would mean that skill specific equipment can't be checked out during downtime, since they do not know whether an employee is allowed to use it.

RI-3:
The fact that all the employees will be checked and monitored every now and then, as to make the new system work, might be considered a breach of privacy. If this is not carefully put into a new contract for every employee, the company might get sued and lose more than what the system would yield.

RI-4:
Lastly, since the system improves efficiency, some employees might get obsolete, which in turn could cause strikes when certain employees get fired for just being unnecessary for the company (after considering putting the employee to work somewhere else within the company). A strike is a waste of money since the employees are not doing their jobs, which in turn provides the company with zero income generated by the employees on strike.

The risks are unlikely, but they should be taken into account.

1.1.6 Major features

FE-1:
Easy checking out of equipment to certain employees by making the system know which equipment can be used by whom, how many pieces of equipment are still in storage and generally decreasing overhead when equipment gets checked out.

FE-2:
Easy checking in of equipment by employees, which will happen in a timelier fashion as employees will get reminder notifications after a certain amount of time.

FE-3:
Clear overviews for people of the company that are higher up in the chain-of-command, of statistics of their employees, to know which ones are more efficient than others, which employees are less careful with their checked-out equipment, and other facts.

FE-4:
Tracking equipment by knowing who checked out what tools, so people will be more careful with what they do with the equipment, as it can all be traced back to them.

FE-5:
Easy ordering of new equipment and replacement parts/tools through a streamlined partnership and link between the information system and the supplier.

1.1.7 Stakeholders profiles

Stakeholder	Major Value	Attitudes	Major Interests	Constraints
Supervisors	Can be considered the boss of a specific department of employees. Supervisors may communicate with the equipment depot staff when problems occur with equipment checked out by someone who is under their employment.	Enthusiastic, because they would benefit from a well-performing company with minimal losses.	Making as much profit as possible.	None identified.
Equipment depot staff	Responsible for the checkouts handed to the maintenance employees, updating skills of employees, purchasing new equipment, ...	Enthusiastic, because it was actually the equipment depot staff who demanded a renewed information system that can remedy the current problems.	Working as efficiently as possible.	The current information system causes an inefficient way of working. So, the information system direly needs changing.

Stakeholder	Major Value	Attitudes	Major Interests	Constraints
Maintenance employees	To be able to check out equipment, temporarily borrowing it to perform the tasks they are required to carry out.	Varies from employee to employee. Some employees took advantage of the fact that the old information system was not that great; opinions of others either will not change or will not matter. In general, employee attitude will improve due to an up-graded information system.	Checking out and checking in equipment as efficiently as possible.	Same problem as described above.
Equipment-deals.com staff	Processing incoming purchases and sending orders to the client	No opinion. As equipmentdeals.com is an external firm, they don't really benefit from improving the information system, apart from gaining a better relationship with their client, GB Manufacturing.	Making as much profit as possible (which has nothing to do with GB Manufacturing actually).	None identified.

1.1.8 Users and characteristics

1.1.8.1 Supervisors

The supervisors will analyse the overviews generated by the information system. Depending on those overviews, they can see which employee works harder than others, who is less careful with the tools, and so forth.

1.1.8.2 Equipment depot staff

The company employs three people as the equipment depot staff. It is their job to record every check-in and check-out and to put possible damaged or stolen or lost equipment in the new information system. The equipment depot staff might need training to get familiar with the new system.

From now on, within this text, the group of the equipment depot staff will be referred to as the depot employees, and one equipment depot staff member will be called a depot employee. These changes make the upcoming texts and diagrams much more readable.

1.1.8.3 Maintenance employee

There are around 200 employees who each need to check in and check out tools from the depot. Each employee who checks in or checks out a piece of equipment needs to wait in line until it is their turn. With the new system, the time they spend waiting would decrease noticeably.

1.1.8.4 Equipmentdeals.com staff

The staff of equipmentdeals.com are not directly related to the new information system, but they will indirectly make more profit thanks to the new information system at the equipment depot, because everything will be made more efficient. In particular, an improved system for ordering new equipment will most certainly turn GB Manufacturing into a more faithful customer.

1.2 Activity table as start for the activity diagrams

Actor	Activity	Action	Object	CRUD (object)	Datastore	CRUD (datastore)
Maintenance employee	Request equipment check-out	1. Arrives at the equipment depot 2. Possibly waits in queue until it is their turn 3. Initiates conversation with depot employee currently on shift 4. Shows employee ID badge to prove they may check-out equipment 5. Requests the equipment they want	Equipment check-out request	Create	-	-

Depot employee	Handle equipment check-out	6. Looks up location of the demanded equipment
		  a) Location exists → 7
		  b) Location or equipment does not exist → <<Order equipment>>
		7. Checks stock at its supposed location
		  a) Quantity needed ≤ quantity available → <<Finalize equipment check-out>>
		  b) Quantity needed > quantity available → <<Order equipment>>
			Equipment check-out request	Read	Equipment depot database	Read

Depot employee	Finalize equipment check-out	8. Retrieves equipment for maintenance employee 9. Gives demanded equipment to maintenance employee 10. Allows maintenance employee to leave the equipment depot with checked out tool(s)	Equipment check-out request	Delete	Equipment depot database	Update

Actor	Activity	Action	Object	CRUD (object)	Datastore	CRUD (datastore)

Depot employee	Order equipment	7.1. Goes to www.equipmentdeals.com
		7.2. Purchases the needed equipment
		7.3. Waits for the equipment to arrive
		7.4. Receives the equipment
		7.5. Adds it to the stock
		7.6. Finalizes order
		    a) Ordered equipment was requested be-fore → signal maintenance employee
		    b) Ordered equipment was not requested before → end of activity
			-	-	www.equip-mentdeals.com database
					Equipment depot database
						Read
						
						Update

Maintenance employee	Check in used equipment	11. Arrives at the equipment depot 12. Possibly waits in queue until it is their turn 13. Mentions possible new state of equipment (i.e. stolen, damaged, lost) 14. Gives used equipment to depot employee 15. Leaves the equipment depot or requests new equipment	Equipment check-in request	Create	-	-
Depot employee	Handle equipment check-in	16. Returns used equipment to stock	Equipment check-in request	Read, Delete	Equipment depot database	Read, Update

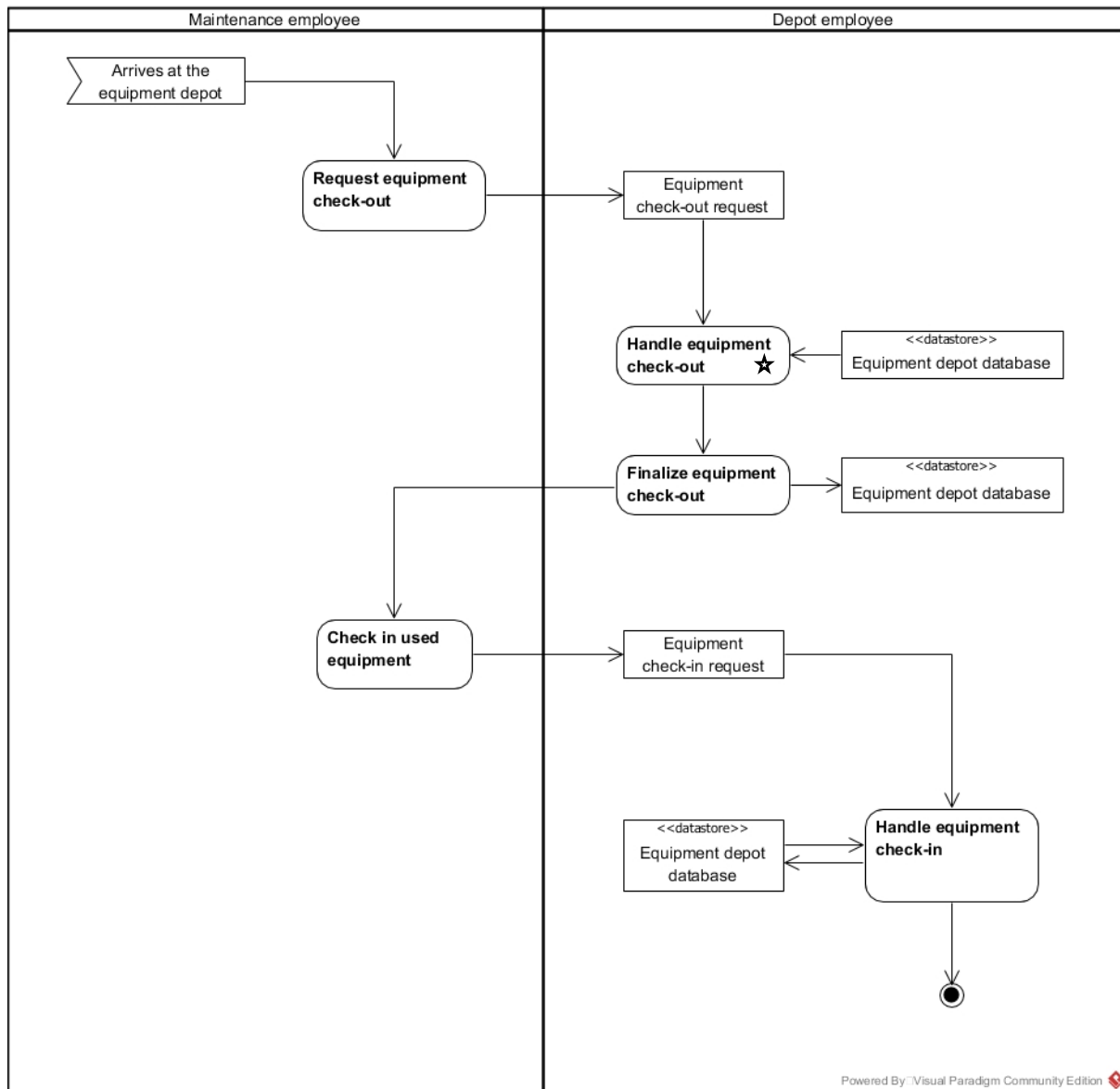## 1.3 Overall activity diagram – business use case current situation

Figure 1: Overall activity diagram of business process "checkOut_checkIn"

1.4 Detailed activity diagram(s) – business use case current situation

1.4.1　Activity diagram: handle equipment check-out
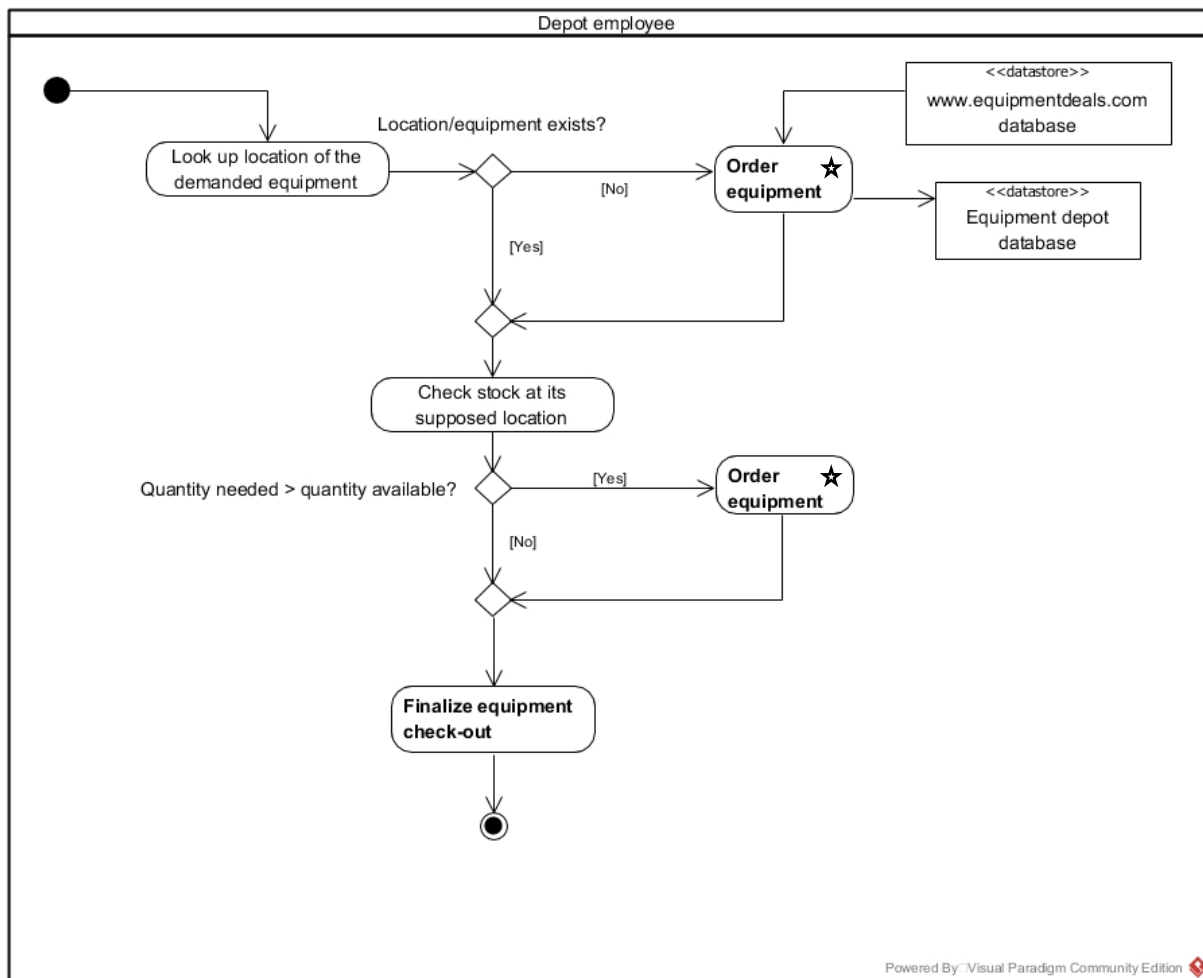

Figure 2: Detailed activity diagram of "handle equipment check-out" activity
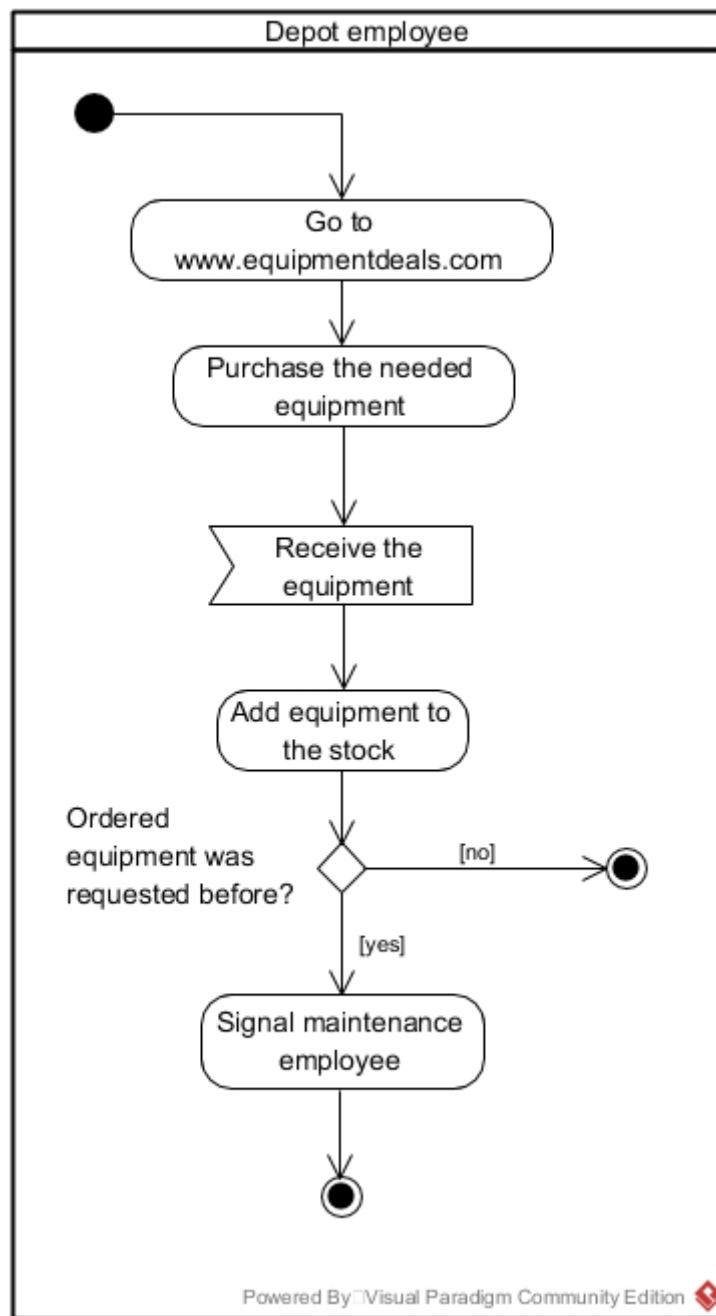
1.4.2   Activity diagram: order equipment

Figure 3: Detailed activity diagram of "order equipment" activity
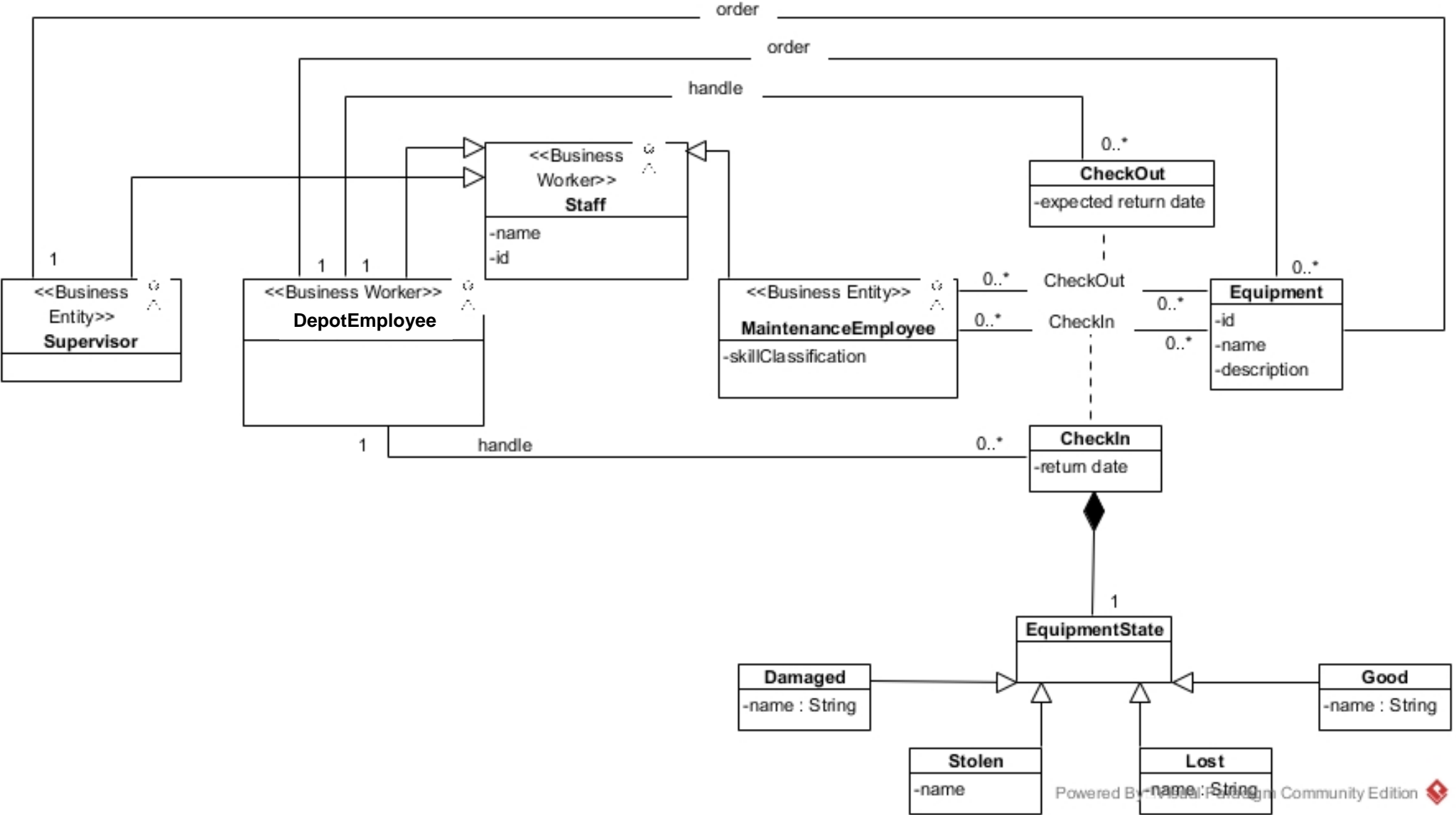
1.5 Business class diagram – current situation

Figure 5: Business class diagram (AS IS)

2. Requirement analysis / use case approach

2.1 Event response list (use case list)

Event	Trigger	Source	Use Case	Response	Destination
Employee wants to check out equipment	Equipment necessity for job	Depot/mainte-nance em-ployee; Supervisor(s) (= any em-ployee)	Check out equipment	Needed equipment	Depot em-ployee
Employee wants to check in equipment	Job fulfilment	Depot/mainte-nance em-ployee; Supervisor(s) (= any em-ployee)	Check in equipment	Returned equipment	Depot em-ployee
Employee logs in to equipment depot web application	Equipment check-out necessity	Depot/mainte-nance em-ployee; Supervisor(s) (= any em-ployee)	Log in	Overview of equipment	-
Employee wants to re-serve equipment online	Equipment reservation necessity	Depot/mainte-nance em-ployee; Supervisor(s) (= any em-ployee)	Reserve equipment online	Reservation confirmation	-
Depot em-ployee views status of which equipment employees currently possess	"At the end of the day"	Depot em-ployee	Track loca-tion of spe-cific equip-ment	List of all equipment in possession of employee (= location of specific equip-ment)	-
Employee wants to re-quest new equipment	New equip-ment neces-sity (because of loss, growth, dam-age, short-age, …)	Depot/mainte-nance em-ployee; Supervisor(s) (= any em-ployee)	Request new equipment	New equip-ment request confirmation	-
Depot em-ployee orders new equip-ment	Lost/sto-len/low-stocked/non-existent equipment	Depot em-ployee	Order new equipment	Transaction; Order confirmation; Order details	www.equip-mentdeals.com
Supplier up-dates order status	"Once a day"	www.equip-mentdeals.com	Update order status	Updated order status	-

| Event	Trigger	Source	Use Case	Response	Destination
Employee checks order status	Order status inquiry	Depot/maintenance employee; Supervisor(s) (= any employee)	Check order status	Order status	-
Supervisor wants to register new employee in the system	Acquisition of new employee	Supervisor	Register new employee	Updated list of employees	-
Supervisor wants to remove employee from system	Dismissal of employee	Supervisor	Dismiss employee	Updated list of employees	-
Depot employee receives overview of all available equipment	"At the beginning of the day"	Depot employee	Get overview of available equipment	List of all available equipment	-
Equipment depot app sends statistics of the maintenance employees with most losses or damages	Statistics inquiry	Equipment depot app	Get usage statistics	Statistics report	Supervisor
Depot employee sends notification if the checked-out equipment is in possession of a maintenance employee for too long	Expiration of the allowed check-out time	Depot employee	Send check-in reminder notification	Check-in reminder notification	Maintenance employee; Supervisor(s)
Supervisor wants to update skill classification of maintenance employee	New skill classification	Supervisor	Update skill classification	Updated skill classification	-
Equipment depot app sets equipment as reserved	Necessity to mark equipment as reserved	Equipment depot app	Set equipment as reserved	Updated reservation state for equipment	-

2.2 Context diagram
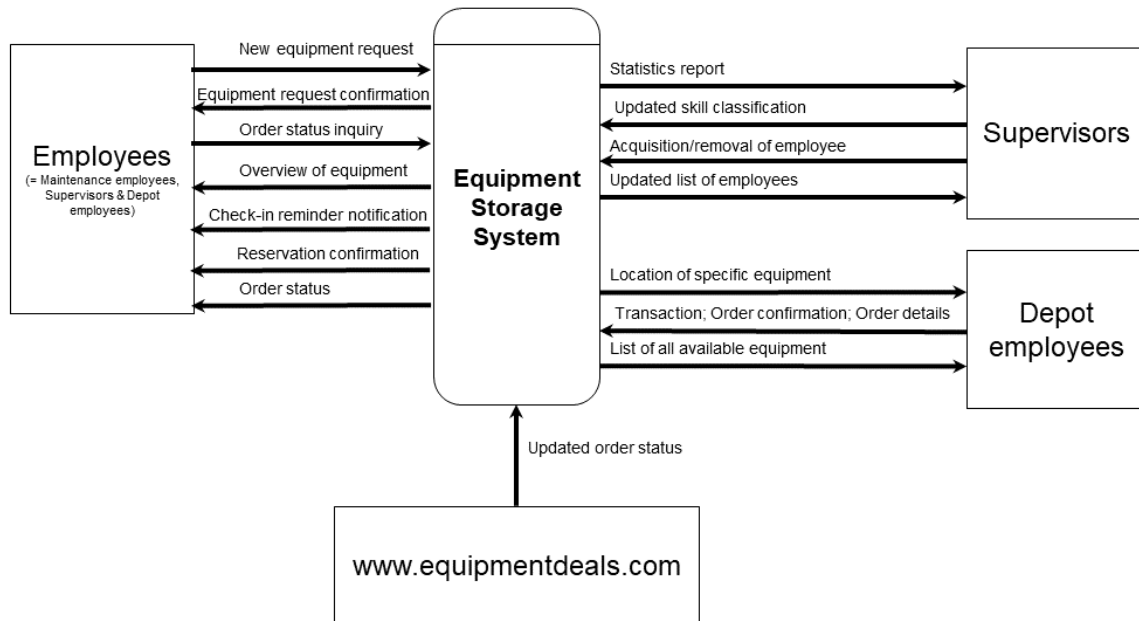
Figure 6: Context diagram of the Equipment Storage System

2.3 Use case list with MOSCOW ranking

Use case	Priority (M, S, C, W)
Check out equipment	M
Check in equipment	M
Check order status	S
Get overview of available equipment	M
Track location of specific equipment	C
Register new employee	M
Dismiss employee	M
Order new equipment	M
Update order status	C
Request new equipment	M
Update skill classification	S
Send check-in reminder notification	S
Log in	M
Get usage statistics	M

2.4 System use case diagram
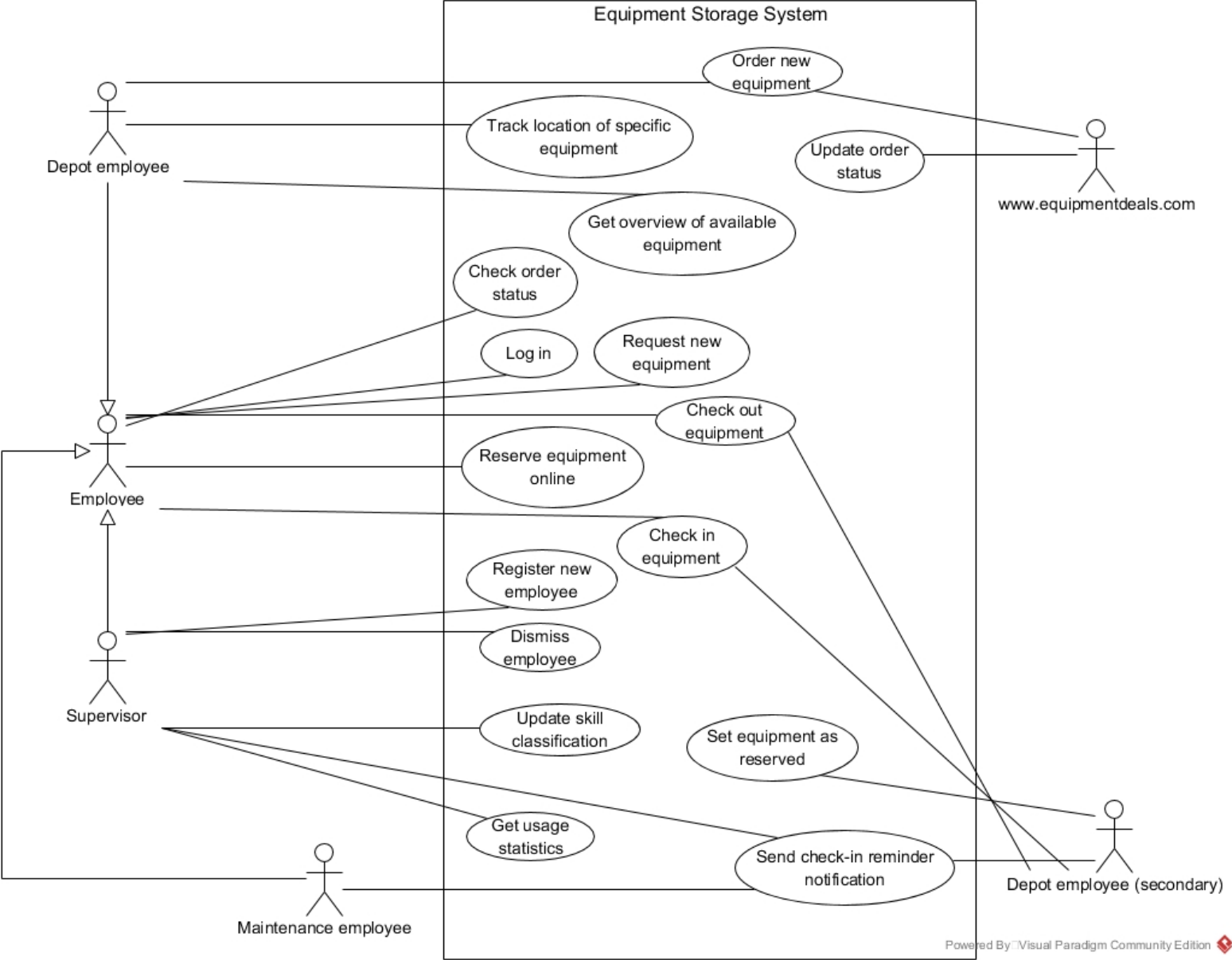
Figure 7: ESS UML use case diagram

2.5 List of business rules

ID	Description business rule	Type	Static/Dynamic	Source
1	Specialized equipment can only be checked out by a maintenance employee with the proper expertise.	Limitation	Static	Safety Committee
2	The location of every piece of equipment must be tracked at all times.	Limitation	Dynamic	Supervisors
3	The condition of equipment must be updated with every check-in.	Event	Dynamic	Depot employees
4	A reserved piece of equipment must be picked up within 24 hours.	Limitation	Dynamic	Depot employees
5	If there is a shortage of equipment, a new order must be made.	Event	Dynamic	Depot employees
6	Statistics of employees must be kept in order to see who damaged or lost the most equipment.	Derivation	Static	Supervisors
7	A checked-out item must be returned within 30 days.	Limitation	Dynamic	Depot employees
8	A piece of equipment can only be checked out if it has been reserved.	Limitation	Dynamic	Depot employees
9	There must be an inventory of all equipment.	Limitation	Static	Depot employees
10	Every piece of equipment that was checked out, should be checked in again at some point.	Event	Dynamic	Depot employees

2.6 List of quality attributes (nonfunctional requirements)

2.6.1 Functionality

1. **Restriction:**
   A maintenance employee should not be able to check out equipment for which he is not authorized to do so. If a maintenance employee does not have the required skill classification, then he is not able to check out that piece of equipment.

2. **Restriction:**
   Only registered maintenance employees can check equipment in or out. It is not possible for non-employees to take advantage of the system (i.e. by wearing a fake ID badge and trying to illegally take equipment, which is company property).

2.6.2 Reliability

3. **Fault tolerance:**
   The system needs to be online at all times. This means that maintenance employees should always be able to check in and check out equipment. Otherwise, the depot employees have to do every check-in and check-out manually, which will result in great losses in terms of time, money and effort.

4. **Error tolerance:**
   If the system shuts down, the depot employees need to enter each data entry manually in the database, to make the data consistent at every moment in time.

5. **Recoverability:**
   If the system shuts down for some reason, then the stored data should not be affected by the shutdown. Furthermore, the generated statistics and reports may not be affected by the shutdown as well.

2.6.3 Usability

6. **Easy to learn:**
   90% of the maintenance employees should be able to use the new system with ease after only one or two occasions of utilising it.

7. **Attractiveness:**
   85% of the maintenance employees should think the new system is better, more efficient and reliable than the old, manual system.

2.6.4 Efficiency

8. **Speed:**
   A check-in or check-out needs to be handled within seconds by the new system, heavily reducing the waiting line at the equipment depot in comparison to the times where the old system was still in use, where everything was registered manually.

2.6.5 Maintainability

9. **Stability:**
   At least 97% of the implemented requirements should not have irregular behaviour. Of course, the aim is to have no irregular behaviour at all.

2.6.6 Portability

10. **Installability:**
    The new system should be installed on-site within a day, so in the future it is possible for additional equipment depots to also start working with this new information system, with minimal install effort.

3. **Logical analysis / flow of events**

3.1 Flow of events for use case "check out equipment" in Word template

Use case name: Check out equipment	
Primary actors: Employee	
Secondary actors: Depot employee, ESS	
Short description: This use case allows an employee, who is a depot employee, a maintenance employee or a supervisor, to check out equipment that they need to complete one of their maintenance-related tasks.	
Preconditions: • The employee has a job to do for which they need the equipment they want to check out • The employee can legitimize themselves at the equipment depot • A depot employee is on shift • The employee has an account on the equipment depot app • The equipment needs to exist within the stock of the equipment depot	
Postconditions: • The employee has the equipment they wanted to check out in their possession • The equipment depot stock no longer has the equipment that the employee checked out in its inventory • The equipment depot app decreases the available amount of this type of equipment by the amount that was checked out	

Basic flow:

1. The employee enters their login credentials in the app.

2. The app verifies the employee's login.
3. The app does a successful login of the employee.

4. The employee searches for the equipment they need, within the equipment depot database on the app.

5. The app shows the search results.

6. The employee selects their equipment from the search results list.
7. The employee indicates they want to reserve the necessary amount of the needed equipment.

8. The app marks the amount of the needed equipment as reserved (for that particular employee).

9. The employee gets a reservation confirmation.
10. The employee goes to the equipment depot within 24 hours to pick up their reservation.
11. The employee gives their reservation details to the depot employee.

12. The depot employee searches for the reserved equipment within the inventory.
13. The depot employee returns with the reserved equipment to the employee and hands it over.

14. The employee checks out their reserved equipment and leaves the equipment depot.

Alternative flow:

A1: temporarily incorrect login

The A1 sequence starts at point 2 of the basic flow.

3. The app informs the employee that their login credentials are incorrect.

The scenario goes back to point 1.

A2: no search results found

The A2 sequence starts at point 5 of the basic flow.

6. The app doesn't show any results for the search query.
7. The employee can optionally request a new equipment order.

The scenario goes back to point 4.

A3: requested equipment not available

The A3 sequence starts at point 6 of the basic flow.

7. The app informs the employee that the selected equipment is not available (either through all checked out, all reserved, all in repair, wrong skill classification …)

The scenario goes back to point 4.

A4: insufficient amount available of requested equipment

The A2 sequence starts at point 7 of the basic flow.

8. The app informs the employee that the selected equipment is available in an amount less than the requested amount.
9. The employee can optionally reserve less the amount than they originally wanted of that equipment.
10. The employee can optionally ask where the currently checked out equipment is and handle things from there on out on their own.

The scenario goes back to point 4.

A5: depot employee puts reserved equipment aside

The A2 sequence starts at point 9 of the basic flow.

10. The depot employee on shift searches for the reserved equipment within the inventory and puts it aside.
11. The employee goes to the equipment depot within 24 hours to pick up their reservation.
12. The employee gives their reservation details to the depot employee and immediately gets the equipment from the depot employee.

The scenario goes back to point 14.

Error flow:

E1: the app crashes

The E1 sequence starts at point 2, 3, 5 or 8 of the basic flow.

3., 4., 6., or 9. The app crashes and is not able to help the employee any further; the use case fails.

E2: employee doesn't show up at the equipment depot in time

The E2 sequence starts at point 9 of the basic flow.

10. The employee doesn't go to the equipment depot within 24 hours of making an equipment reservation.
11. The app deletes the reservation; the use case fails.

E3: reserved equipment is not at its supposed place

The E3 sequence starts at point 12 of the basic flow.

10. The depot employee doesn't find the reserved equipment at the place where it's supposed to be found.
11. The depot employee returns with the bad news to the employee and investigates further; the use case fails.

3.2 Flow of events for use case "check in equipment" in Word template

Use case name:	
Check in equipment	
Primary actors:	
Depot employee	
Secondary actors:	
ESS, employee	
Short description:	
This use case allows an employee, who is either a depot employee, a maintenance employee or a supervisor, to check in equipment they had previously checked out to complete one of their maintenance-related tasks.	
Preconditions:	
• The employee has the equipment in their possession • The employee can legitimize themselves at the equipment depot • A depot employee is on shift • The employee has an account on the equipment depot app • The equipment needs to exist within the stock of the equipment depot	
Postconditions:	
• The employee no longer has the equipment they used for their job in their possession • The equipment depot stock has got the equipment that the employee checked in (and previously had checked out) back in its inventory	

Basic flow:

1. The employee finishes their job using the equipment they had checked out.
2. The employee returns with their checked-out equipment to the equipment depot within 30 days of checking the tool(s) out.
3. The employee enters their login credentials in the app.

4. The app verifies the employee's login.
5. The app does a successful login of the employee.

6. The employee selects the option to make a check-in request.

7. The app shows the employee all their active check-outs.

8. The employee selects the correct check-out to now make a check-in request for.

9. The app generates the check-in request and its details.

10. The employee hands over the checked-out equipment to the depot employee on shift and shows them their check-in request details.

11. The depot employee returns the equipment to its rightful place within the inventory, using the check-in details.
12. The depot employee returns to the employee to tell them the check-in succeeded.

13. The employee leaves the equipment depot or makes a new check-in or check-out.

Alternative flow:

A1: late check-in

The A1 sequence starts at point 1 of the basic flow.

2. The employee doesn't return with their checked-out equipment to the equipment depot within 30 days of checking the tool(s) out.
3. The app sends a reminder notification to the employee.
4. The employee soon returns to the equipment depot with their checked-out equipment.

The scenario goes back to point 3.

A2: temporarily incorrect login

The A2 sequence starts at point 4 of the basic flow.

5. The app informs the employee that their login credentials are incorrect.

The scenario goes back to point 3.

A3: equipment can't be put back at its supposed location

The A3 sequence starts at point 10 of the basic flow.

11. The depot employee goes with the equipment to its supposed location.

12. The location is either unavailable through nonexistence, or because something is already occupying the place.
13. The depot employee fixes the mess.

The scenario goes back to point 12.

Error flow:

E1: too late check-in

The E1 sequence starts at point 1 of the basic flow.

2. The employee doesn't return with their checked-out equipment to the equipment depot within 30 days of checking the tool(s) out.
3. The app sends a reminder notification to the employee.
4. The employee doesn't return soon to the equipment depot with their checked-out equipment.
5. The employee is in for some trouble with their superiors; the use case fails.

E2: the app crashes

The E2 sequence starts at point 4, 5, 7 or 9 of the basic flow.

5., 6., 8., or 10. The app crashes and is not able to help the employee any further; the use case fails.

E3: equipment lost, stolen or too damaged

The E3 sequence starts at point 9 of the basic flow.

10. The employee actually informs the depot employee that the equipment that they had previously checked out is either too damaged to return to the inventory or stolen or lost.
11. The depot employee is mad and/or disappointed that this happened, the check-in can't continue; the use case fails.

E4: wrong equipment

The E4 sequence starts at point 10 of the basic flow.

10. The employee actually has equipment to check in that is different from the equipment selected on the app for a check-in request. A different check-in request has to be made; the use case fails.

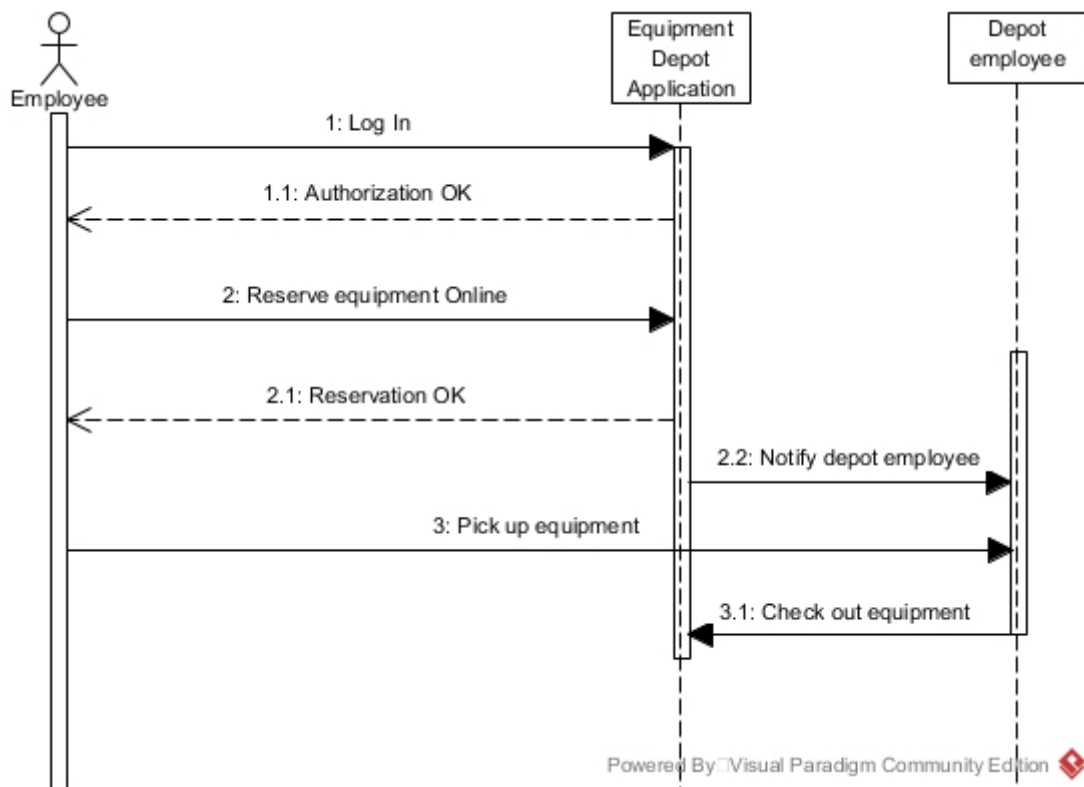## 3.3 System sequence diagram for main success scenario "check out equipment"

Figure 8: System sequence diagram for the main success scenario of use case "check out equipment"

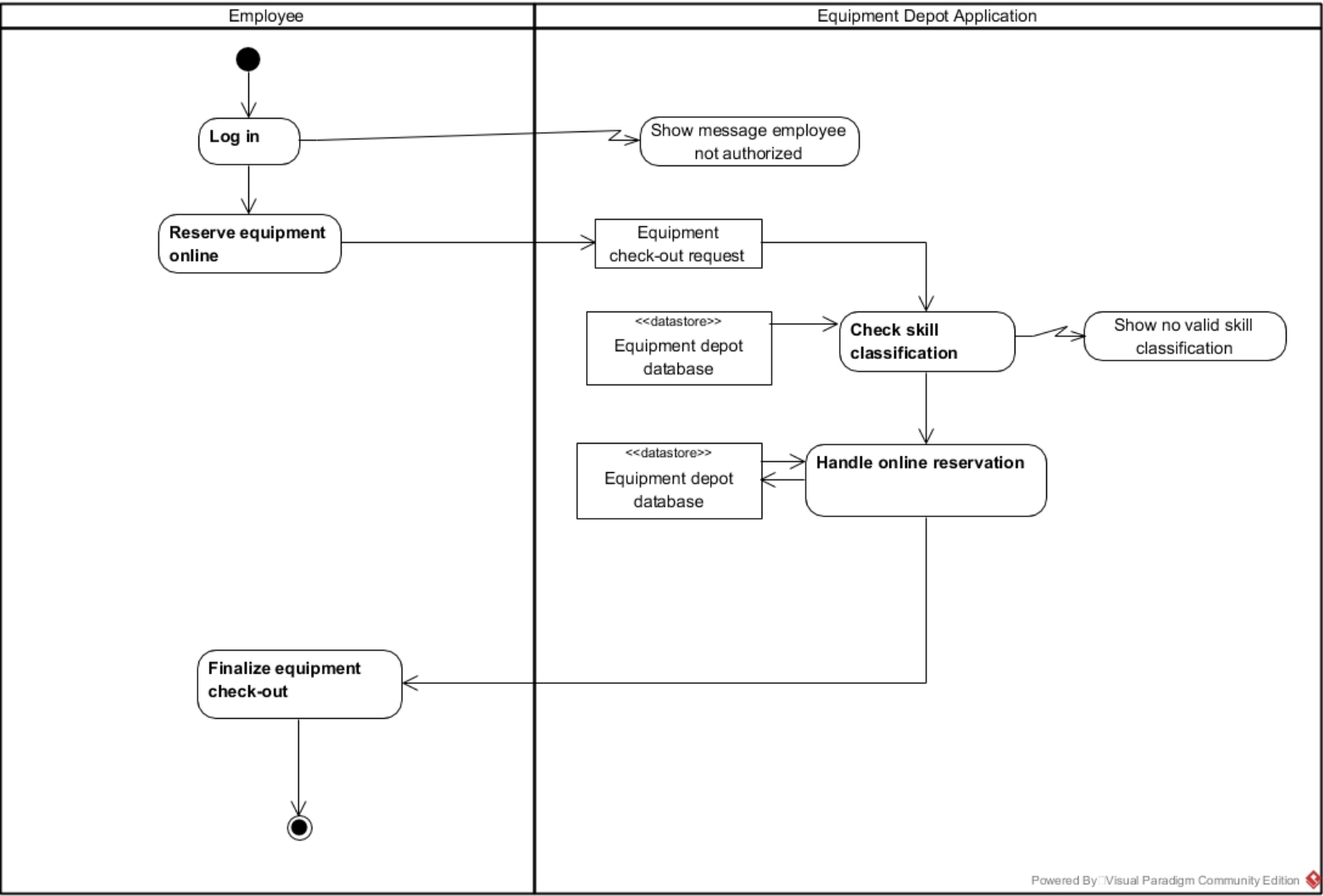## 3.4 Activity diagram for use case "check out equipment"

Figure 9: Activity diagram for the use case "check out equipment"
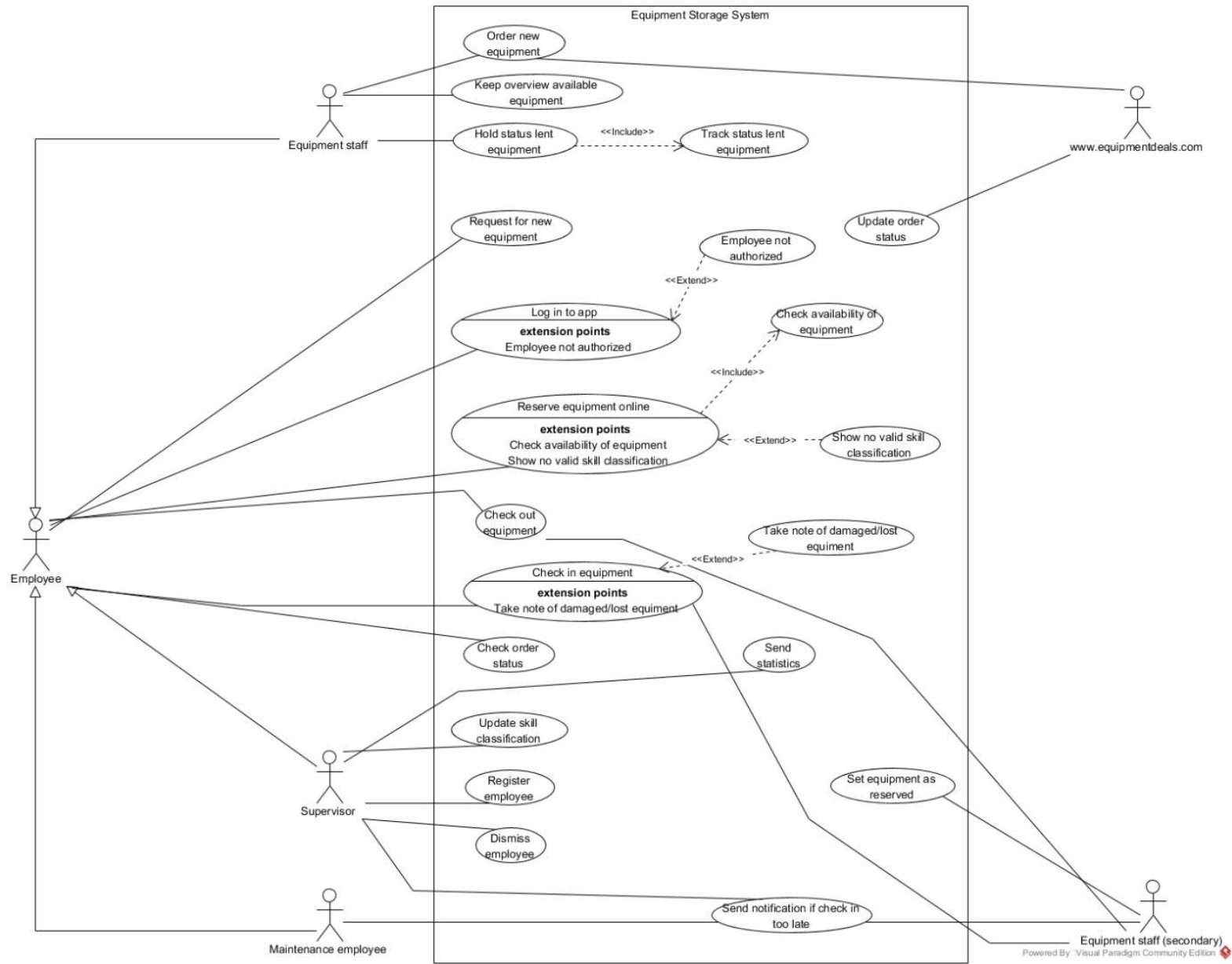
3.5 Refactored use case diagram

Figure 10: Refactored ESS use case diagram
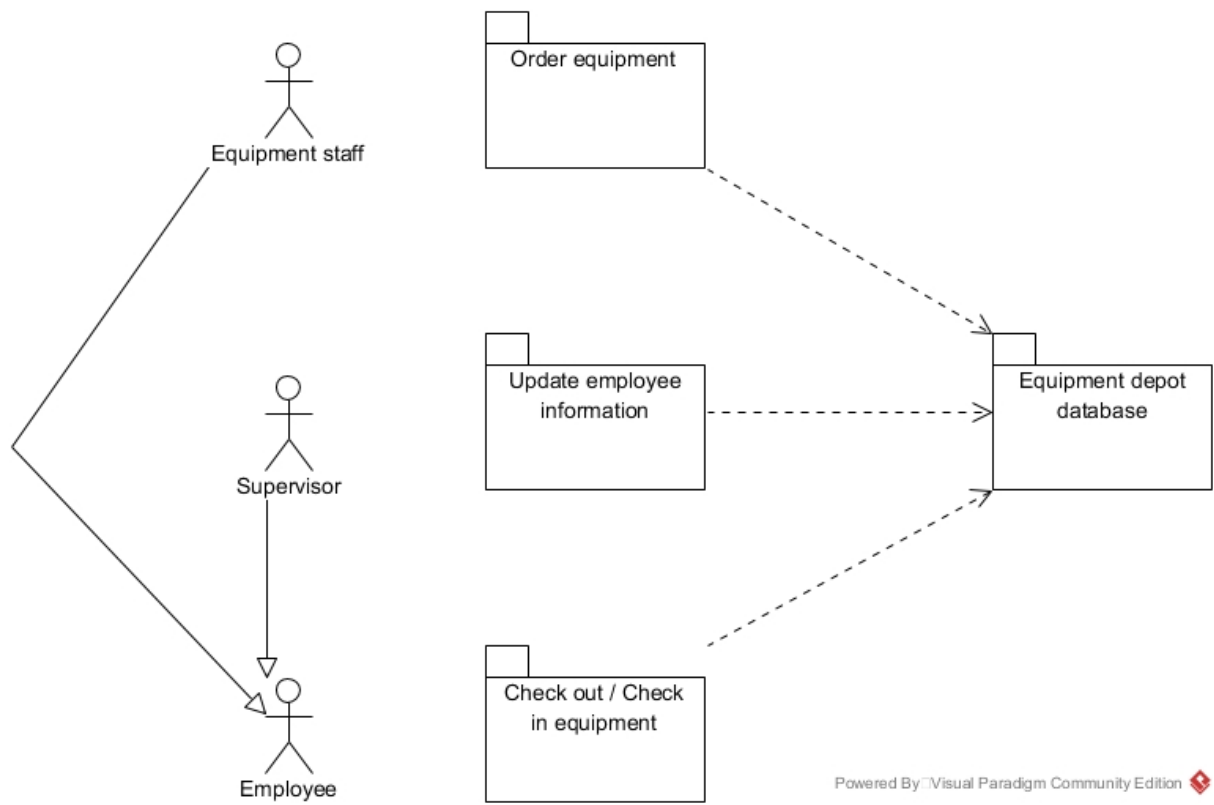
3.6 Main use case diagram (package diagram)

Figure 11: Main use case diagram as a package diagram

3.7 Domain class diagram

Figure 12: Domain class diagram for use cases "check out" and "check in"

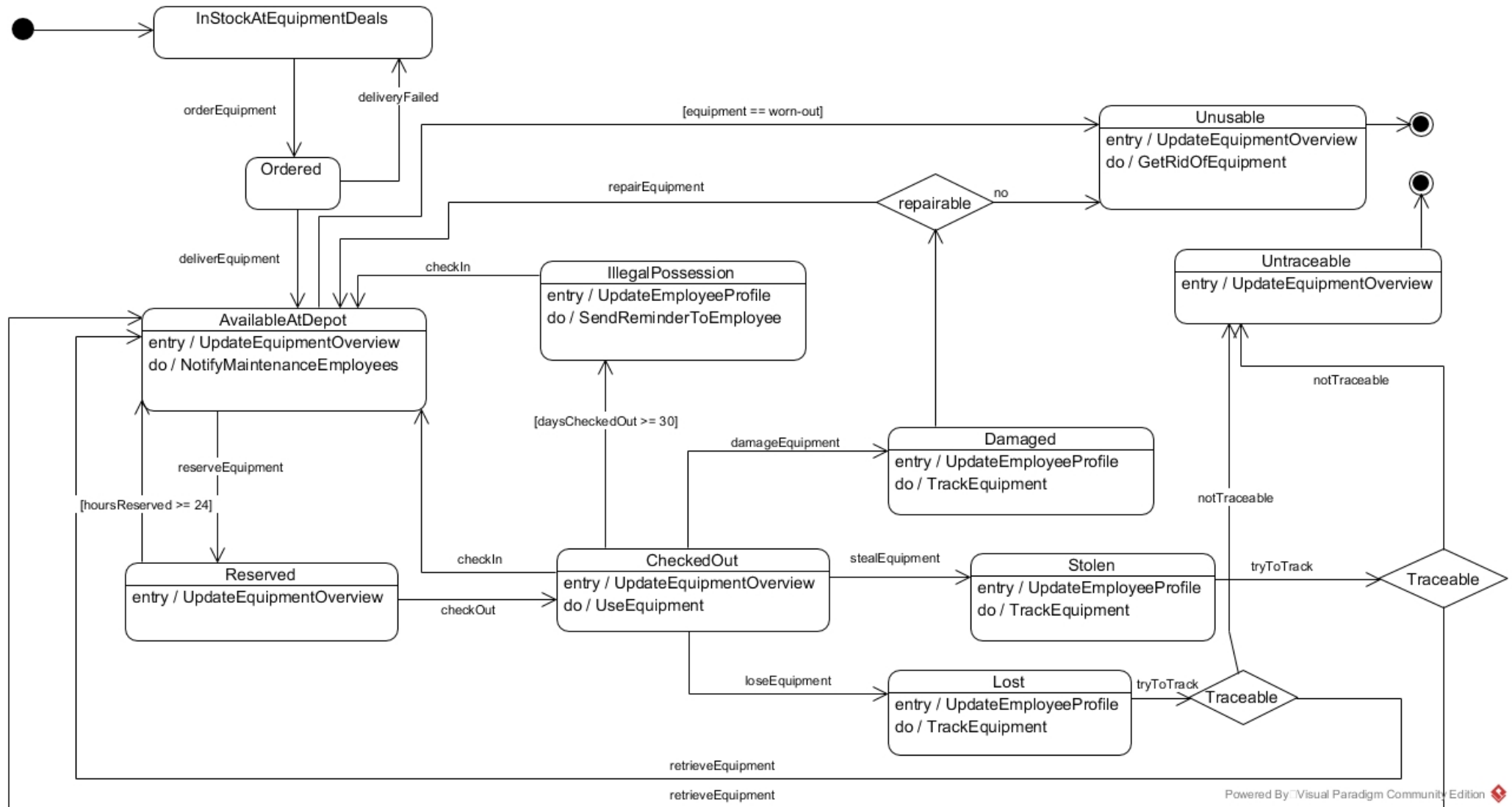## 3.8 State chart diagram for domain class "Equipment"

Figure 13: State chart diagram for the domain class "Equipment"

4. **Technical analysis / use case realisation**

4.1 Operation contracts for main success scenario "check out equipment"

4.1.1 Log In

Name
- Log in

Responsibilities
- To log in to the Equipment Depot Application where maintenance employees can reserve equipment. Log in is also possible for the depot employees to get an overview of the available equipment

References
- *Check out* use case

Preconditions
- A maintenance employee has an account in the Equipment Depot Application
- There is at least one piece of equipment available
- The Equipment Depot Application is online, meaning it is possible to connect to it
- All equipment is linked to the Equipment Depot Application

Postconditions
- A maintenance employee is linked to the Equipment Depot Application
- The Equipment Depot Application is online
- There is at least one piece of equipment available
- The maintenance employee got a message that they are logged in to the Equipment Depot Application
- The employee is now able to reserve a piece of equipment

4.1.2 Reserve equipment online

Name
- Reserve equipment online

Responsibilities
- To reserve a piece of equipment so the maintenance employee who wants it reserved can check it out later at the equipment depot

References
- *Check out* use case

Preconditions
- The maintenance employee who wants to reserve equipment is linked to the Equipment Depot Application
- The maintenance employee has the required skill classification for the equipment they want to reserve
- The Equipment Depot Application is online
- All equipment available is linked to the Equipment Depot Application
- There is at least one piece of equipment available
- The equipment they want to reserve is not linked to any other maintenance employee

Postconditions
- The maintenance employee has reserved (a piece of) equipment
- The maintenance employee is linked to the equipment they reserved
- They have received a notification that the equipment is, in fact, reserved
- The equipment overview is updated

4.1.3   Notify depot employees

Name
- Notify depot employees

Responsibilities
- After a maintenance employee has made a reservation, the depot employees will receive a notification, so they can already make sure the piece of equipment is easy to pick up and ready to check out. Also, due to the notification, the depot employees know how much work they will have beforehand

References
- *Check out* use case

Preconditions
- A maintenance employee has made a reservation
- The Equipment Depot Application is online
- The depot employee is logged in to the Equipment Depot Application
- The equipment that was reserved is physically available at the equipment depot

Postconditions
- The equipment is set to be picked up or checked out by the maintenance employee who made the reservation
- The Equipment Depot Application is still online

4.1.4   Check out equipment

Name
- Check out equipment

Responsibilities
- After the equipment reservation, the maintenance employee must pick up their reserved equipment so that the check-out process can be completed, and that it is not reserved just to not be picked up later (by which other maintenance employees would not be able to reserve that same piece of equipment).

References
- *Check out* use case

Preconditions
- A maintenance employee has made a reservation
- The Equipment Depot Application is online
- The depot employee is linked to the Equipment Depot Application
- The maintenance employee is linked to the equipment they reserved
- The equipment is ready to be picked up

Postconditions
- The equipment has been checked out
- The equipment overview has been updated
- The check-out process is completed
- The maintenance employee is linked to the equipment they checked out

4.2 MVC sequence diagram for main success scenario "check out equipment"
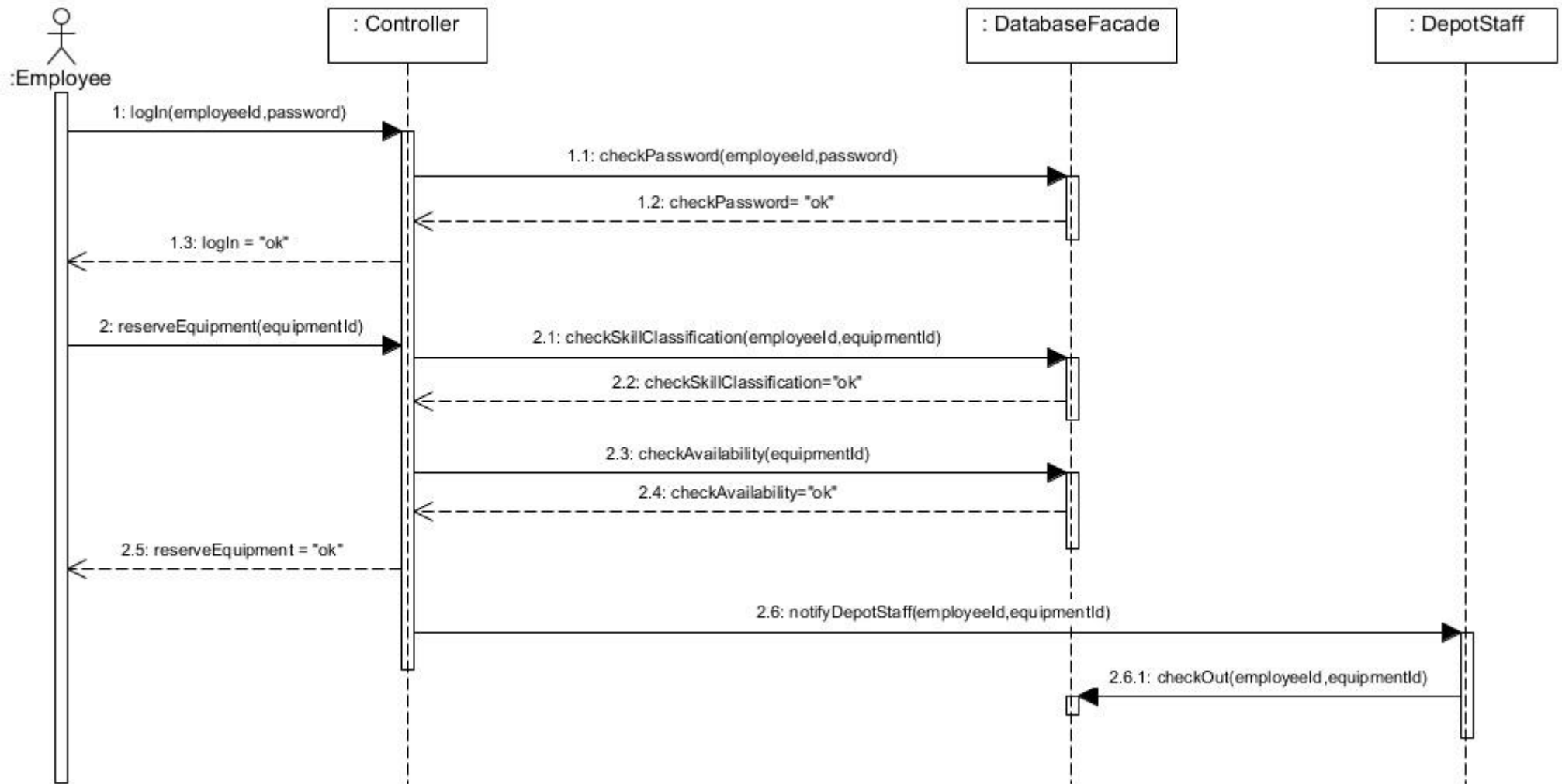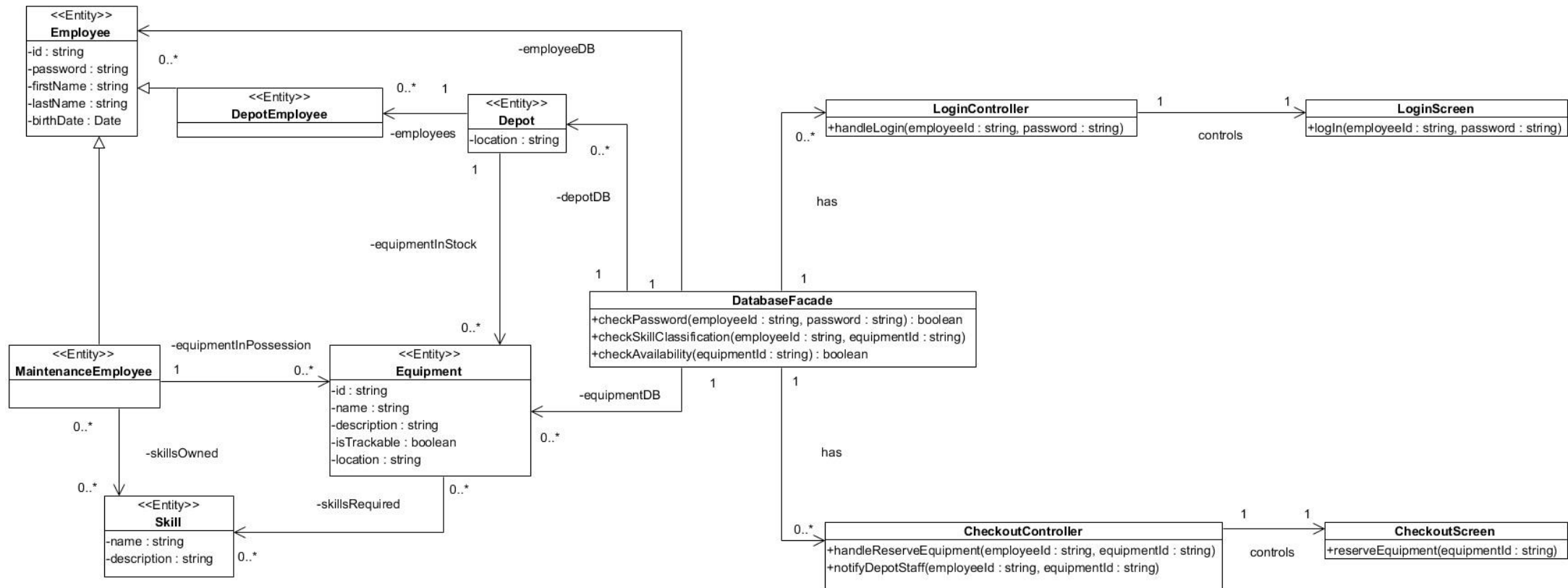

Figure 14: MVC sequence diagram for the main success scenario of the use case "check out equipment"

4.3 Design class diagram for main success scenario "check out equipment"
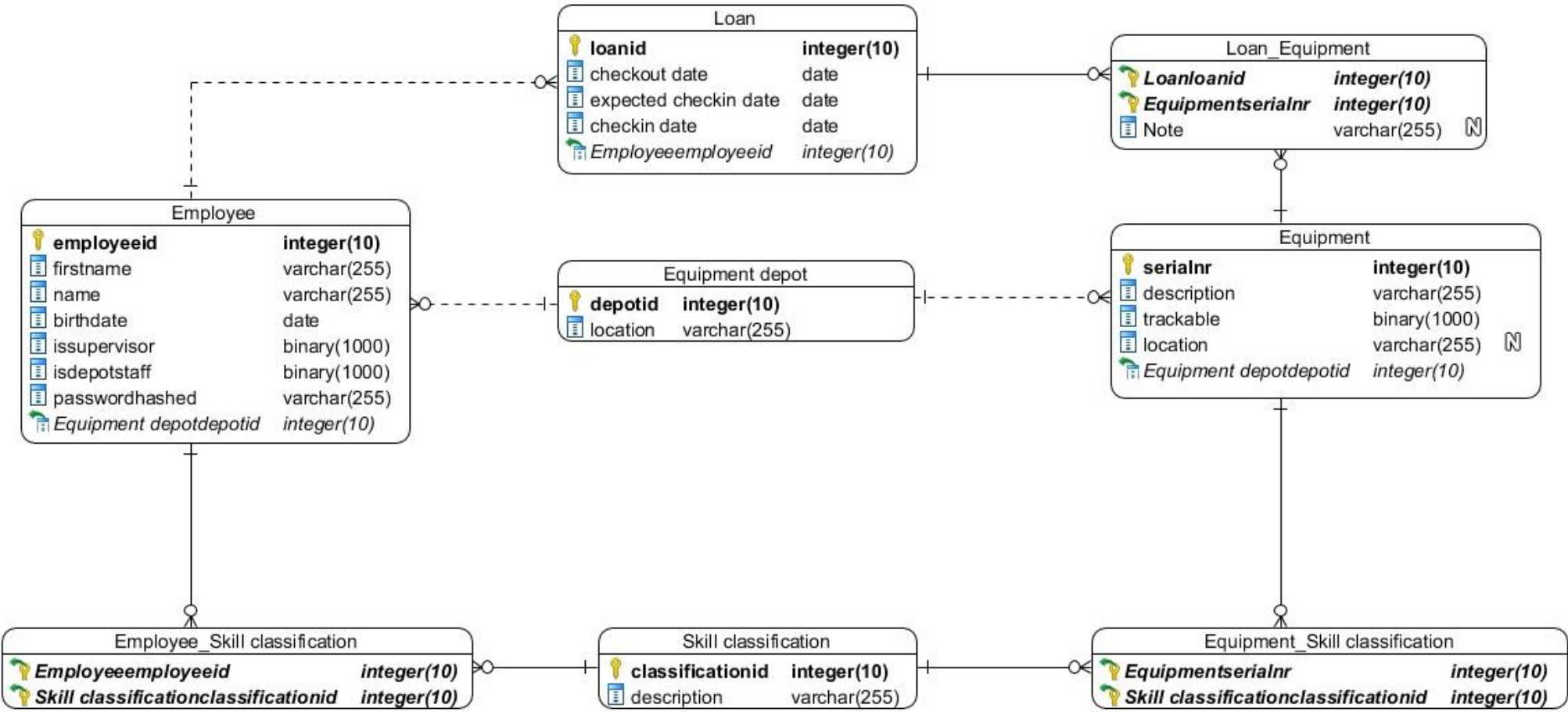
4.4 Physical ER model

Figure 15: Physical ER model for the main success scenario of the use case "check out equipment"

5. Requirement and logical analysis / agile approach

5.1 User story map

Check in/out equipment		Update employee database			Get overview of equipment		Order equipment		Request new equipment		Track location of specific equipment		Get usage statistics		USE CASES
Checking in or out through the app	Checking in or out at the depot	Empl. acquisition	Empl. dismissal	Empl. skill update	As depot empl.	As other empl.	Send order	Receive order	As depot empl.	As other empl.	GDPR	Location tracking of empl.	Empl. efficiency	Risky empl.	USER TASKS
Log in															
Reserve equipment online	Get depot employee on shift	Make account	Remove account	Get all skills list	Locate depot tools	Search tools on app	Make transaction	Check order status	Verify request with superior	View suppliable tools	Complete GDPR training	Link employee to location	Get fast check-in reports	Get damage re-posts	**Release 1**
Get equipment availability	Reserve equipment at depot	Go through tutorial	Remove tracking	Update skill classification	Get amount & status of depot tools	Locate tools in use by other empl.	Get order details	Import order in database	Convert request to order	Send request to depot empl.	Raise GDPR awareness	Link checked out tool to location	Get satisfied service reports	Get stolen tools reports	
Get skill classification	Verify availability	Assess skill level	Retrieve tools		Locate checked-out tools		View estimated arrival	Follow-up on order						Get lost reports	**Release 2**
Get reservation confirmation					View shortages		Choose faster delivered options	Return order				Migrate checked out tools from one empl. to other	Get check-out/job completed ratio	Get overdue check-in reports	
Send check-in reminder														Get dissatisfied reports	**Release 3**

Log in

As an employee, I want to log in so that I can be identified and use the system.

Conversation/Wireframe

Confirmation/Acceptance Criteria

Verify rule 1 *Only allow logged out employees to log in*

	Given	**When**	**Then**
1	The employee is already logged in	The employee would like to log in	The employee does not log in
2	The employee is not logged in	The employee would like to log in	The employee logs in

Verify rule 2 *Only allow valid combinations of employee's ids and employee's passwords*

	Given	**When**	**Then**
1	The employee's password doesn't match the employee's id	The employee would like to log in	The employee does not log in
2	The employee's password does match the employee's id	The employee would like to log in	The employee logs in

Reserve equipment online

As an employee, I want to reserve equipment online so that I can check them out later.

Conversation/Wireframe

Equipment	Description	Required skill classifications	Availability	Check-out
XXXXXXXXXXXX	XXXXXXXXXXXXXXXXXXXXXX	XXXXXXXXXXXXXXXXXXXXXXXXX	XXXXXXX	Check-out
XXXXXXXXXXXX	XXXXXXXXXXXXXXXXXXXXXX	XXXXXXXXXXXXXXXXXXXXXXXXX	XXXXXXX	Check-out
XXXXXXXXXXXX	XXXXXXXXXXXXXXXXXXXXXX	XXXXXXXXXXXXXXXXXXXXXXXXX	XXXXXXX	Check-out
XXXXXXXXXXXX	XXXXXXXXXXXXXXXXXXXXXX	XXXXXXXXXXXXXXXXXXXXXXXXX	XXXXXXX	Check-out
XXXXXXXXXXXX	XXXXXXXXXXXXXXXXXXXXXX	XXXXXXXXXXXXXXXXXXXXXXXXX	XXXXXXX	Check-out
XXXXXXXXXXXX	XXXXXXXXXXXXXXXXXXXXXX	XXXXXXXXXXXXXXXXXXXXXXXXX	XXXXXXX	Check-out
XXXXXXXXXXXX	XXXXXXXXXXXXXXXXXXXXXX	XXXXXXXXXXXXXXXXXXXXXXXXX	XXXXXXX	Check-out
XXXXXXXXXXXX	XXXXXXXXXXXXXXXXXXXXXX	XXXXXXXXXXXXXXXXXXXXXXXXX	XXXXXXX	Check-out

Confirmation/Acceptance Criteria

Verify rule 1 *Only allow check-out when the equipment is available*

	Given	When	Then
1	Requested equipment is not available	The employee would to reserve the equipment	Reservation not accepted
2	Requested equipment is available	The employee would like to reserve the equipment	Reservation accepted

Verify rule 2 *Only allow check-out when employee has the required skill classifications*

	Given	When	Then
1	The employee does not have required skill classifications	The employee would like to reserve the equipment	Reservation not accepted
2	The employee does not have the required skill classifications	The employee would like to reserve the equipment	Reservation accepted

Check in equipment

As an employee, I want to check in equipment so that the equipment I used will become available again.

Conversation/Wireframe

My Equipment

Equipment	Description	Return Date	In Possession	Check-in
XXXXXXXX	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	Check-in
XXXXXXXX	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	Check-in
XXXXXXXX	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	Check-in
XXXXXXXX	XXXXXXXX	XXXXXXXXXXX	XXXXXXXX	Check-in

Confirmation/Acceptance Criteria

Verify rule 1 *Only allow check-in when the employee is logged in*

	Given	When	Then
1	An employee is logged in	The employee wants to check in equipment	The equipment is accepted, and the check-in is handled correctly
2	An employee is not logged in	The employee wants to check in equipment	The equipment is not accepted, and the check-in did not happen

Verify rule 2 *The check-in is handled according to the state of the equipment and the return date*

	Given	When	Then
1	The returned equipment is damaged	The employee wants to check in equipment	The equipment was checked in and the employee profile will have an extra entry with the damaged equipment
2	The returned equipment is stolen/lost	The employee wants to check in equipment	The equipment was not checked in. The employee profile will get an extra entry for the stolen/lost equipment
3	The returned equipment is in a good state	The employee wants to check in equipment	The equipment was checked in
4	The returned equipment is overdue	The employee wants to check in equipment	The equipment was checked in and the employee profile will have an extra entry with the equipment that was not checked in on time

Order equipment

As a depot employee or supervisor, I want to order new equipment so there would be no shortage of equipment

Conversation/Wireframe

Order Equipment

Equipment	Description	In Stock	Order
XXXXXXXX	XXXXXXX	XXXXXXXXX	Order
XXXXXXXX	XXXXXXX	XXXXXXXXX	Order
XXXXXXXX	XXXXXXX	XXXXXXXXX	Order
XXXXXXXX	XXXXXXX	XXXXXXXXX	Order
XXXXXXXX	XXXXXXX	XXXXXXXXX	Order

Confirmation/Acceptance Criteria

Verify rule 1   *Only allow orders when I am a supervisor or a depot employee*

	Given	When	Then
1	I am a supervisor	I try to order new equipment	The equipment was ordered successfully
2	I am a maintenance employee	I try to order new equipment	The equipment was not ordered
3	I am a depot employee	I try to order new equipment	The equipment was ordered successfully

Verify rule 2 *Only order new equipment when there is a shortage of equipment*

	Given	When	Then
1	There are enough pieces of equipment available	The employee tries to order new equipment	The equipment was not ordered
2	There is no equipment available	The employee tries to order new equipment	The equipment was ordered successfully

Register employee

As a supervisor, I want to register an employee so that they have access to the system and are added to the list of employees

Conversation/Wireframe

Register employee

EmployeeID

Password

First name

Last name

Date of birth

DD/MM/YYYY ▽

Register

Confirmation/Acceptance Criteria

Verify rule 1 *Only allow fully filled out forms to pass*

	Given	**When**	**Then**
1	One or more fields are empty	The supervisor would like to register the employee	The employee does not get registered
2	All fields are filled in	The supervisor would like to register the employee	The employee can get registered

Verify rule 2 *Only allow a password that has at least 8 characters, 1 uppercase letter, 1 lowercase letter and 1 number*

	Given	**When**	**Then**
1	The password doesn't meet the requirements	The supervisor would like to register the employee	The employee does not get registered
2	The password does meet the requirements	The supervisor would like to register the employee	The employee can get registered

Verify rule 3 *Only register an employee when I am a supervisor*

	Given	**When**	**Then**
1	I am a depot employee or a maintenance employee	I would like to register an employee	The employee does not get registered
2	I am a supervisor	I would like to register an employee	The employee does get registered

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Remove (dismiss) employee

As a supervisor, I want to remove (dismiss) employees so that they are no longer under our deployment and not in our system anymore

Conversation/Wireframe

Remove employee

Are you sure to remove the employee with the given information below?

Employeeid

XXXXXXXXXXXXXXXXXXX

First name

XXXXXXXXXXXXXXXXXXX

Last name

XXXXXXXXXXXXXXXXXXX

Remove

Confirmation/Acceptance Criteria

Verify rule 1 *Only remove an employee when I am a supervisor*

	Given	When	Then
1	I am a depot employee or a maintenance employee	I would like to remove an employee	The request will be refused
2	I am a supervisor	I would like to remove an employee	The request will be authorized

Get overview of available equipment
As a depot employee, I want to get an overview of the available equipment so that I can see where possible shortages could arise, what needs repairing and so on
Conversation/Wireframe

All available equipment

ID	Description	Amount	Location	Details
XXXXXXX	XXXXXXXXX	XXXXXX	XXXXXXX	Details
XXXXXXX	XXXXXXXXX	XXXXXX	XXXXXXX	Details
XXXXXXX	XXXXXXXXX	XXXXXX	XXXXXXX	Details
XXXXXXX	XXXXXXXXX	XXXXXX	XXXXXXX	Details
XXXXXXX	XXXXXXXXX	XXXXXX	XXXXXXX	Details

Confirmation/Acceptance Criteria

Verify rule 1 *Only give overview of available equipment when I am a depot employee*

	Given	**When**	**Then**
1	I am a supervisor or a maintenance employee	I would like to get an overview of all the available equipment	The request will be refused
2	I am a depot employee	I would like to get an overview of all the available equipment	The request will be author-ized

Request new equipment

As an employee, I want to request new equipment so that I can complete my job for which I don't have the correct equipment right now

Conversation/Wireframe

Equipment on equipmentdeals.com

ID	Description	Cost	Skill Class	Details	Request
XXXXXXX	XXXXXXXXX	XXXX	XXXXXXX	Details	Request
XXXXXXX	XXXXXXXXX	XXXX	XXXXXXX	Details	Request
XXXXXXX	XXXXXXXXX	XXXX	XXXXXXX	Details	Request
XXXXXXX	XXXXXXXXX	XXXX	XXXXXXX	Details	Request
XXXXXXX	XXXXXXXXX	XXXX	XXXXXXX	Details	Request

Confirmation/Acceptance Criteria

Verify rule 1   *Only allow new equipment requests when equipment is not yet in equipment depot*

	Given	When	Then
1	The equipment exists in the equipment depot	The employee tries to request new equipment	The new equipment was not requested
2	The equipment does not yet exist in the equipment depot	The employee tries to request new equipment	The new equipment was requested

Verify rule 2 *Only allow new equipment requests when logged in*

	Given	When	Then
1	An employee is logged in	The employee wants to request new equipment	The request is accepted and will be looked at
2	An employee is not logged in	The employee wants to request new equipment	The request is not accepted