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Information Systems 01PDWOV

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Books, notes are not allowed. Write only on these sheets.

Hospital drug management. A large hospital is divided in many departments (neurology, general surgery, intensive care, emergency room, etc.). Each department has a small warehouse with drugs. Besides, the hospital has a central warehouse.
The department warehouse is in fact a cabinet in a room accessible to anyone, the cabinet can be locked up using a key.
In each department a person is responsible for the management of the warehouse. Her responsibilities are to control and deliver drugs (some drugs are dangerous or addictive, like morphine, and should be locked up), keep track of stock, reorder drugs when stock is low, receive deliveries from the central warehouse and update stock, discard drugs past expiration date.
Deliveries from the central warehouse can happen up to every day. Orders are sent by fax to the central warehouse. The inventory of the department warehouse is kept using an excel file on a PC in the department.
The central warehouse is a large room with controlled access, and several cabinets. A person is in charge of it (receiving orders from departments, collecting drugs from cabinets, keeping inventory updated, reordering to external suppliers when needed, accounting). Another person delivers drugs to the departments. The central warehouse is equipped with a PC (for inventory, orders to supplier, internal orders from departments, and accounting) and a fax (for receiving internal orders).

The current situation is not effective under many points of view

- The actual number of drugs available is often inconsistent with what recorded on the excel file.
- Internal orders to the central warehouse are lost or subject to errors. Needed drugs happen to not be in stock. To avoid this departments tend to request larger quantities than needed. So drugs expire and have to be discarded because they were ordered in excessive quantity.
- Control on who/when takes drugs from the local warehouse is poor. The cabinet is often not locked. It is possible (but hard to demonstrate) that drugs are stolen.
- The department personnel complaints about the drug warehouse. Also the direction of the hospital is not satisfied (missing drugs, excessive expense, poor service).

In the following you are requested to propose a better TO BE situation, focusing mostly on the department warehouse management.

0 Summarize here shortly the main choices for the TO BE situation

- Department + central warehouse
- Department warehouse in room locked
- Access control to department warehouse (each employee has badge and access rights, badge reader authorizes or not access to warehouse, barcode reader to be used each time a box with a drug is taken by an employee). Goal is to avoid a full time person to control access (too expensive). Dept warehouse responsible remains, but as part time job (for supervision only)
- One client server application to manage warehouses (stock, internal and external orders) and access control to them (no fax, no excel), and transactions (each input/output of a drug box from /to any warehouse is traced)

Other possible options:

- sort of 'vending machine' of drug boxes in each department. More expensive, requires more room and complexity (hundreds of drug boxes of different types and dimensions to be managed, refilled), more risks (mechanical problem, power outages).
- Person as 'guardian' of dept warehouse: expensive (considering an hospital works 24h/365days a year this means 3-4 persons per department warehouse).
- No central warehouse. In principle possible, and cheaper, but requires more sophisticated management of stocks. In any case orders to external suppliers must be centralized.

1 IT Model / Technological model: describe the hardware architecture of the system

Client server.

Server with application and inventory (for ALL warehouses)

Clients: a PC in each department, in central warehouse, to access application via browser (no local DB or local application)

2 Organizational model: list roles or organizational units involved

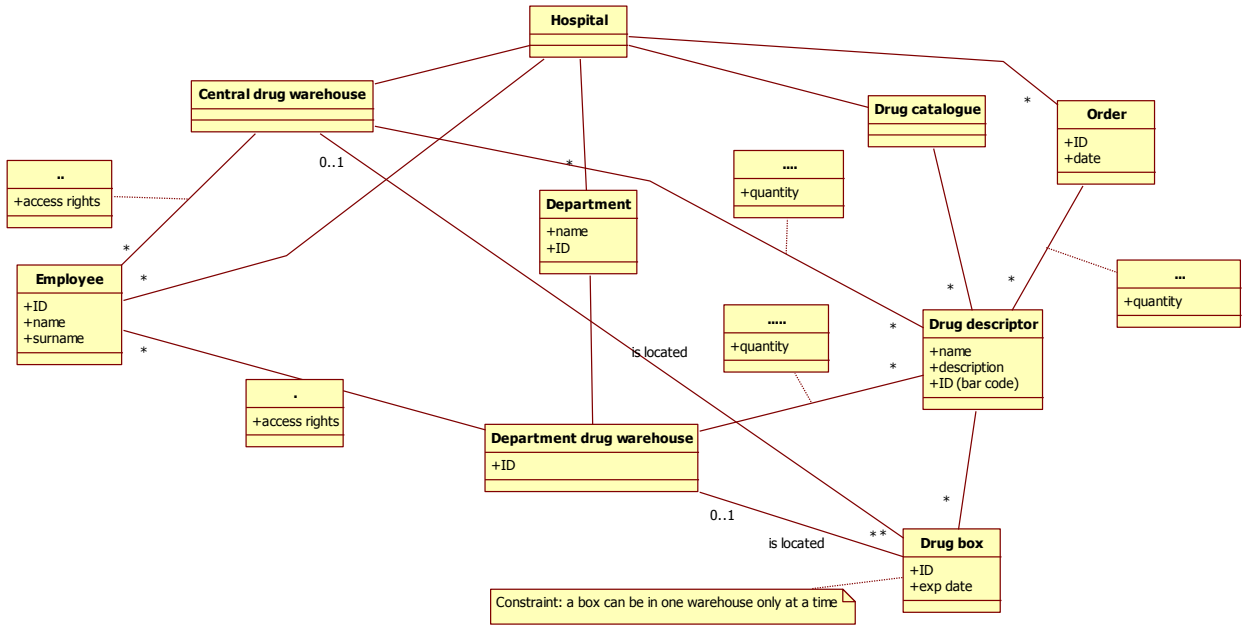
Department (doctor, nurse)
Warehouse in department (responsible)
Central warehouse for hospital (responsible, deliverer)

3 Functional model: Design and model (using UML activity diagrams with swimlanes + class diagram) the processes to manage the local warehouse

CONCEPTUAL (class) DIAGRAM
It is important to store the access rights of employees to the warehouses. This information is needed to grant access to the warehouses after reading the badge. The access right depends both on employee and warehouse, so it is modeled as an association class.

The catalogue of possible drugs is implemented through class Drug descriptor (it describes a type of drug, not a box, ex Aspirin). Class Drug box models a specific instance (ex a box with 10 Aspirin pills). The quantity of drugs is a relationship (depends on the warehouse). If each box of a drug is identified, then it will be possible to manage expiration dates automatically. Clearly, identifying the specific box is a cost (the bar code usually identifies the type, not the instance). If the box is identified then the inventory (quantity of boxes in stock) is given by the multiplicity of the relationships Drug box – warehouse, and the association class quantity between Drug descriptor and warehouse becomes useless.
There is no attribute 'location' for a box. The assumption is that the dept warehouse is small enough to be managed visually (ex a dozen of shelves, with labels, with a few hundred boxes for less than 50 different drug types). If this is not the case it is straightforward to add a 'location' attribute for each box.

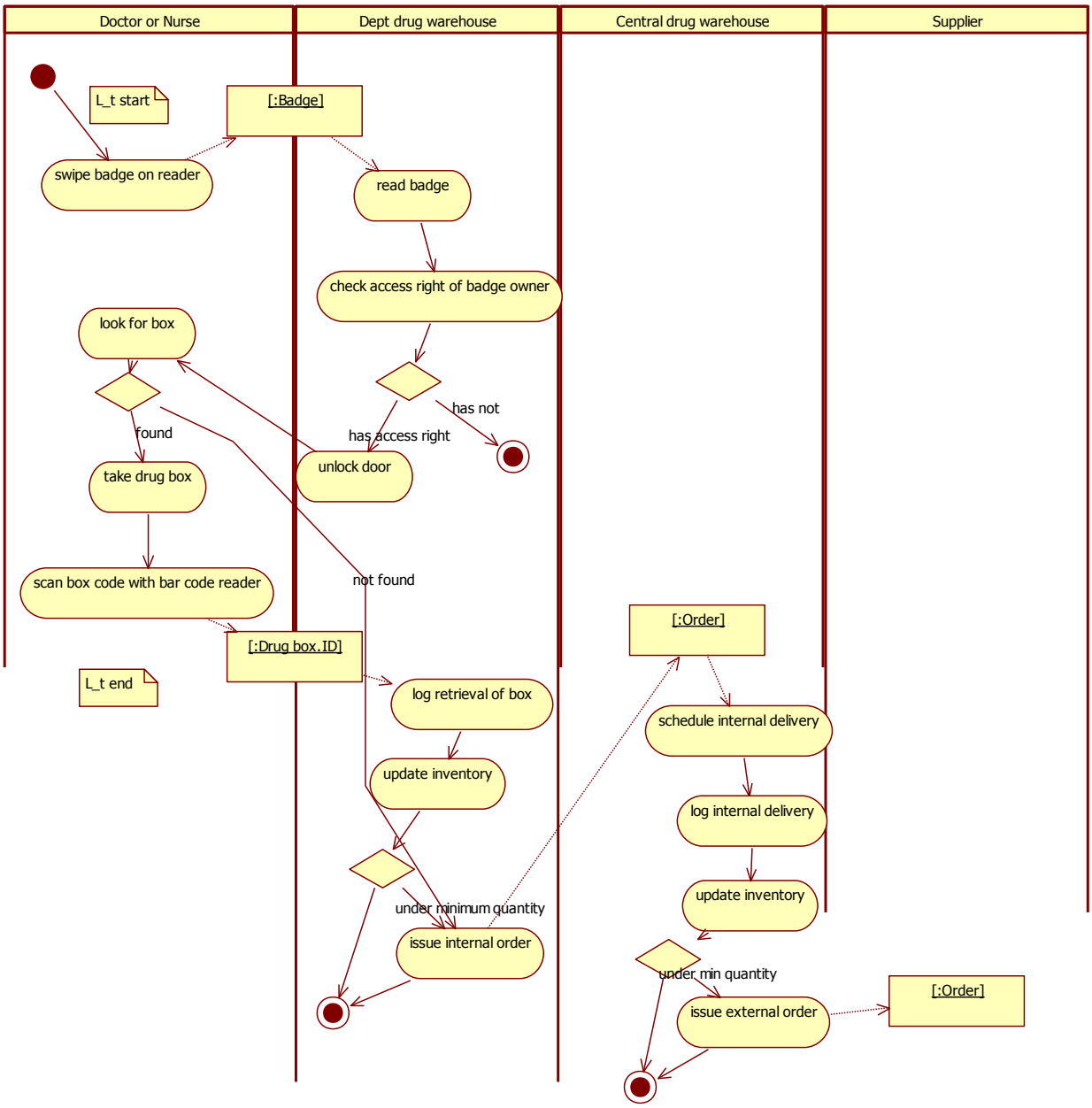
Orders, both internal (from department to central warehouse) and external are modeled via class order, plus a relationship with a Drug descriptor, and a quantity (as association class).



PROCESSES

Main processes to be modeled are: retrieval of drug at dept warehouse, reception of internal order at dept warehouse. Other processes: reception of external order at central warehouse, check expiration date of boxes in inventory, schedule internal delivery

Retrieval of drug box


Doctor or Nurse
Dept drug warehouse
Central drug warehouse
Supplier
L_t start
[:Badge]
swipe badge on reader
read badge
check access right of badge owner
look for box
has not
found
has access right
unlock door
take drug box
scan box code with bar code reader
not found
[:Order]
[:Drug box.ID]
L_t end
log retrieval of box
schedule internal delivery
update inventory
log internal delivery
update inventory
under minimum quantity
issue internal order
under min quantity
issue external order
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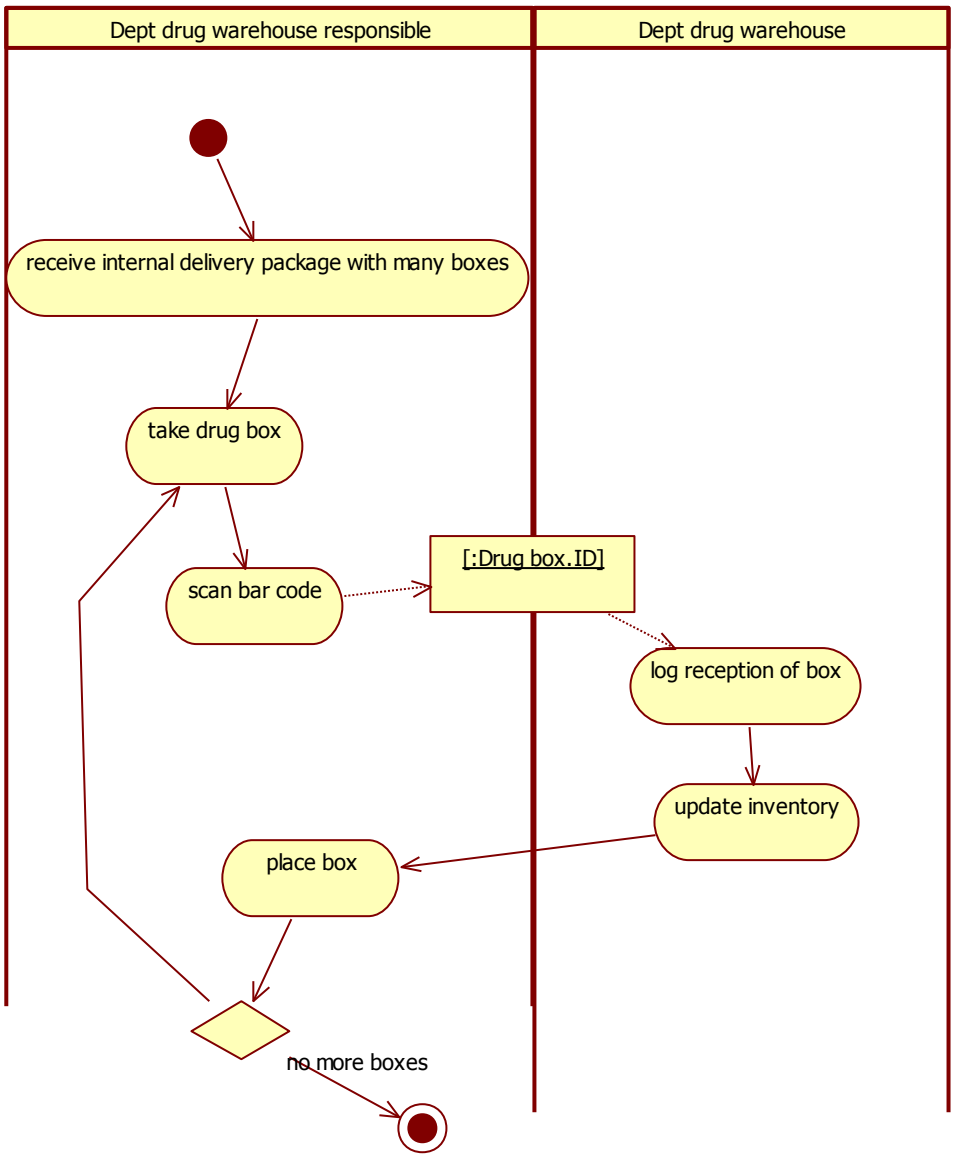
Reception of internal delivery



4 Define the KPIs, considering these high level business goals (or CSF), CSF1 increase satisfaction of personnel, CSF2 minimize cost of warehouse management. In the table below show the correspondence CSF – KPI

CSF name	KPI Category (General, cost ..)	KPI Name	KPI Description	Unit of measure
	Gen	N_dep	Number of departments	-
	Gen	N_DT	Number of drug types	-
	Gen	N_box	Number of drug boxes used per year, per dept	-
CSF2	Efficiency	C_w	Cost of managing a dept warehouse (personnel effort + infrastructure cost+ waste1 + waste2)	Euro
CSF2	Efficiency	Unit cost	C_w/N_box	Euro
CSF2	Quality	Precision	Precision of inventory (actual number of drug boxes in warehouse / number of drug boxes according to IS)	%
		Missing	Number of times a drug box requested is not available, per year per dept	
CSF2	Efficiency	Waste1	Price of drug boxes expired per year	Euro
		Waste2	Price of drug boxes disappeared, per year	Euro
CSF1	Service	L_t	Average time to obtain a drug box (see activity diagram)	t

5 Compare the previous and the current situation, using the KPIs defined above

KPI	AS IS	TO BE
N_dep	No change	
N_DT	No change (due to BPR)	
N_box	No change (due to BPR)	
C_w		Should decrease, especially due to waste1 and waste2 decreasing in C_w
Missing, precision		Should decrease, due to automatic management of stock, and better tracing of boxes
L_t		Should decrease, especially if Missing decreases (when a box is missing, average L_T increases)

6 Define the TCO for the hospital to shift to the TO BE situation

Phase	Cost
Construction	C1 Hardware (computers, bar code readers, locks, cabinets), sw application
Deployment	C2 Install hardware and software, train employees, adapt
Operation	C3 electricity, system adimin,
Maintenance	C4 changes and improvements to hw and sw, repair hw
Dismissal	C5 uninstall hardware, transition data to new system

7 Considering a 5 years period, define costs and savings (ROI analysis) by adopting the TO BE situation

Year/ cost or saving	Year 1	Year2	Year3	Year4	Year5
Cost	C1, C2				
Cost	C3, C4	C3, C4	C3, C4	C3, C4	C3, C4
Cost					C5
Saving	Waste1+waste2	Waste1+waste2	Waste1+waste2	Waste1+waste2	Waste1+waste2

Remark that savings must be stated in terms of one or more KPIs.

8 Considering the KPIs and the ROI, is the TO BE situation better? (answer Yes or No):
yes

Why?

Roi result depends on many cost factors (especially the investment in physical security for the department drug warehouse). However service times, precision, and especially Missing, should improve. Even for a possibly negative ROI these results may be worth the investment.

9 In the previous case the hospital decides to outsource the IT infrastructure (all kind of computer equipment and network) to an external company, while keeps internally the development and operation of software.

- Propose a few SLAs to monitor the outsourcing relation between the hospital and the external IT provider.

-cost per computer per year (with computer defined as: cpu clock > xGhz, ram > y GB etc)
-cost per network service per year (service defined as: bandwidth > zB/sec, latency < x sec)
-availability of servers > 99.99%
availability of client PCs > 99%

- Considering the 3 outsourcing dimensions, place this outsourcing case over the 3 dimensions

Activity: infrastructure
Location: on site
Unicity: shared (commodity PCs and network)

10 Analyze the hospital drug management case in terms of Agency theory and Decision theory

Agency: monitoring cost (supervisor on responsible of warehouses, responsible of warehouses on employees)
Bonding
Residual loss: orders too large / too small / too late

Decision:
Documentation: IS for logging all transactions
Opportunity: computing best time to place order, optimal quantity

11 Consider an insurance. What are the main high level business processes the insurance must set up and operate?

See slides