Matricola_____
Surname_____
Name:_____

Information Systems 01PDWOV

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

Water consumption collection

Company WATER manages water supply to buildings and houses. The company manages the supply of clean water (from wells or rivers), the pipes, the points of delivery. A point of delivery (PoD) is the connection of the company pipes to a user (building with many apartments or individual house with one apartment). A PoD has a faucet (rubinetto) and a meter. The meter has an ID and measures the consumption of water at the PoD. The PoD is logically connected to a user and a contract defining usage conditions and costs. At regular intervals the meters are read and WATER computes the related costs and sends the bill to the user.

AS IS process
The user of a PoD is requested to read the value of the meter at least every 6 months, and communicate the value to WATER, using a web site.
If the user does not communicate any value for more than 6 months, WATER reminds him. In case of no reading, WATER computes the bill using an estimate of consumption based on past data. Anyway at least once per year WATER sends an employee for a reading. The employee accesses the PoD, manually reads the meter value, the meter ID, and enters them on the company web site using a smartphone.

TO BE process
Digital meters are used instead. A digital meter is connected to the cellular network, powered by a battery (with average 3 years life) and can send values to a WATER back end server. The reading frequency (ex once per day, once per month) is a parameter that can be set by WATER. The meter also signals battery low, abnormal consumptions, malfunctioning of the meter.

As a context for the problem, consider the Piedmont region, with around 300K PoD, 100 euro cost of a digital meter, 100 euro cost to install it, 10 euro cost for a manual reading.

In the following model the TO BE situation.

1 Organizational model: list roles or organizational units involved

Water
- Accounting office
- Maintenance team
- Meter

User

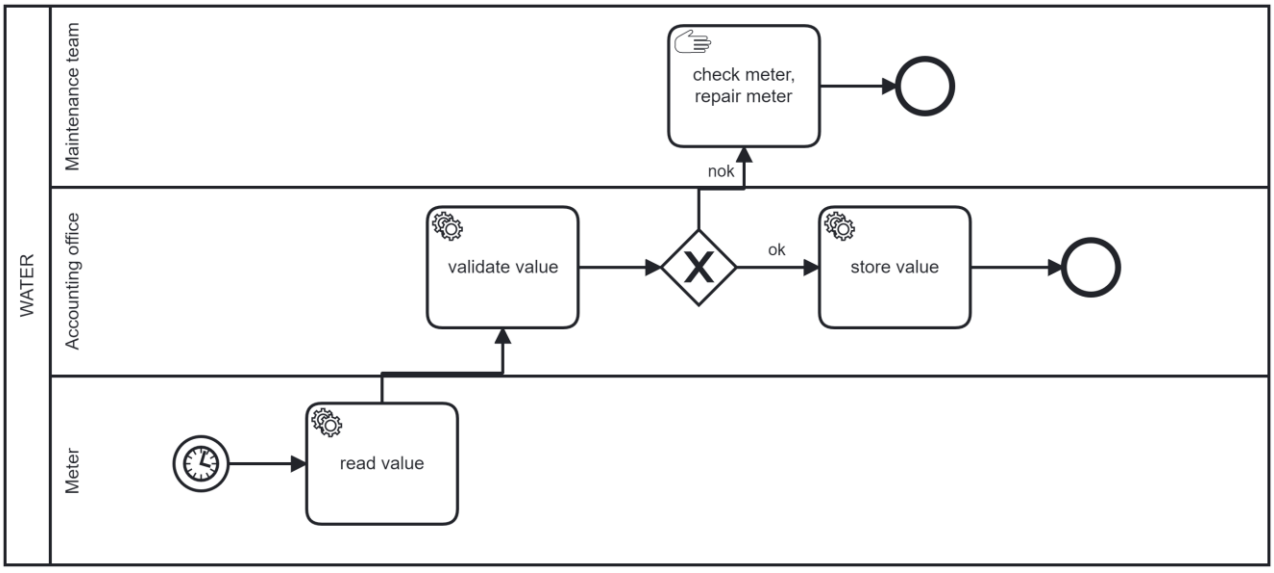
2aProcesses. List the key processes. For each process define name, input, output, description

Process name	Input	output	description	OU involved
Read consumption	Value from meter	Value stored	Receive value from meter, validate and store	Water
Billing	Certain delay passed (ex 2 months)	Bill computed and sent for all PoDs	Fetch consumption for a PoD, apply rules, compute bill, send it	Water
Manage exceptions	Signal from meter	Exception closed, problem solved	Analyze exception, do appropriate action (change battery, service or change meter)	Water
Install / change meter	Request to	Meter installed and working	Find available team to do the job, schedule job, do job, report job done, record new meter attached to PoD	Water

Remark that reading of consumption and billing are different process, because they are not synchronous (especially with digital meters, reading can happen even every day, billing not more frequently than once per month)
Install meter process was not mentioned in the text. However it may be triggered by one of the exceptions.

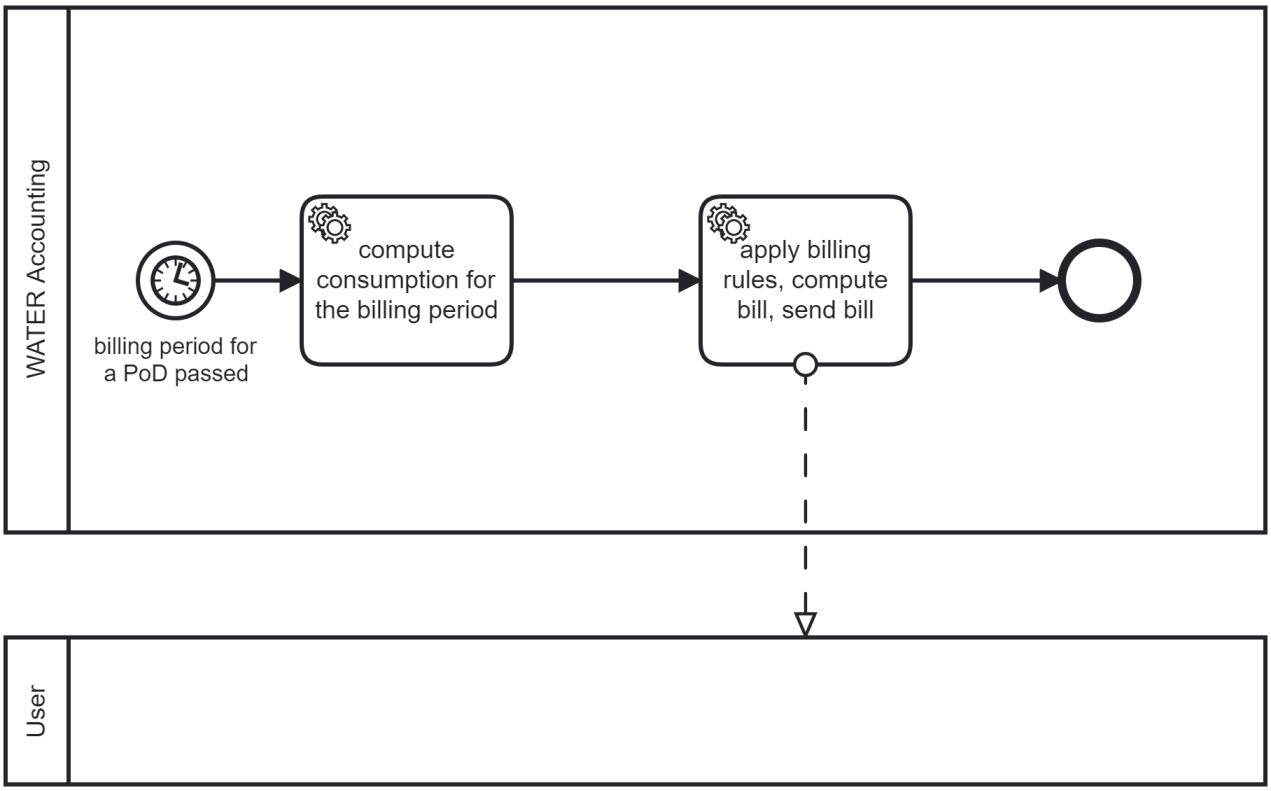
2b Processes. Define a BPMN process model for the process(es) listed in the previous question

Read consumption

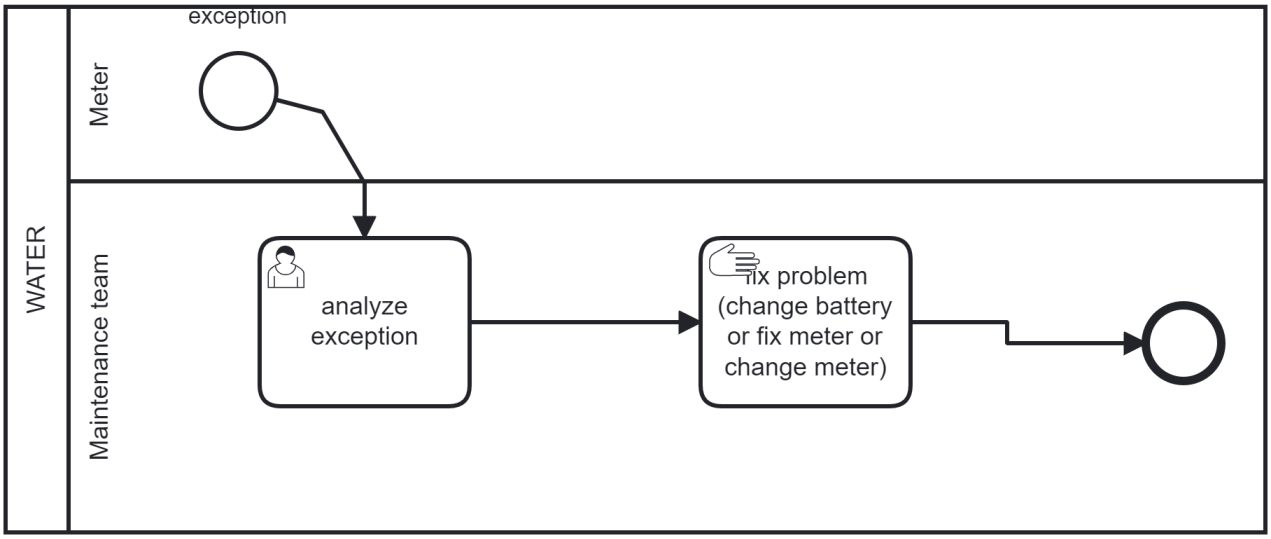


‘validate value’ checks the reading vs historical values (ex within mean and two standard deviations), if reading is not consistent then specific actions need to be taken, otherwise the value is considered valid and can be used later for billing

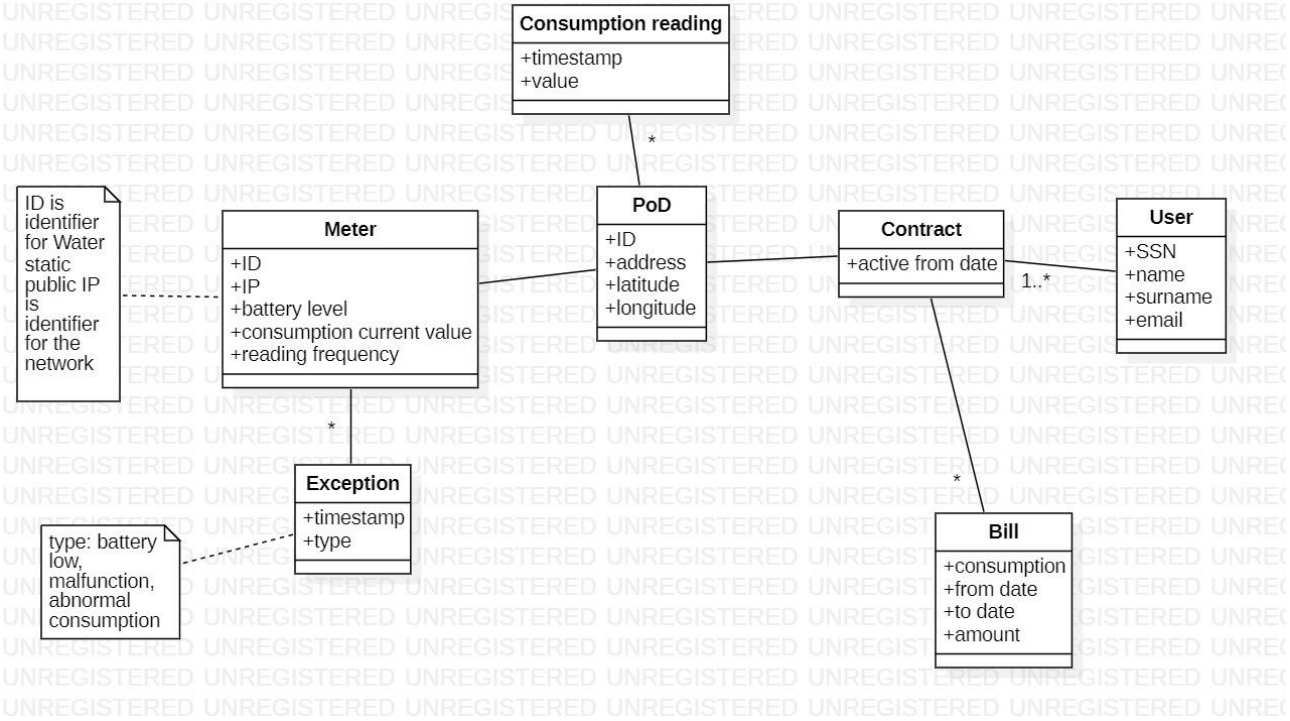
Billing



Manage exceptions

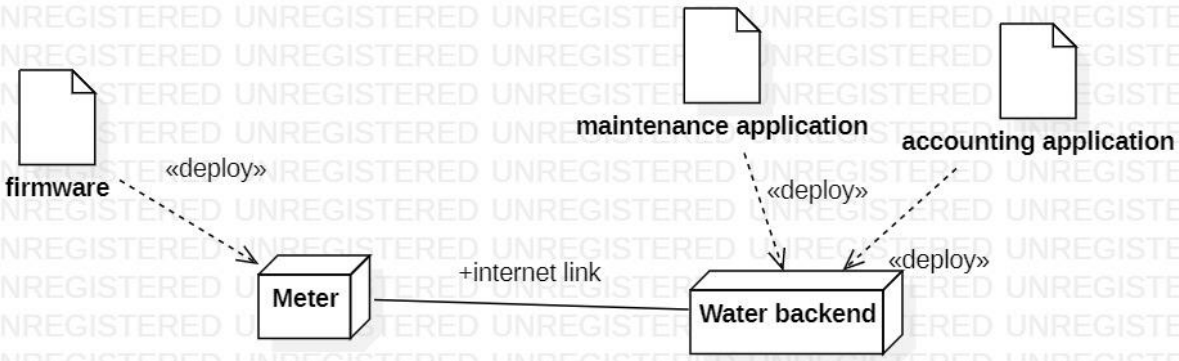


2c Conceptual model. Describe key concepts and their relationships using UML class diagram



Remark that a user can have many contracts / PoDs.
Address could be a class in itself, here reduced to an attribute since it is not a key concept in this case
Over a long period of time the same PoD can be attached to different contracts (because the user changes, or contract conditions change), and meters (ex when meter substituted for failure). For simplicity these cases are not considered here.

3-a IT Model / Technological model: describe the hardware architecture of the system
(use **UML deployment diagram**)



3-b Business rule: define (in English, or formally) at least one business rule for the process

Reading of Consumption must be made at least every X months
Bill each user every X months

5 Define the KPIs, considering these high level business goals (or CSF), CSF1 maximum convenience for users, CSF2 cost effectiveness for WATER
If needed, define also indicators that are not KPIs.

If not differently stated, time range for all KPIs is one year

CSF name	KPI Category (General, cost ..)	KPI Name	KPI Description	Unit of measure
	General	N_PoD	Number of PoDs to manage (equals to number of meters)	
	General	N_readings	Number of readings per year, by WATER (not by user). Is a multiple of N_PoD	
		N_bills	Number of bills per year. Also a multiple of N_PoD (6x if bill every two months – max 12x if bill every month)	
		N_readers	Number of WATER employees in charge of reading meters.	
CSF2	Efficiency	UC_reading	Unit cost of reading of a meter = T / N_readings	Euro
		T	Total cost for readings = cost of personnel per year (AS IS) + cost of digital readers (TO BE) + cost of maintenance digital readers (TO BE) + cost of communication (TO BE) + cost of IT infrastructure for reading (TO BE) See discussion question 8	Euro
CSF2	Service	LT_reading	Lead time to obtain a reading by WATER	hours
CSF1 CSF2	Quality	P_reading	Precision of reading, reading of meter received corresponds to actual consumption measured by the meter = N_correct readings / Total number of readings	%
CSF1 CSF2		Availability	Availability of reading at least once per month N_meters read by WATER at least once per month / N_PoD	%
CSF1 CSF2		Water losses	water losses	mc

Regarding quality the key point is the availability of accurate and frequent readings (this is not strictly a KPI). Manual reading produces readings that may be wrong (if taken by the user) or simply not available (no reading by WATER during several months). Automated reading allows frequent readings (even many per day) and accurate. Accurate readings are important both for producing correct bills, and for recognizing leakage of water (in pipes or in user) (Water loss also is not strictly a KPI).

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

KPI	AS IS	TO BE
N_PoD		No change
N_readings	Low, because manual	Much higher
N_bills		No change
N_readers		Much lower
UC_reading		To be computed, hopefully lower
LT_reading	Hours if not days	seconds
P_readings	Unknown, but probably not high	Possibly close to 100%
Availability	low	Very high
Water loss		Should decrease since leakages are recognized earlier

7 Considering the WATER company and the infrastructure it has to build or acquire for the TO BE, define the software functions needed

Process /Activity	Software function(s) needed
Read consumption	Read value, validate value
Manage exceptions	Analyze exception

8 Considering the comparison in point 6, summarize pros and cons for the actors in the TO BE situation (add actors if needed)

	PROS	CONS
WATER	LT_reading, P_reading, availability, all increase largely N_readers decreases Better control on water losses	Investment in digital meters However, UC_reading could even decrease (see discussion below)
User	Bills are more accurate, no need to send manual reading Better control on water losses	
…		

UC_reading requires to consider a long time frame (TCO concept), that could be 10 years or more (the estimated lifetime of a digital reader).

TCO for one reader: cost of meter + cost of installation +cost of changing batteries (3times in 10 years) + cost of communication + cost of IT infrastructure for reading (prorata one meter)
= 100 +100 + (10x3) +cc + cIT.

Cost of a reading (assuming only 2 readings per year, as in AS IS) = (230 + cc + cIT) / (2x10)
This cost is >= 11,5
Current cost of manual reading is 10 euros.

However the real advantage of digital readings is the capability of reading every month (at least), not feasible today for the cost.
With 12 readings per year we amortize the fixed costs over many more readings so
(230+ cc + cIT) / 12x10 >= 2 euros
To be compared again with 10 euros
This makes digital reading way less expensive.

9 A large service company selects these options for their IS. The company buys for every employee a laptop connected to the internet. A data server is bought and installed on premise. A data server (hw) and the related sw is bought and installed on premise. An ERP / CRM product from an external provider is used as a service, but data is on the owned database. Frame this case in terms of the outsourcing dimensions

Object	Activity/service	Unicity	Location	
Laptop, data server	IT infrastructure	Not unique	On premise / on site	Insourced (owned)
ERP CRM	Application	Not unique	Off site	Outsourced
Data management sw	Application	Not unique	On site	Insourced (owned)

10 Define 'culture' as organizational variable, and make an example of two opposite company cultures

See slides

11 According to the 5 forces Porter model, the strategy of an organization should consider 5 forces. One of them is 'substitute products'
Define what it means and make an example

Different product that can substitute another and kill it. The substitute product is typically made by a company coming from another business domain
Ex.: Music streaming service (Spotify – software company) vs music on hard device (Sony music, Virgin, ..- content producer companies)
Ex.: paper towels (Kleenex, chemical company) vs textile towels (textile company)

12 What should be considered when selecting one option out of many in an outsourcing decision?

See slides
Functionalities, vendor reputation and size, support, price

13 IS Architectures. Which are the three most common IS architecture models, and how they differ?

See slides
Silos, one database shared, microservices

14 What is the BOM, Bill Of Materials ?

See slides