University of Tartu – Institute of Computer Science

MTAT.03.229 – Enterprise System Integration

Iniital Plant Hire Scenario

In this series of assignments, we will design and implement a collection of inter-connected software services and front-end application(s) that showcase the principles of a service-oriented architecture. The domain is that of plant hire (also known as equipment rental). A description of a scenario is given below, but this is only given as a source of inspiration for designing your solution. The description may be ambiguous or incomplete in some points and it is your task to resolve any ambiguities and to complete the missing information. Do not hesitate to ask questions to the lecturer or lab assistants about ambiguities or design choices you make.

Context: Plant Hire

Buildit is a construction company specialized in public works (roads, bridges, pipelines, tunnels, railroads, etc.). Within Buildit, it often occurs that engineers working at a construction site (called "site engineers") need a special type of equipment, such as a truck, an excavator, a bulldozer, a water pump, etc. A piece of heavy equipment is called a "plant" in the construction jargon.

Buildit owns very little equipment and instead it hires most of its equipment from specialized heavy equipment suppliers. One of Buildit's preferred plant hire supplier is Rentit.

Figure 1. Plant for hire (image taken from Holden Plant Hire Ltd., UK)

Buildit's Plant Hire Process

The business process for hiring a plant (seen from Buildit's perspective) is described below.

When a *site engineer* needs to hire a plant, he/she consults the catalogue of a plant supplier in order to identify a plant that fulfils the requirements. Every plant provided by a supplier is identified by a plant identifier.

Once the site engineer has identified the required plant, he/she checks the plant's availability during the required period of time as well as the price. If the plant is available, the site engineer creates a *Plant Hire Request*, which includes the identifier of the construction site where the plant is needed, the supplier of the plant, the plant's identifier, the expected start and end date of the hire period and

the cost of hiring the plant for this period of time. This cost is calculated based on the plant's price per day of the selected plant and the number of days the plant is hired. Naturally, the plant hire request also includes the name of the site engineer making the request.

Every plant hire request has to be approved by a *works engineer* ay BuiltIT. The purpose of this approval is to avoid excessive or unnecessary plant hiring and, more generally, to ensure that plant hiring costs are minimized. In some rare cases, the works engineer rejects the plant hire request or makes modifications to the plant hire request before approving it. If the works engineer rejects or changes the plant hire request, they normally write a short explanation in a "comments" field in the plant hire request. In such cases, it is usually the case that the works engineer talks with the site engineer prior to rejecting or modifying their request in order to avoid misunderstandings.

Once the works engineer has approved the plant hire request, Buildit's information system automatically generates a Purchase Order (PO) for hiring the plant and sends this PO to the plant supplier. The supplier may accept or reject the PO. One reason why a PO might be rejected is that the plant that is being requested is no longer available during the requested period of engagement (e.g. it has been hired by someone else).

When the plant is hired, the supplier delivers it to the construction site at the required date (or in about 6 working hours if the request is urgent). The site engineer inspects the plant and if everything is in order, he/she accepts the engagement. In some cases, the plant is sent back because the plant does not comply with the original specifications of the site engineer.

When the period of engagement is concluded, the supplier comes to pick up the plant. Sometimes, the site engineer requests an extension of the period of engagement (e.g. in order to keep the plant for an additional week). In order to request an engagement, the site engineer should first check the availability of the plant with the supplier for the period of the extension. If the plant is available, the site engineer can modify the plant hire request. Buildit's information system then sends a modified PO to the supplier.

A few days after the plant is picked up, the plant's supplier sends an invoice to Buildit by e-mail. The invoice is automatically matched with a PO by Buildit's information system. The invoice should then be approved by the site engineer who hired the plant. The reason why this check is needed is to ensure that the supplier is not invoicing for a plant that was rejected or for an incorrect time period. If the invoice is accepted, payment is scheduled and a remittance advice is sent to the supplier. If the invoice is rejected, the payment is not scheduled and the site engineer is responsible for communicating with the plant supplier in order to resolve the issue.

Plant suppliers may send reminders of unpaid invoices (every invoice has a due date). When BuildIT's system receives a payment reminder, it checks if the corresponding payment has been scheduled or not. If it has been made, BuildIT re-sends the corresponding remittance advice. If on the other hand the payment has not been made yet because the site engineer still needs to approve the corresponding invoice, the site engineer is notified (in one way or another) that a payment reminder has been received for an unapproved invoice. This is achieved for example by marking the unapproved invoice with a ``late payment'' note.

Initial Functional Requirements

The goal of this project is to implement a service-oriented system in order to support the above business processes (both on Buildit's side and on Rentit's side).

The requirements for Buildit's system are:

CC1. The system should allow site engineers to create a plant hire request.

CC2. The system should allow site engineers to modify a plant hire request prior to its approval by the works engineer.

CC3. The system should allow site engineers to cancel a plant hire request. Cancellations are allowed until the day before the plant is due to be delivered. If a cancellation is requested after the PO has been sent, a request for cancellation should be sent to the supplier.

CC4. The system should allow site engineers to check the status of a plant hire request.

CC5. The system should allow works engineers to approve, reject or modify a plant hire request.

CC6. The system should produce a PO for every approved plant hire request and forward it to the corresponding supplier. The supplier may respond that the plant being requested is no longer available (which means the PO is rejected), or it may respond with a confirmation of the PO.

CC7. The system should allow Buildit employees to view all submitted POs.

CC8. The system should allow site engineers to request an extension in order to keep a plant longer than its initial period of engagement. When an extension is requested, the system should produce a modified PO and forward it to the supplier. The supplier may accept/reject the modified PO.

CC9. The system should allow a supplier to submit invoices for a given plant hire.

CC10. When an invoice is received, the system must check that the PO number in the invoice corresponds to an existing and unpaid Purchase Order. If the PO does not exist, an error message is returned to the supplier.

CC11. The system must allow site engineers to approve an invoice and to retrieve the PO associated to an invoice.

CC12. The system must submit a remittance advice to the supplier after the invoice is approved (normally the remittance advice should only be sent after the payment has been triggered, but in this project we do not deal with sending payment orders to the bank).

NOTE: One should keep in mind that the accounts payable department handles hundreds of invoices per month, not only for plant hiring but for many other types of expenses such as construction material, office supplies, sub-contracting services, etc. In this project we will focus on building a sub-system for handling invoices for plant hiring, but we should keep in mind that the system should be extensible to handle many other types of invoices.

The above features are described from the perspective of the construction company's system (Buildit). The plant supplier (Rentit) also needs a system. One can derive the features of the plant supplier's system from the above ones. In particular:

PS1. The system should allow a customer to list the available plants and their prices

PS2. The system should allow a customer to check the price for a given plant (given the plant identifier)

PS3. The system should allow a customer to check the availability of a given plant during a given time period

PS4. The system should allow a customer to submit a PO for hiring a plant. The PO may be accepted or rejected depending on the plant's availability

PS5. The system should allow employees at Rentit to determine which plants need to be delivered on a given date

PS6. The system should allow a customer to submit modified POs requests and accept/reject a modified PO depending on the plant's availability

PS7. The system should allow a customer to submit a request to cancel a PO. A cancellation request is normally accepted if the request arrives prior to the plant being delivered. If the plant has already been delivered, the cancellation request is rejected.

PS8. The system should allow employees at the plant depot to mark the plant as "rejected by customer".

PS9. The system should allow employees at the plant depot to mark a plant as "returned", meaning that the plant has been returned in due form and the rental period has expired.

PS10. The system should submit invoices for "returned" plants.

PS11. The system should submit payment reminders for unpaid invoices.

PS12. The system should allow customer to submit remittance advices and mark the corresponding invoice as "paid" once the corresponding remittance advice is received.

NOTE: The plant supplier has two separate sub-systems: one for handling plant hire requests, and the other for invoicing (i.e. accounts receivable).