Project Plan *(version 2.0)*

Danfoss Forklift Request Application

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Problem Statement

Danfoss Power Solutions, a branch of the Danfoss group, make hydraulic pumps, motors, and controls for off-highway applications. The facility in Ames manufactures pumps and motors in a variety of sizes for firms such as John Deere and Caterpillar.

Each assembly line in the facility has a team member called the material handler, who stocks supplies for each line. Often, the material handler needs a forklift to fetch parts from another area of the facility, or load parts on to delivery systems within each assembly line.

The current process for requesting a forklift is to manually flag one down as it passes the area. A previous attempt to create a more efficient dispatch system was to give each forklift operator a cell phone. This solution was abandoned because the operators often did not hear the phone, due to ambient noise in the facility, and safety issues related to the phones.

Danfoss has requested a web application that allows material handlers to submit requests for the forklifts via a web browser. The forklift operators will receive requests via a web interface on an iPad, associated with each forklift. A forklift operator will be able to accept a request, carry out the task, and mark the request as complete.

Solution

The forklift request application is a tool that will improve productivity and safety at the Danfoss Ames facility. Under the current dispatch system, when a cell needs assistance, an employee must flag down an available forklift as it drives by. Often, forklifts are already fulfilling requests for other areas, which creates bottlenecks at cells awaiting materials.

A previous solution was to issue forklift drivers cell phones, but the drivers had difficulty hearing the phones, and were required to stop before answering. The proposed solution is to create a web-based application that allows cell users to create requests for forklift drivers to see, acknowledge, and complete.

This will reduce downtime at cells waiting for forklifts. With a mobile device platform, such as an iPad, forklift drivers will be able to acknowledge requests when they are available and safely stopped, without interrupting their current task.

Business Case

The request application will benefit the Ames Danfoss facility in several ways.

First, the application will provide a safer solution for forklift dispatch. Safety is the first priority at Danfoss, and the current system creates a safety concern. Manually flagging down a forklift diverts the operators attention from driving, causing a hazard. In addition, cell phones cause an additional hazard, and are difficult to use in the facility.

Second, the application will improve forklift dispatch and traffic at the Ames facility. For example, if a material handler needs an item from a different area in the facility, he must flag down a forklift in his vicinity. From there, the forklift operator will travel to the other side of the facility, retrieve the item, and deliver it to the assembly line. This can be a time consuming process if the assembly line and item are on different sides of the facility. The application will allow a forklift operator in the area of the item to accept and process the request, preventing a trip across the facility.

Finally, the application will allow metrics to be generated about forklift response times. This may allow future improvements in material placement and forklift dispatching.

Application Interfaces

Cell User Interface

- Ability for cell users to enter a request for forklift via a web interface
- Requests should identify the requesting cell, a basic overview of the requested task, and a cell contact

Forklift User Interface

- Forklift users should have an interface available on a mobile platform that allows them to see incoming requests, acknowledge a request, and complete the request
- This interface should display information collected in the request submission

Administrative User Interface

- An interface that allows administrators to see and report about groups of requests

Requirements

Group 34 has an array of functional requirements for the forklift request application. These requirements have been defined by three different stakeholders: Danfoss, the CPR E 491 syllabus, and Group 34's willingness and drive to deliver the best possible solution at the end of the year. The group has two main sets of requirements: functional and nonfunctional. Functional requirements include things like the "physical" (with respect to software) abilities the application must provide. Nonfunctional include objectives such as reliability, responsiveness, and accessibility.

Functional

Functionally, the application must allow cell operators to create requests, and forklift operators to respond to said requests. Additionally, administrators must be able to perform operations such as viewing the request log in both tabular and graphical form.

Non-Functional

Non-functionally, the application must be reliable, responsive, and accessible. To insure reliability, Group 34 will create unit tests covering most of the code base. These tests will validate normal , edge case, and illegal input, to ensure the data that is displayed to the user is as accurate as possible. To ensure responsiveness and accessibility, data will be stored efficiently and in an indexed form, and will populate the UI asynchronously, to ensure efficient and non-redundant data transfer and processing.

User Interface Description

Danfoss has set the following user interface requirements: first, the UI must be web-based, using web standards such as html, css, and javascript. Second, the web-based UI must be compliant with Internet Explorer and Mobile Safari. Finally, the interface must be touch-friendly, and highly usable on the Apple iPad.

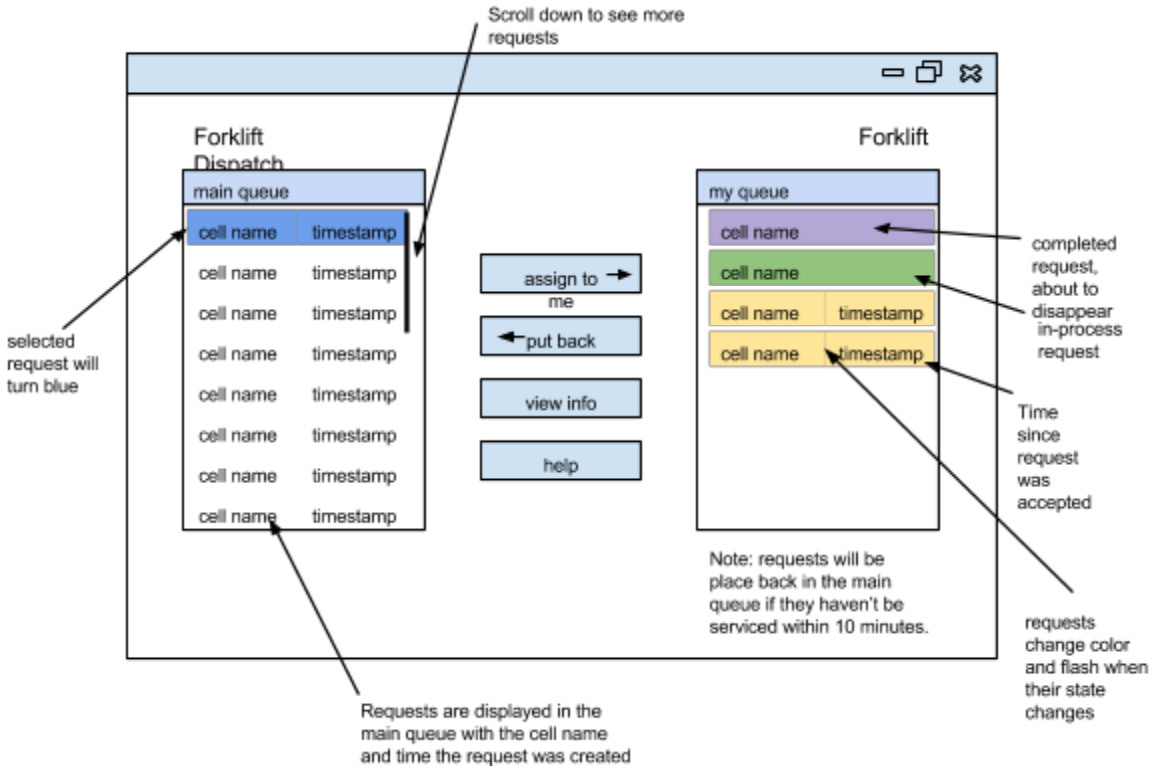
In addition to the Danfoss requirements, Group 34 decided it would be beneficial for the UI to not include dragging or right-clicking, as these gestures are difficult on touch-based devices.

To further accommodate touch-based users, Group 34 plans on creating a UI with large buttons. The UI is also designed to keep the number of actions to complete an operation at a minimum. This will allow Danfoss employees to spend less time dealing with the application, so they can focus on their jobs.

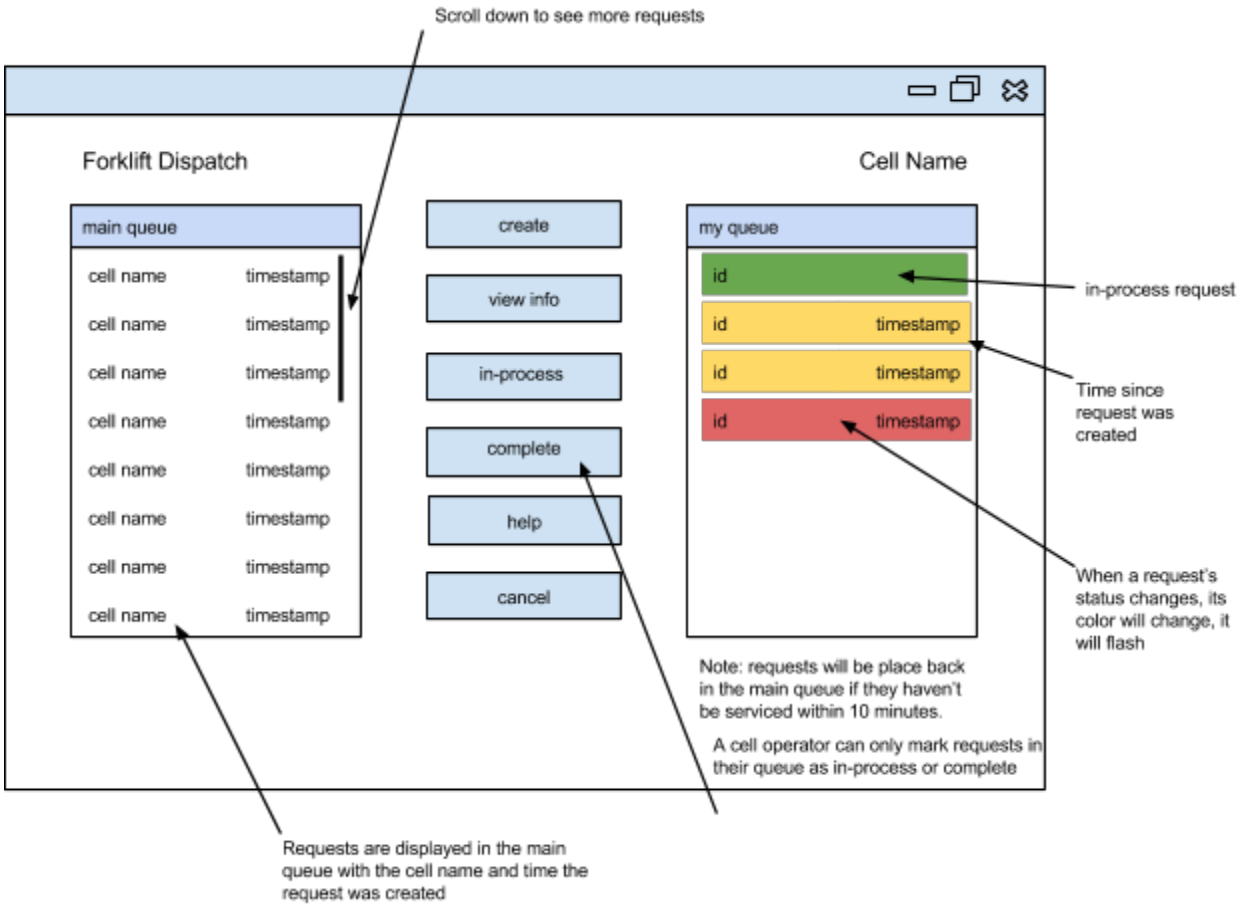
The final aspect of the UI is the accommodation of color-blind users. The application (as the screenshots in this document show) uses a color code scheme to denote different forklift request states. These states are also denoted by symbols, to accommodate color-blind users.

Concept Sketches

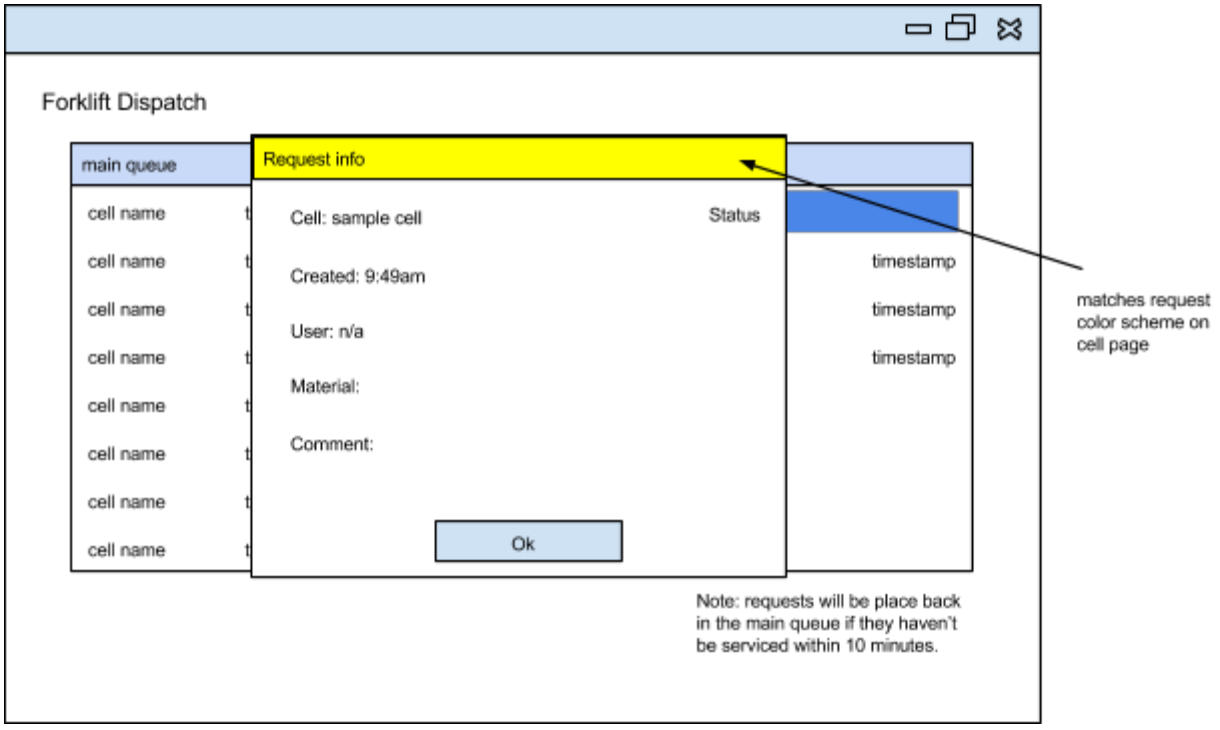
Forklift page



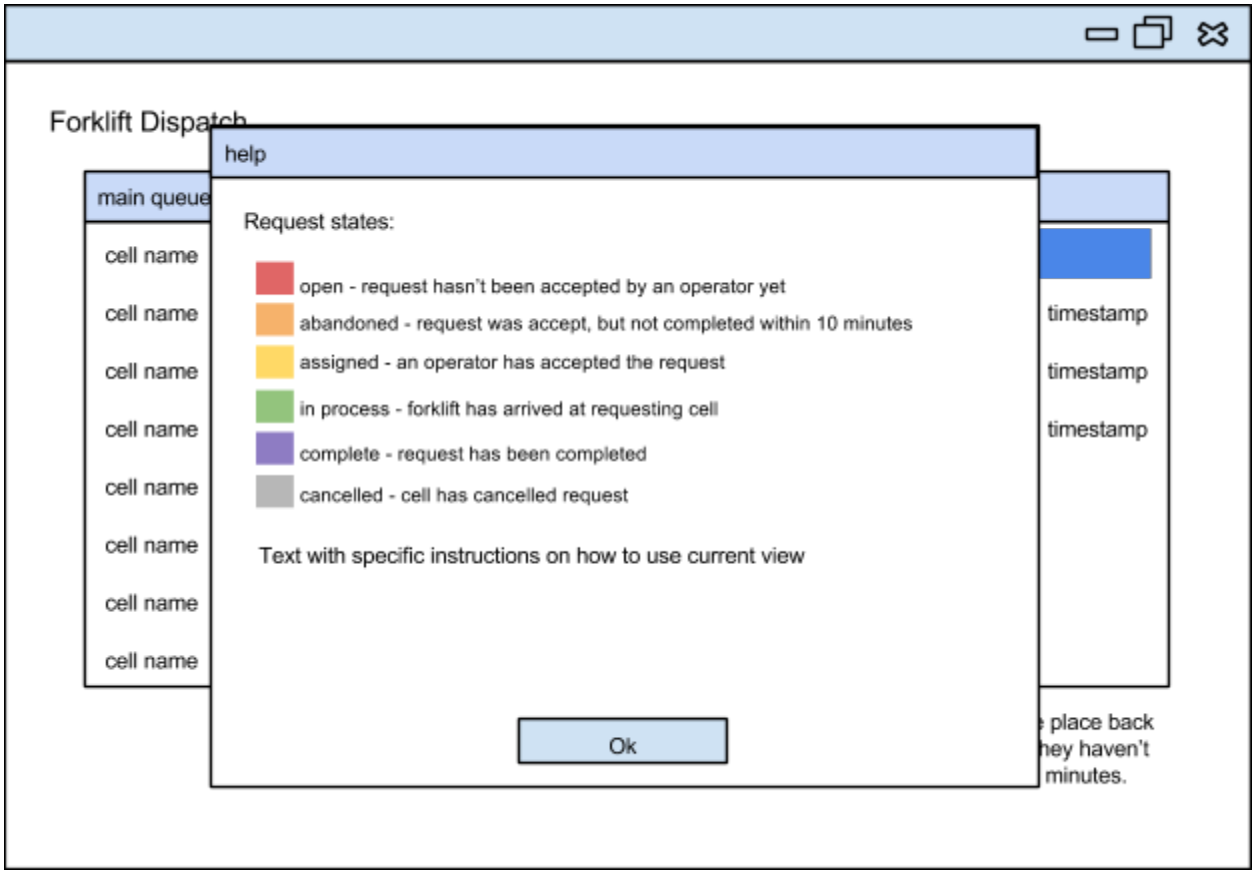
Cell page


Scroll down to see more requests
Forklift Dispatch
Cell Name
main queue
cell name timestamp
cell name timestamp
cell name timestamp
cell name timestamp
cell name timestamp
cell name timestamp
cell name timestamp
cell name timestamp
create
view info
in-process
complete
help
cancel
my queue
id
id timestamp
id timestamp
id timestamp
in-process request
Time since request was created
When a request's status changes, its color will change, it will flash
Note: requests will be place back in the main queue if they haven't be serviced within 10 minutes.
A cell operator can only mark requests in their queue as in-process or complete
Requests are displayed in the main queue with the cell name and time the request was created

Info Screen

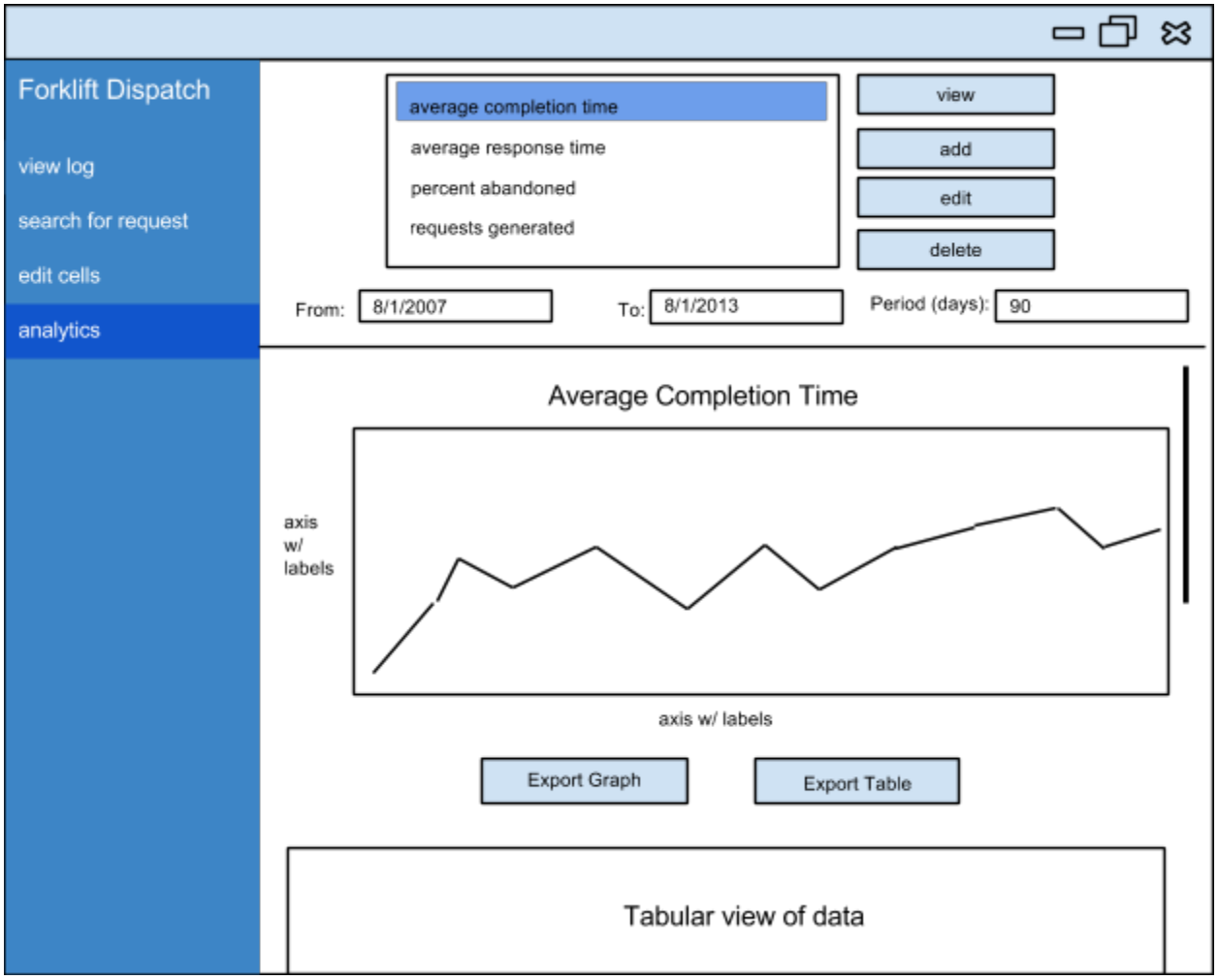

Forklift Dispatch
main queue
cell name
cell name
cell name
cell name
cell name
cell name
cell name
cell name
Request info
Cell: sample cell
Status
Created: 9:49am
User: n/a
Material:
Comment:
Ok
timestamp
timestamp
timestamp
matches request color scheme on cell page
Note: requests will be place back in the main queue if they haven't be serviced within 10 minutes.

Help Screen


Forklift Dispatch
help
main queue
cell name
cell name
cell name
cell name
cell name
cell name
cell name
Request states:
open - request hasn't been accepted by an operator yet
abandoned - request was accept, but not completed within 10 minutes
assigned - an operator has accepted the request
in process - forklift has arrived at requesting cell
complete - request has been completed
cancelled - cell has cancelled request
Text with specific instructions on how to use current view
Ok
timestamp
timestamp
timestamp
place back
hey haven't
minutes.

Admin Screen

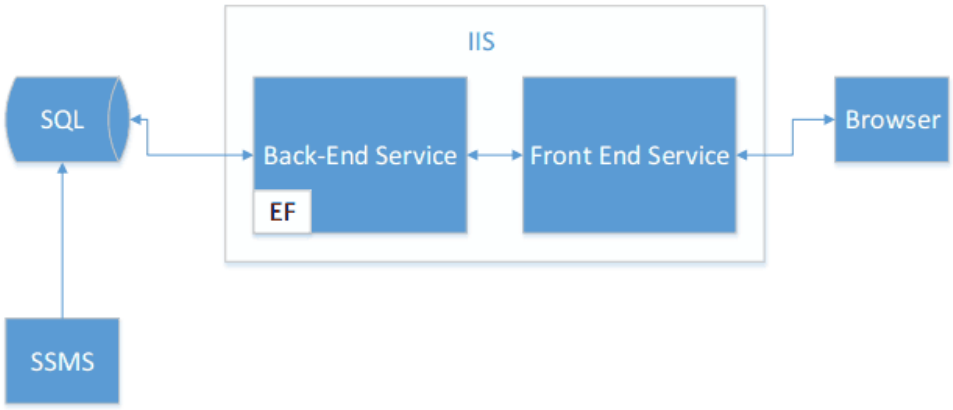
Sample Analytics Page



System Description

SQL	Structured Query Language for databases
Visual Studio	The Integrated Development Environment the team will use to write the application's code base.
IIS	Stands for Internet Information Services and is the web server a (Windows) computer will run to serve web pages to the Browser using the Hypertext Transfer Protocol.
Browser	The web browser an end user interacts with to send input and receive output from the Forklift Request Application.
SSMS	SQL Server Management Studio (SSMS) is a Windows based application used to manipulate SQL databases. Operations such as insert, update, delete can be combined into stored procedures using SSMS
Entity Framework	An object relational map framework used to map SQL result sets into C# objects
Web service	responds to client requests from the front end service
Front end services	Responds to HTTP requests from the browser and passes them off to the web service after appropriate "filtering"

System Block Diagram



Deliverables

First Semester Deliverables

As defined by Danfoss, the first semester deliverables include the project plan, design document, mock UI, and a sample C# web application.

The project plan is the foundation of the application, and explains the high level components. The plan also outlines the business case, proposed schedule, and project risks and mitigations.

The design document is the technical specification for the project. It details the functional and nonfunctional requirements, as well as modular design diagrams and database schema.

The mock UI will be used to validate the interface with users and project stakeholders. Because the UI is the only interaction most users will have with the application, it is critically important.

Second Semester Deliverables

The second semester is the “implementation” semester. It is the time when group 34 will code and test to ensure the end product can be delivered on time, thoroughly tested, and complete.

Deliverables for the semester include the application itself, unit and automation tests, the final project report, and the presentation to faculty.

Work Breakdown Structure (Semester One)

Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Determine group															
Determine project															
Meet with advisor															
Meet with Danfoss															
Tour Danfoss															
Rough brainstorm															
Rough project report															
Present rough report to Danfoss															
Set-Up local dev. env.															
Create project report version 1															
Set-up remote code repo.															
Set-up remote dev. env.															
Implement sample C# project															
Implement UI															
Present mock UI															
Create final project report for first semester															
Present project report															

Technical Risks and Their Mitigations

Risk	Probability of Occurrence	Criticality (0-100)	Risk Factor	Mitigation Strategy
iPad unable to access or unable to query forklift request information.	0.1	90	9	The application must wait until the server responds again.
A Cell users another Cell's iPad to request a material	0.6	20	48	This will only cause minor confusion and can be mitigated best by placing a sticker on the iPad stating "Do not remove from Cell"
The team doesn't have the technical skills to finish the project.	0.1	85	8.5	Team members have each had various experiences to bring to the project. The project's schedule allows for them to have enough time to collaborate and ask questions. Also, the team plans on keeping in contact with Danfoss' IT Services for questions regarding Danfoss C# and database design standards.

Non-Technical Risks and Mitigations

Risk	Probability of Occurrence	Criticality (0-100)	Risk Factor	Mitigation Strategy
Team is unable to complete the essential parts of the product by the set delivery date.	0.2	30	6	The delivery date has been set to allow additional time for any problems that may arise. The WBS has been created and accounts for each stage in the process. Since the project is not terribly time sensitive (with the exception of graduation), if major issues arise, the in-progress project can be delivered, and a second release would occur shortly after (since Danfoss employees are on the team).
There isn't enough demand for the product or forklift drivers will not find enough value.	0.1	75	7.5	The project's team members doing use case research to find current forklift efficiency. At the end of the year, it would be great to see forklift efficiency increase as a result of the application.