Working Backwards Deliverables

1 Working Backwards Questions:

1.1 Who is the customer?

The customers are the facility managers of the museum of London as well as the building owners.

1.2 What is the customer problem or opportunity?

As of now, the overall energy consumption in the museum is too high resulting in energy-waste and high operating costs. The facility managers have to rely on historical data and are dependent on 3rd parties to build their reports on energy usage, which stands in the way of optimising their performance and becoming carbon neutral. There is a great opportunity in saving costs, time and energy by making data access easier. Therefore, the museum's goal is to find a scalable solution to replicate in the new Museum of London, which is still under construction.

1.3 What is the most important customer benefit?

By providing the facility manager with data in real time, it becomes a lot easier to analyse, track and understand the baseload and overall energy usage in the building and hence adapt it to any changes or react when the data shows anomalies. Our solution can be a vital tool to not only save and track energy and costs but can also support the museum in reaching its vision to become carbon neutral by 2030.

1.4 How do you know what customers need or want?

In order to properly understand the needs of the client, several discussions were held with the client to gather qualitative feedback. The information gathered helped to understand the challenges the client was facing and to develop a solution to the problem. The client was present during the development phase and was able to provide regular feedback.

1.5 What does the customer experience look like?

Our solution offers a user-friendly and interactive interface with the ultimate goal to engage the Facility Management staff and provide an integrated overview of all relevant information so that their everyday working life gets easier.

2 Empathy Map
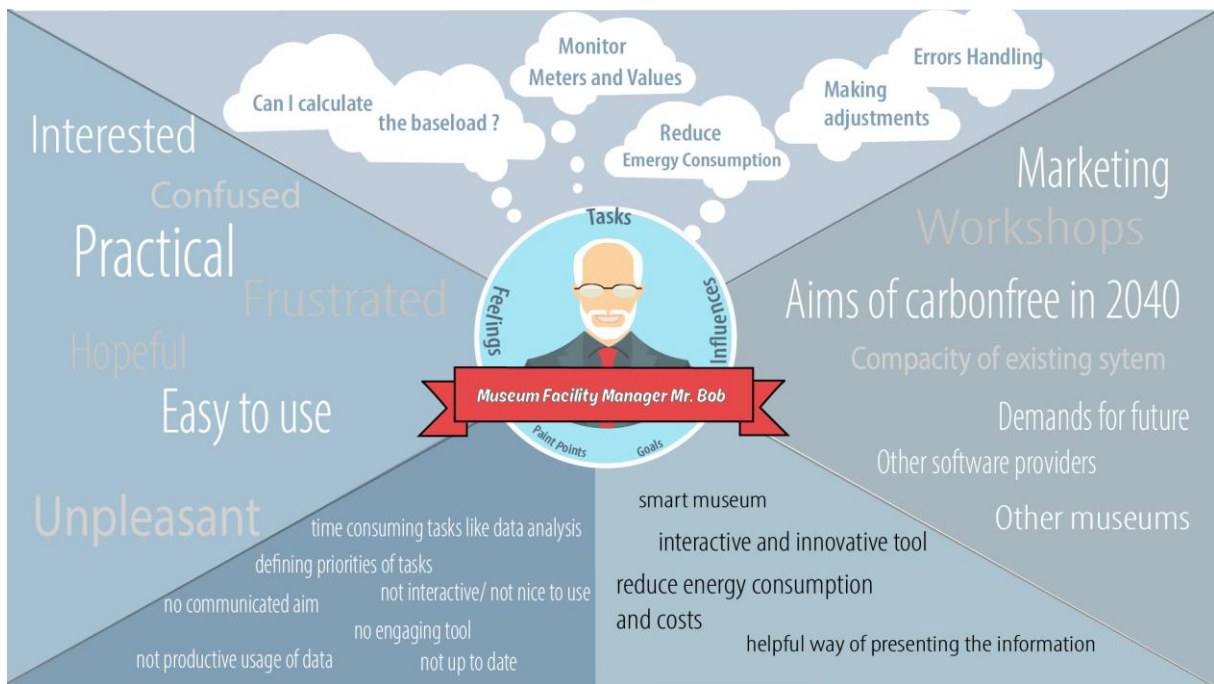
3 Storyboard

Bob, the Facility Manager of the Museum of London is standing on the site of the new museum that is due for completion in 2025. He's concerned. The net zero target is approaching, but with the current building management processes, it seems impossible to achieve. He would like to understand the energy consumption of the building, but unfortunately he currently only has

access to third-party reports summarising data from previous months. With this data he is unable to react to building conditions in time. Bob needs real time data. Fortunately, the Museum of London Docklands has sensors that can provide real-time data on building conditions.

With the help of a team, he starts developing an application that collects the sensor data and builds relevant graphs, to help him make decisions. The MoLEnergy app collects data on energy consumption, breaks energy down into baseload and variable energy, and provides alerts when there is a sudden spike or drop in energy consumption. The mobile app also allows him to monitor current conditions in the building while on the move and react when necessary. To offer incentives to reduce wasted energy, Bob can also use the app to set a weekly budget for energy consumption.

When the new museum is finally ready, Bob is prepared and confident. With the new app, MoLEnergy, he has the tools to operate the facility efficiently and help achieve the zero-carbon goal on time.

4 Press Release

Museum of London starts its journey into a new future with MoLEnergy

March 1, 2022

The Museum of London acknowledges its leadership role in the London community and is aiming to be carbon neutral by 2040, in line with the targets set by the City of London Corporation. As the Museum of London is at the moment building a new museum, it offers a great chance to reinvent the way of operating and to improve their processes. For this, MoLEnergy - the new facility management app - was designed to understand and manage the energy consumed.

Museum of London aiming to be carbon free by 2040

As of now, the museum's energy consumption is too high, resulting in energy-waste and high costs. Furthermore, the facility managers only have access to scattered and historical data and need to rely on 3rd parties to build their reports on different variables of energy consumption in the building. The new Museum of London will open in 2025 and until then they should have innovative technology. Therefore, they need a scalable solution that is engaging the Facility Management staff and provides an integrated overview of relevant information. This results in

a great opportunity to save costs, time and energy by making data access easier and supporting decision making.

Co-Innovation Lab develops MoLEnergy - an application that helps MoL in managing their energy consumption

MoLEnergy is a mobile application that enables the facility managers of the Museum of London to see different information based on the building's smart sensors. The app collects data about overall and baseload energy consumption, provides warnings in case of spikes and drops and visualises related effects on costs and budget. With MoLEnergy the museum will be able to connect to the building and enhance decision making to optimise the performance of the museum, making it more efficient and reducing the museum's carbon footprint.

Receiving great feedback from the museum's leaders and facility managers

"The Museum of London acknowledges its leadership role in the London community and is aiming to be carbon neutral by 2040, in line with the targets set by the City of London Corporation. A very important component of this is the understanding and management of the energy consumed by its building portfolio for the purposes of exhibiting the Museum's collection." - Steve Watson, Technical Building Lead at MoL

"The app gives me more of a connection to the building. It really helps giving me the right information needed with the ability to find out more and look further if needed. Being able to visually see the data and using the history of the data collected will help in having more of a role in making decisions to optimise the performance of the museum, making it more efficient and in helping us in reducing our carbon footprint goals." - John Iaciofano, Facilities & Electrical Maintenance Manager at MoL

Engaging facility managers with the user-friendly interface of MoLEnergy

The app-based solution provides the ability for more engagement as real-time data can be easily accessed from anywhere, it gives a simple overview of the most relevant information and incentives like budget tracking are included. The user-friendly and interactive interface is a strong tool to lead facility managers to actively make use of the app and therefore motivates them to save energy.

If you are curious and want to get further information, you can visit the website of the Museum here: https://www.museumoflondon.org.uk/museum-london. There you can already find pictures of the construction of the new museum.

Munich, Germany

5 FAQ

The FAQ is separated into two different parts: Solution customer FAQ and Solution client FAQ.

5.1 SOLUTION CUSTOMER (Facility Manager) FAQ

- **Question 1:** How will it be possible to manage the energy consumption with the application as a facility manager?

  Answer: The app engages the facility manager in energy management on a daily basis and shows the 'big' picture. Energy use can be adapted more efficiently, as real–time data makes fast decision-making possible. In addition, the budget can be kept track of at all times, allowing a valid, forward-looking financial planning.

- **Question 2:** Why should I use the App? What is the generated value? What are the benefits?

  Answer: Data is easier accessible and more relevant as it is collected in real time. You are directly "connected" to the building and do not have to rely on a 3rd party to get out-dated information about the status of the building and all connected sensors anymore.

- **Question 3:** Will this solution have an impact on asset maintenance?

  Answer: The app will ensure that all systems are operating correctly and PPM´s are carried out. In case of anomalies, the user receives a warning and can react quickly. That will have a positive impact to extend the life of the assets and reduce the asset maintenance costs to a minimum.

- **Question 4:** How is the facility manager able to manage the different "open" and "resting" conditions/times of the museum?

  Answer: The facility manager is able to manage the different states by using the various views offered by the application. One view shows the baseload, the other view the total energy consumption. As the baseload represents the minimum required energy consumption, it can be used as a synonym for the "resting" condition of the museum. The energy consumption on top describes the variable load or the "open" condition of the museum.

- **Question 5:** Who is allowed to access the app?

  Answer: Access is limited to the facility managers and everyone related to their work; access may be extended if there is an urgent and justified demand for it.

- **Question 6:** How do you separate between different users / roles?

  Answer: At the current status of the app there is no differentiation between different roles planned. One solution could be to implement a favourite option in the future. This would allow them to select their favourites in order to adapt the app to their specific needs. As an example the energy manager could add the graph that shows the current energy consumption to his favourites and a facility manager could for example see current temperature in specific rooms.

- **Question 7:** How can I get more detailed information about the energy consumption and the causes for higher values?

  Answer: The app's purpose is to inform the user of the consumed energy in the building and to give an overview. When it comes to detailed explanations, the future web-based solution can support this and give detailed information about causes for those anomalies.

- **Question 8:** How can I download the app?

  Answer: The following describes the needed steps for the app installation:

  1. Connect your android device to computer via USB-cable and enable USB debugging when prompted

   2. Once the phone is connected it shows up as another drive in the computer's file explorer. → Open up the phone's file directory

  3. Move the .APK file to desired folder (/Download folder is recommended) in the phone's file directory

  4. Once the file is transferred find the .APK file on the phone from files and tap the file to install the application. If you receive a warning that for security reasons the phone cannot install from this source, click settings and **Allow from this source**, go back and click **Install**

  5. The application should now be installed and should be seen on the home screen

  The needed file is provided to the Museum of London who is now responsible for granting access.

- **Question 9:** Is any training required before usage?

  Answer: The application itself is not complicated and can be easily understood by everyone who has some knowledge about the Museum of London and its energy consumption. Nevertheless a short introduction within the framework of a short

explanation video could be beneficial to promote all integrated features to the future respective users. Nevertheless, the Business Concept and Project Documentation already provides a detailed overview of the main features.

5.2 SOLUTION CLIENT (Museum of London) FAQ

- **Question 1:** What value does this solution offer to the MoL?
  Answer: The app will enable the facility managers to better manage energy use in the building which is one of the business requirements of the Museum. Another advantage is that the app enables you to identify wasted energy or areas where energy savings can be made, also the contribution of greenhouse gases to the environment and the operating costs can be reduced drastically. But the best thing about it is that you will be on track to meet the UK Government's Net Zero 2050 target.
- **Question 2:** What different types of data will be used and provided?
  Answer: The app uses two sets of the data:
    - Baseload: the minimum energy needed to run the building
    - Variable load: Everything that is added to the baseload (e.g. normal energy consumption needed during opening times)

These data sets will support the facility manager with changes, trends forecasts and other analytics.

- **Question 3:** How could the solution be used in the future?
  Answer: One specific requirement for the solution is that it must be scalable. Besides the current Museum of London, it is additionally planned to launch it in the New Museum of London. Along with that, additional features can be added to the app based on the needs and future plans.
- **Question 4:** How do you collect the data?
  Answer: The telegraf agent collects all the data in a 15 minute interval, which is collected by the MQTT Broker (all published sensor data from the Museum of London). Then the data is stored in the timestream database. From that point on the mobile app sends queries to the database and gets the data in return and can therefore display the correct data.
- **Question 5:** Why did you focus on the baseload?
  Answer: The baseload has been calculated by referring to the energy consumption of

the building during the night or none-operating hours. During night machines are still operating that consume energy but on a lower amount than during the daytime. That's why it shows the minimum energy consumption, which makes the ongoing calculation easier and more logical. Additionally, there are less parameters to focus on, like the current number of visitors, that affects the energy consumption. That is the reason why in the end the focus has been set on the baseload in order to simplify the case. In addition to that, the solution can be transferred to daytime as well by adding the variable load.

- **Question 6:** Why did you choose an app-based solution over a web-based solution?
  Answer: An app-based solution offers way more possibilities for user engagement than a web-based solution. In an app there is for example the possibility to receive push notification on the facility managers' smartphones. In addition, the facility manager can access the information from anywhere. There is also the possibility of extending the solution with a web-based solution, but due to time limits in this project, the focus has been placed on the application.

- **Question 7:** What are the planned features for the future?
   Answer:
    - Forecast energy use based on historical data (if we could change the parameters); Machine learning model for this (looking at last time and calculating costs)
    - Seeing where we are currently compared to the assumed forecast (maybe also showing reasons why we are not at the same point)
    - Showing consumption and derive predefined action points
    - Not just monitoring but controlling the building

- **Question 8:** Is the data always available?
  Answer: Yes - as long as it is correctly fetched from the museums' sensors by the MQTT Broker.

- **Question 9:** Do I have to use the cloud?
  Answer: Right now there is no other solution besides using the cloud, as the app is running on the AWS solution and the data gets stored in the cloud. This allows all users to have the right data and also the best possible overview regardless of time and the Facility manager's current location.

- **Question 10:** Who does the maintenance?
  Answer: This project is only supposed to be a prototype, which means that the

original team has stopped working on it and the future maintenance is handled by the future team engaged in the development and maintenance process. However, the Munich University of Applied Sciences has access to all AWS resources and can therefore provide the MoL with needed data in case any problems occur.

- **Question 11:** How does it pay off? How much does it cost?

  Answer: At this point it is not possible to estimate how much the savings will account for in the future. This depends on how accurate the solution is implemented and what respective period you are looking at. The costs for further development could be slimmed down by collaborating another semester with the Munich university of applied sciences.

- **Question 12:** What data is this based on?

  Answer: As previously explained in question 5, the data is collected from the Museum of Londons' sensors. They monitor every sub-system that is currently running and therefore provides the MQTT Broker with data on energy consumption.

- **Question 13:** How can the MoL continue working on this app?

  Answer: It would be beneficial for the Museum of London to conduct regular meetings regarding the experiences with the utilisation of the application and what is missing from the facility managers' point of view. If improvement potential is identified, adaptations can be made to the solution, either by collaborating another semester with the Munich university of applied sciences or by hiring professional developers.