Smart Sustainable Districts

Dock de Saint Ouen, Paris

3D Interactive Web Map Client "NUMDocks"

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1. Intorduction:

The 3D interactive web map client was initially developed on the request of Docks de Saint Ouen district. It consists of different categories each including a series of applications. The district is in fact interested in developing a numerical tool by which the communication between the stakeholders and the district urban planning department can be organized in a more efficient way. Moreover, the overall design of this tool has been done considering it as a main channel for engaging more citizens in the enhancement of their living environment. For the design of this tool, our partner in Paris, Aria Technologies[1] advised us based on the input from the districts partners.

This report is conducted in order to describe the general functionalities and capabilities of the platform. A demonstrator link is provided for the users to further discover the platform by themselves[2].

2. NUMDocks:

NUMDocks is thought of as a platform in which different applications can potentially be added and run independently. This means that a background interface carries out the essential elements and functionalities of the platform. On top of this platform, different applications can be developed and added. In the year 2016, two main themes were chosen and under each, several applications were introduced.

- Background interface:
  - Background imagery (OpenStreetMap is used for this district. But there are several other options that users can choose from.)
  - 2D/3D Virtual District Model (3D/2D VDM)
- Theme 1
  - Collaborative Map
  - Industrial Plume
- Theme 2
  - Resource Consumption
  - Forum

2.1. 2D/3D Virtual District Model (VDM)

The Virtual District Model (VDM) includes the topography information model of the Docks de Saint Ouen district (St. Ouen). This model is created based on the OGC CityGML standard. Accordingly, VDM can potentially include the topography

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[1] http://www.aria.fr/
[2] Please note this report is neither a tutorial on how to work with the tool nor includes any technical description of the developed tool.

information model of any district provided, based on the OGC CityGML standard. The 2D/3D VDM of St. Ouen currently consists of 3D building and bus station models. The semantic 3D building and bus station models of St. Ouen are represented in level of detail 2 (LoD2) according to the CityGML Building and Transportation modules respectively. In order to provide the CityGML LoD2 data, the following datasets were used:

   i.   BD Topo (in GML 3.2.1) all layers
   ii. BD Address (in GML 3.2.1)
   iii. Premium Address (in GML 3.2.1)
   iv. BD Ortho with resolution of 50cm I Jpg2000
   v.   DTM with 1m grid RGE Alii® with metric precision 1M, format Grid ASCII (ArcInfo)
   vi. DSM with 50cm grid (MNS) Grid ASCII (ArcInfo)
   vii. KML file consisting of bus stations and their transporting information according to actual information provided by RATP.The last one was provided by our partner in Paris (Aria Tech) and the rest were bought from IGN (National Institute of Geographic and Forestry Information), France.

In Figure 1, on the top right, there are two options, "show in 3D model" and "Show in 2D model". These options provide the possibility for a user to decide to work either on a 3D or a 2D environment. This is in order to avoid any complexity caused by the 3D model.

Accordingly, for any object created in the district a set of information can be provided. This can be seen in Figure 1, on top right in the information box.

In order to store and manage the CityGML datasets, an open-source geodatabase called 3DCityDB[3] is used. 3DCityDB stores, represents, and manages the large CityGML datasets on top of a standard spatial relational database such as Oracle Spatial and PostgreSQL. It provides a Java frontend application named '3DCityDB Importer/Exporter', which allows for high performance importing and exporting of the CityGML datasets with arbitrary file sizes. It also allows exporting of the contents in the form of different visualization formats such as KML, COLLADA, and glTF, allowing the 3D objects to be viewed and interactively explored in the web applications.

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[3] http://www.3dcitydb.org/3dcitydb/3dcitydbhomepage

Figure 1. Virtual District Model of St. Ouen (Screenshot taken from NUMDocks Web Client developed by TUM)

2.2. Collaborative Map

This is one of the main applications developed for NUMDocks. In fact this is where citizens will be encouraged to use the information provided by other partners and stakeholder and to provide information and share them with other citizens. Additionally, in this way citizens can also inform stakeholders and district planners about their requirements and interests. The design of the interface was provided by the Paris partners and delivered to us by Aria Tech.

This application offers several functionalities. Some of them which are shown in Figure 2 are listed below:

i. Everybody can see the information added through this application. But only those users who have valid accounts can register and create information in this application. However, with the exception of the administrator, nobody can manipulate the information unless the information is provided by that user him/herself.

ii.   In this application all added information are shown from the beginning. However, there is a functionality by which a user can show those place marks added in a specific period of time. Another way to show the information dynamically is to use the atomic clock on the bottom of the client and set it either forward or backward.

iii. By adding a place mark, an information box will automatically appears on the top right of the view. Users should update the information on this box and then save it. One of the items is the validation time which can be set to any time from past to future. Please note the freedom given to the user can be changed anytime by the administrator. So, there can be restriction of only setting the validation time from current to the future and not from the past.

Figure 2. Collaborative map (Screenshot taken from NUMDocks Web Client developed by TUM)

iv.   The information can be updated in any time. Only the latest update will be shown to the users. But, on the background, all the changes can be stored

into a database. This can later be useful for further analysis or calibration of other analysis.

2.3. Industrial Plume

Using this application, users can see the almost real-time distribution of a selected set of pollutants (e.g. NOX, PM10, etc.) in a pre-defined set of height categories. These are time series raster layers which show the pollutant distribution in the previous minutes or hours (depending on the requirements and also national laws). The user can simply switch between various pollutants and see the current and past conditions. These layers can also be shown for different heights such as 20 or 70 meters or in our case for 43 meters. Figure 3 and Figure 4 show two views of this application representing the pollutant "PM10" on the ground level (height = 0 meter) and the above ground (height = 43 meters) respectively, over the district.
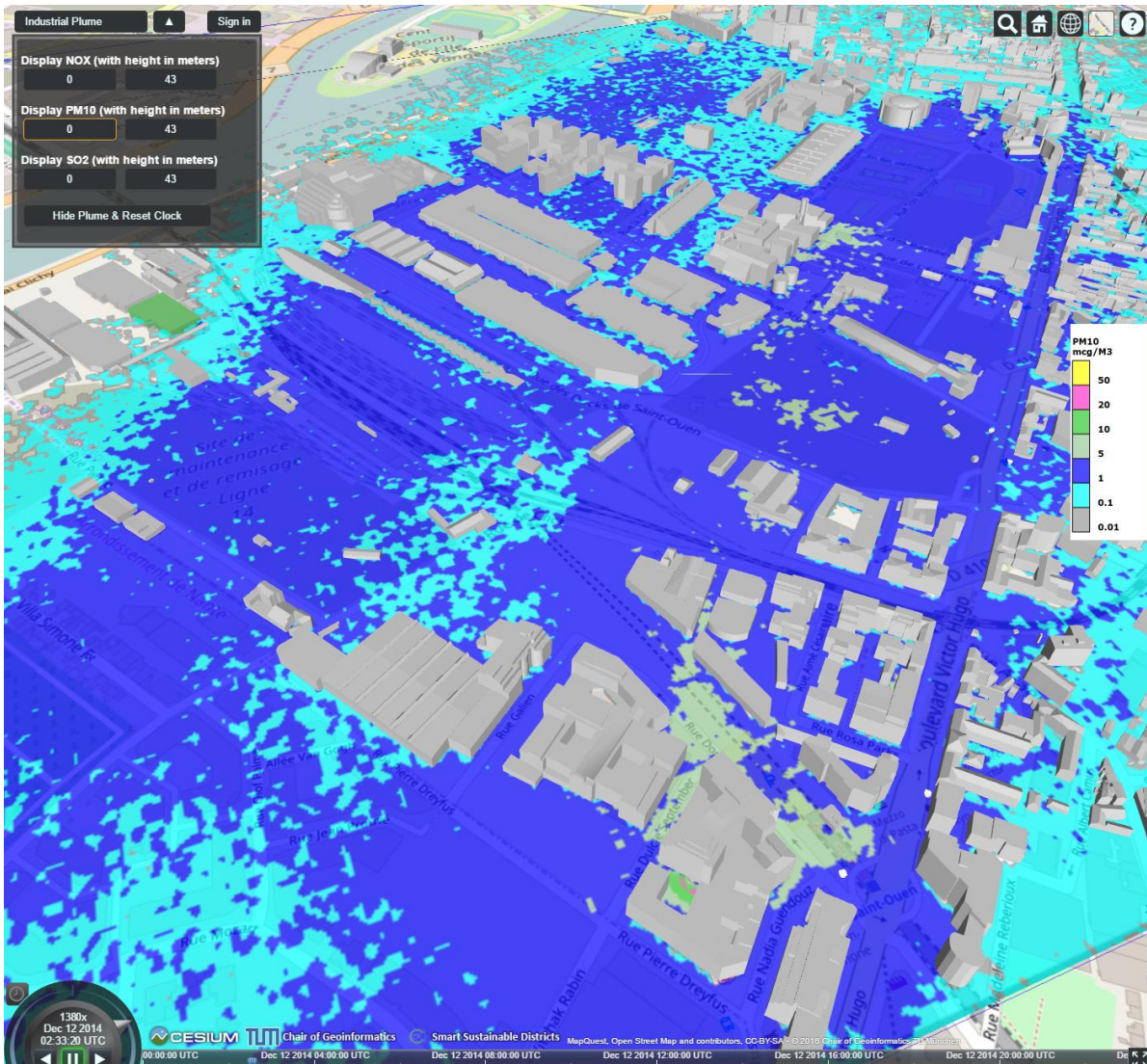
Figure 3. Industrial Plume – PM10[4] in 0m (Screenshot taken from NUMDocks Web Client developed by TUM)

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[4] Please note the data used in this application are fictional. They are provided only to test the functionality of the tool.
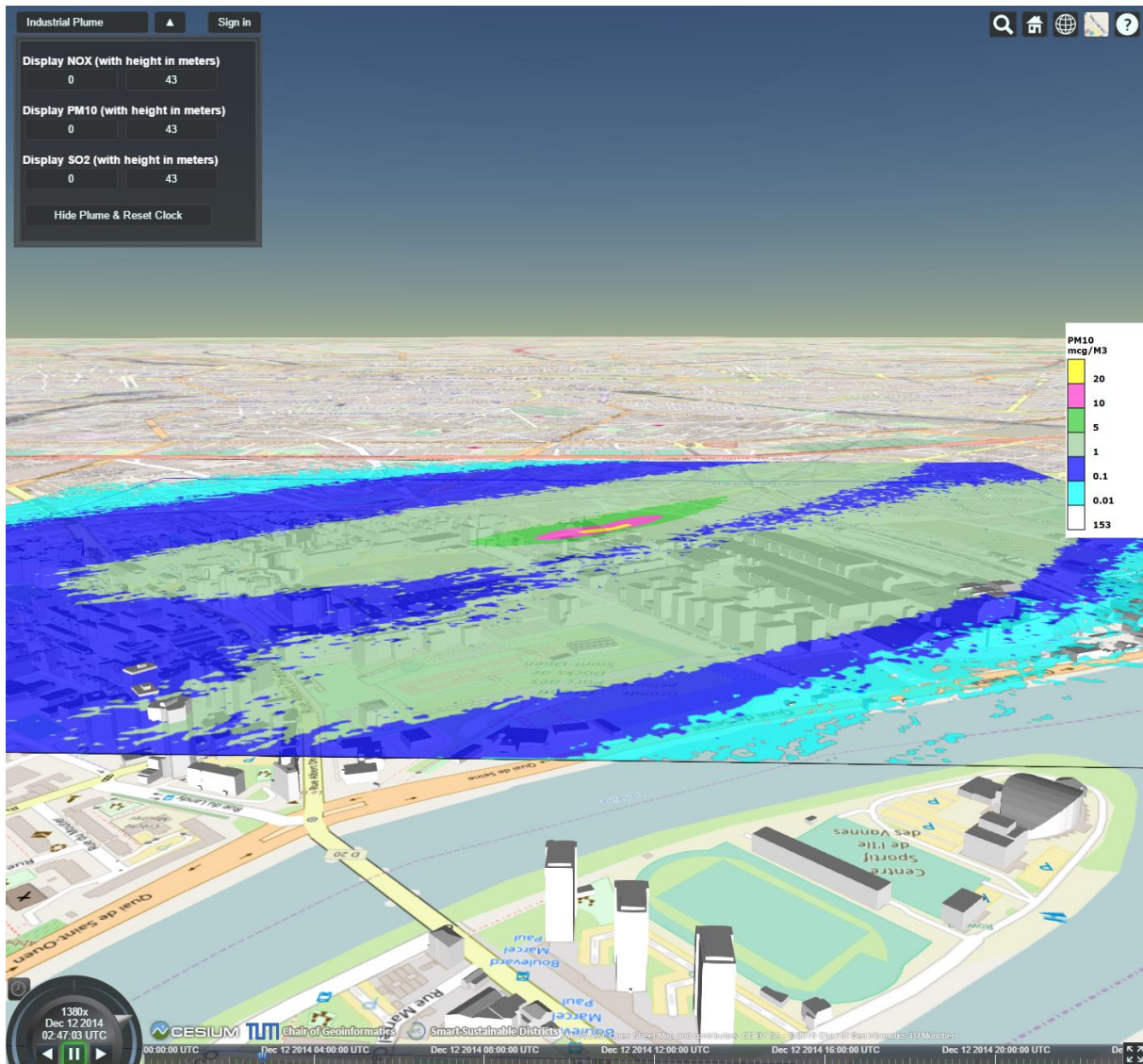
Figure 4. Industrial Plume – PM10[5] in 43m (Screenshot taken from NUMDocks Web Client developed by TUM)

2.4. Resource Consumption

Resource consumption was one of the complicated applications developed for NUMDocks. The complexity was not only due to the technical development of the application but also very much related to the difficulties of getting real and trustable data from the direct providers. Therefore, for the time being, it was decided to use some fictional data stored on the local server and not directly fetch the data from resource providers' servers. This application also offers several functionalities. Some of them (shown in Figure 5) are listed below:

i. This application shows the resource consumption in different scales. First, when this application is opened (by a click), only an information box will appear on top right of the view showing the corresponding values aggregated for the district level. Then, on building level, the values will be

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[5] Please note the data used in this application are fictional. They are provided only to test the functionality of the tool.

represented in two different ways. One is only the consumption of that specific building denoted by "Resource Consumption". The other is the tab named "Normalized Resource Consumption" showing the actual consumption of that specific building. It is named normalized because in addition to actual values shown with blue bars, the average consumption of the district as well as the best and the worst consumption values are shown with graphs. This is in order to provide a more understandable and tangible information of the situation to the users.

ii.   The values in the information box shows the previous month and in the diagram shows the consumption trend in the past twelve months.

iii. The user can decide which set of information can be shown using the "turn on/off" button on the top left of the view.

Figure 5. Resource Consumption – normalized data[3] (Screenshot taken from NUMDocks Web Client developed by TUM)

2.5. Forum

The last application is Forum or in another term a discussion platform. This application is designed at the building level which means to each building one forum has been allocated in which the residents of that specific building can register and participate in the discussions. There are various ways to implement this. The way it has been implemented in NUMDocks is briefly explained here.

First of all the forum itself is not designed inside the NUMDocks tool. The forum is provided separately and via the NUMDocks a link is provided for each building in order to redirect the user to the discussion platform. However, this can be done in

different ways. For example, the discussion platform can be accessible via a pop-up windows on top of the NUMDocks (shown in Figure 6). Users should log-in and after that, they can post or write their comments. It is not only text-based, but also images and videos can be uploaded and shared. This can also be a very useful property of this tool by which the discussions are more transparent.
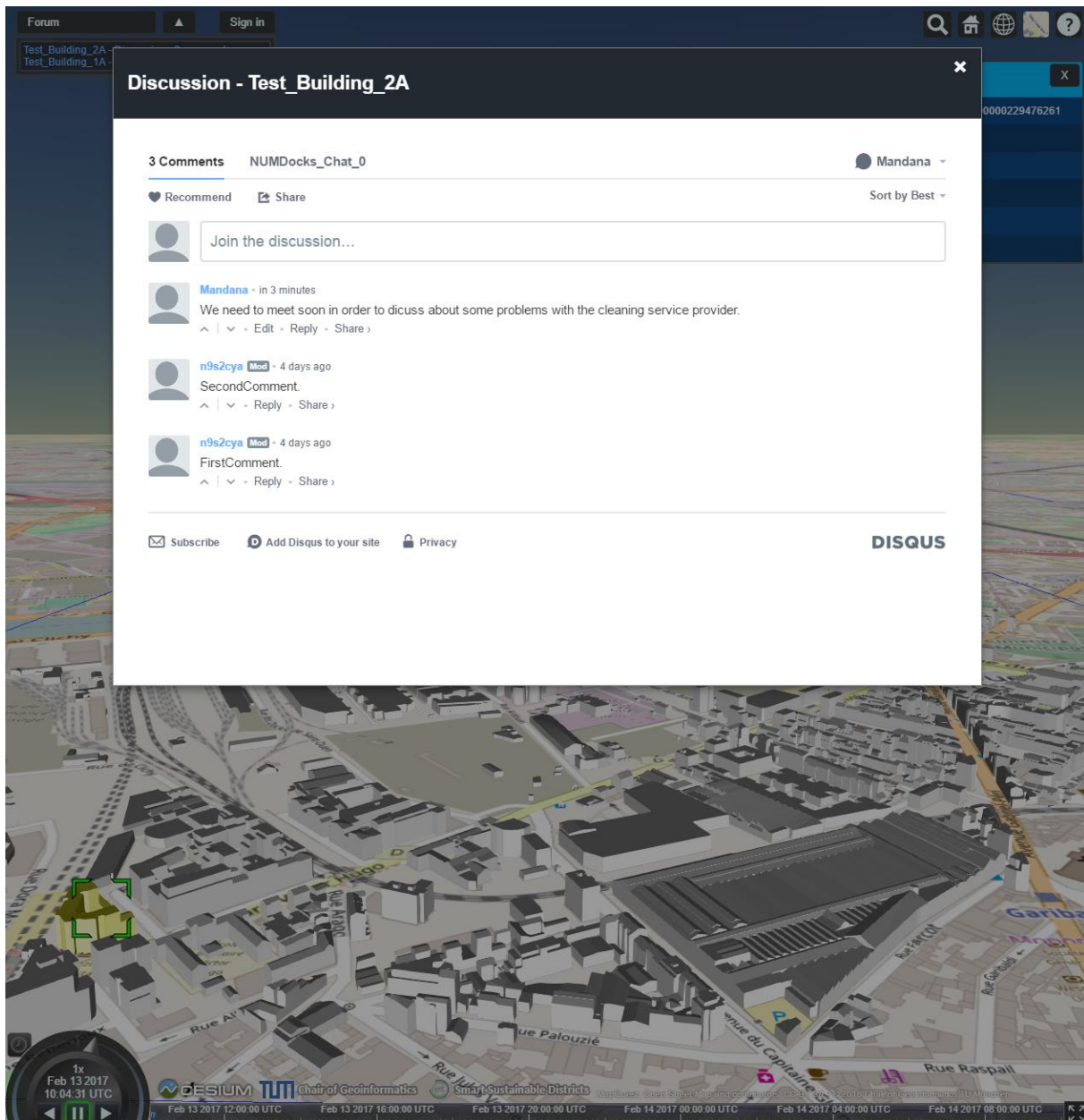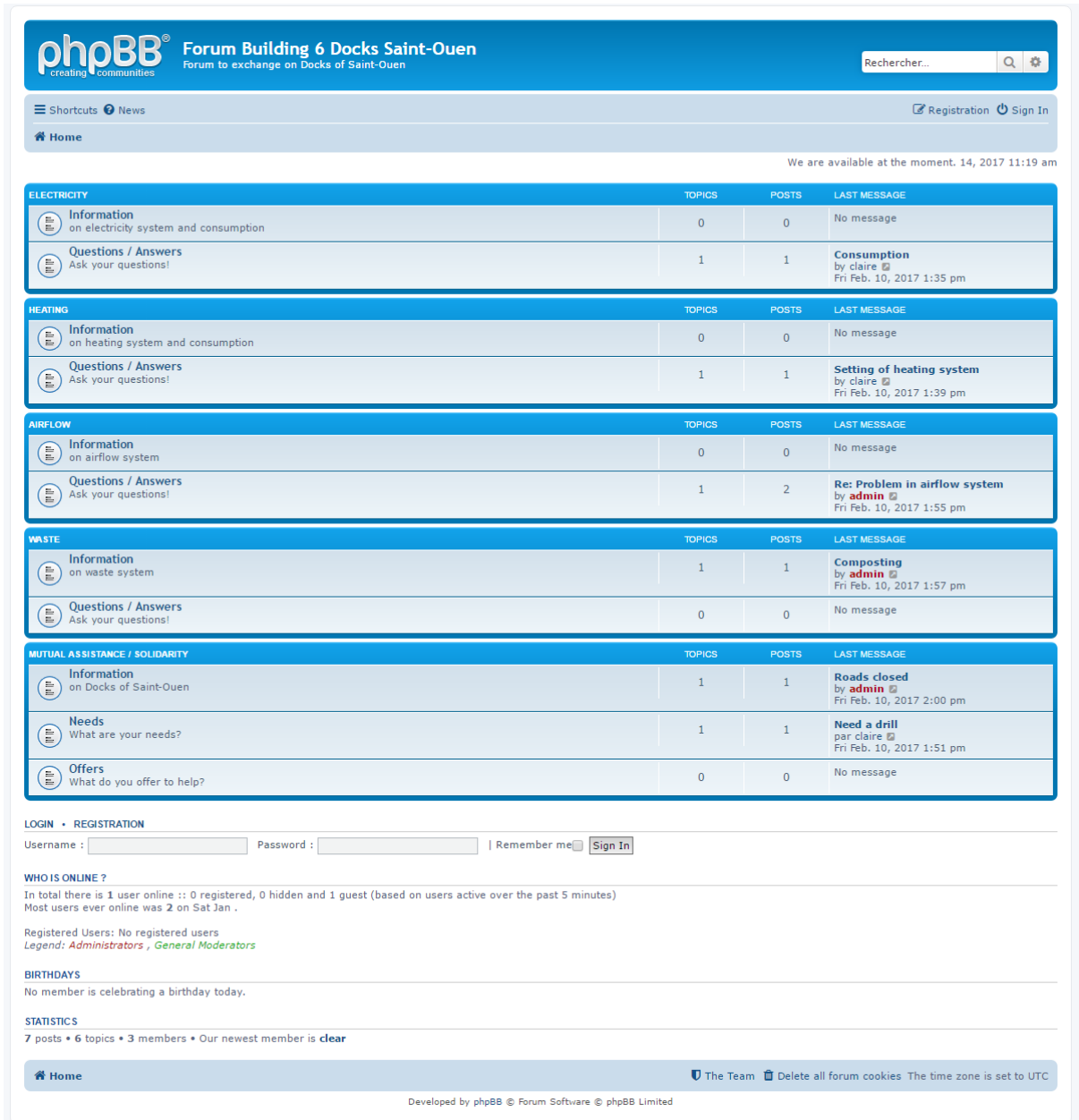

Figure 6. Forum – Integrating DISQUS[6] discussion platform into NUMDocks (Screenshot taken from NUMDocks Web Client developed by TUM)

Of course, there are many other forum templates which are interesting for such a discussion platform. Figure 7 shows another and different layout for the discussion platform designed and provided by Aria Technologies[7]. Similar to the previous example, here for each building one forum is designed and a link is provided. These

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[6] https://disqus.com/
[7] http://www.aria.fr/

links will be presented as an attribute for their corresponding buildings. By clicking on the building and then on the provided hyperlink to the building forum, user will be redirected to the discussion page (see below). In this template, the discussions are divided based on five main topics, each has its own sub-topics.

Figure 7. Forum – Forum Building designed and provided by Aria Technologies.

In order to discover the NUMDocks tool by your own please use the [Demonstration Link⁸](#).

For the latest version of the tool, further information and if there is any problem in using this link please contact any of the members of the development team:

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⁸ This version of the NUMDocks webclient does not include the Forum application. In order to have access to the latest version please contact Mandana Moshrefzadeh.