D5-3 Analysis of services to support decision making

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Introduction

Services and products are an important part of HAQT because they are the means to deliver the benefits of new high resolution data to possible customers and the general public. This report presents examples of applications and products that utilize the HAQT measurement network and the air quality data in order to support authorities as well as citizens in their everyday decisions that will affect their health and well-being.

Most of the services and applications presented here are potential concepts; only the first one, the Helsinki metropolitan area air quality map, is already implemented (Table 1). Thus, the other product descriptions contain many propositions about what the service could include rather than describing an application in detail with fixed properties. The possibilities within the actual products are various: what data to include, how to personalize the application, etc.

While all the services and applications presented here will depend on the new high resolution air quality data and/or forecasts, some of them may require the AQ data to be collected over a longer time period. Also, while the data in a grid point is represented by a single AQ index, a more detailed analysis of the respective concentrations of various pollutants might be needed for some purposes. This information could be made available at some stage.

In addition to the services and applications presented here, making the high-resolution air quality data open for anyone will provide practically limitless possibilities for third parties to make use of the data.

The product concepts have mostly been developed in various occasions during HAQT. In the HAQT kickoff, representatives of companies were met in order to gather information about their needs. There have been stakeholder workshops and meetings where ideas have been discussed. Some of the proposed concepts have come up in earlier projects and have been modified with the new AQ data in mind. One of the concepts was created by interdisciplinary students working under Demola Helsinki.

The product descriptions are divided into three subcategories: the actual description, the review of the intended customer base, and the future prospects and potential of the product.

application/service	status
1. The Helsinki metropolitan area high resolution air quality map	implemented
2. Clean air route planner	concept
3. Bad air quality warning system for risk groups	concept
4. Support for street dust management	concept
5. Regulating the quality of intaken air and optimizing the position of air intakes	concept
6. AQ-optimized outdoor activities for elderly people, children etc.	concept
7. Comparison tool for residential districts based on long-term AQ data	concept

Table 1: Current status of the proposed services.

Application/service 1: The Helsinki metropolitan area high resolution air quality map

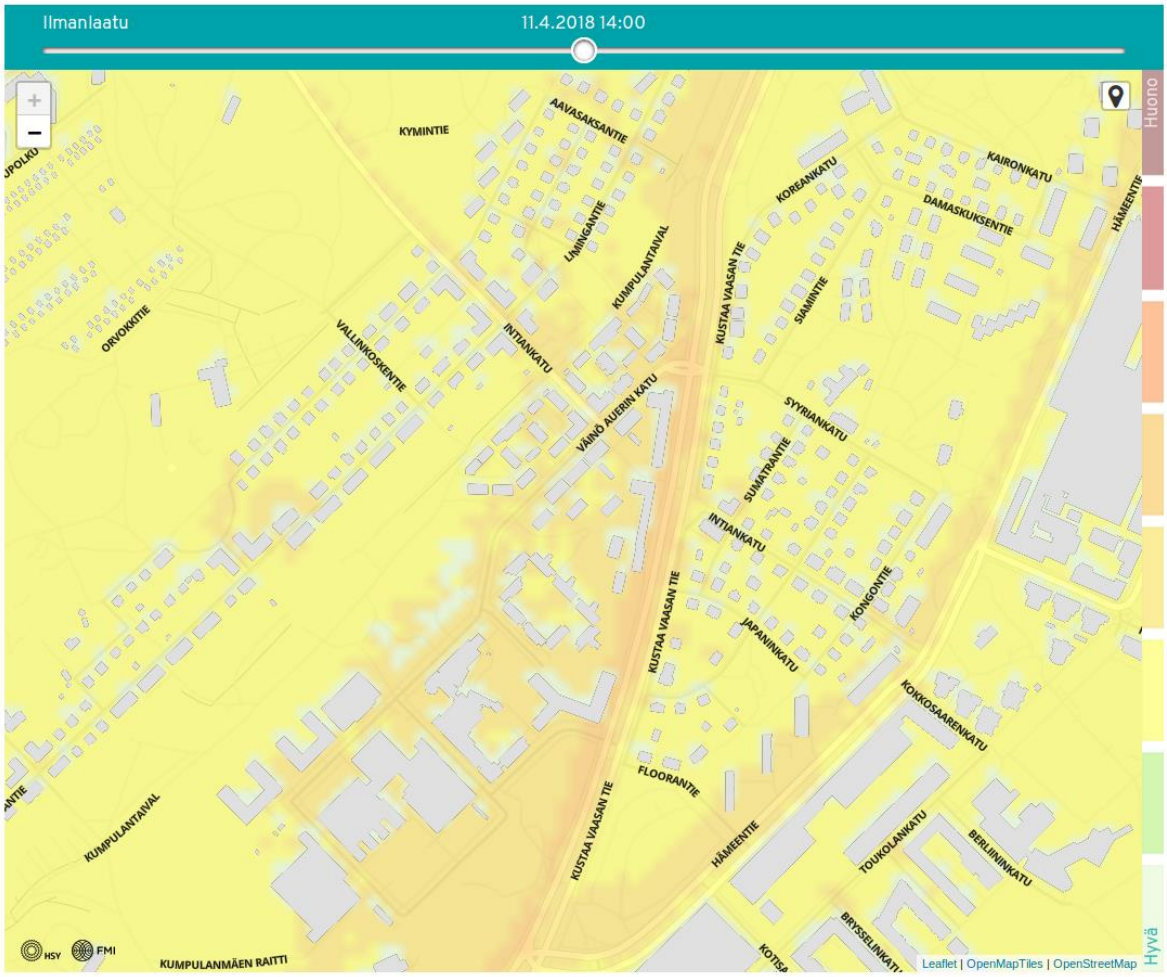

Figure 1. A zoomed view of the air quality map

1.1 Description of the service

The Helsinki metropolitan area high resolution air quality map was launched in February 2018 at the HSY website, ilmanlaatukartta.hsy.fi.

The map (Figure 1) shows localized, up-to-date air quality in the whole Helsinki metropolitan area in a 12 x 12 m resolution, on an hourly basis. The map always opens at the current hour. By moving the white circle in the center of the upper panel, the user can check the hourly air quality by moving 12 hours either backwards or forwards from the current hour.

The user can zoom in and out on the map and look at the air quality in specific locations. By zooming in, buildings come visible. At the zoom level where buildings can be seen, the user can also open a pop-up graph (Figure 2) which shows the air quality 12 hours backwards and forwards from the current hour at the location of the user's choice. The map does not show the air quality inside buildings, however.

The air quality is presented using an air quality index. On the map green colour is good, yellow is satisfactory, orange is fair and red is poor. The colour bar is also shown at the right hand side of the map.

Figure 2. Air quality pop-up graph with information ranging to ±12 hours at a user

The map is based on the ENFUSER modelling (Figure 3), which is developed by the Finnish Meteorological Institute. In the ENFUSER model, the air quality information produced by the measurement network is combined to the factors influencing the local air quality situation, such factors being, among others, weather conditions, geographical features, land use, traffic volume, long-range transportation and emission estimates for wood burning.

In the future the modelling of street dust will be improved by using salting, dusting and road cleaning activity data as well as surface moisture measurements and modelled data. Dust from construction sites is not included in the model because, as of yet, there is not enough source information available on estimating and forecasting of local dust amounts.

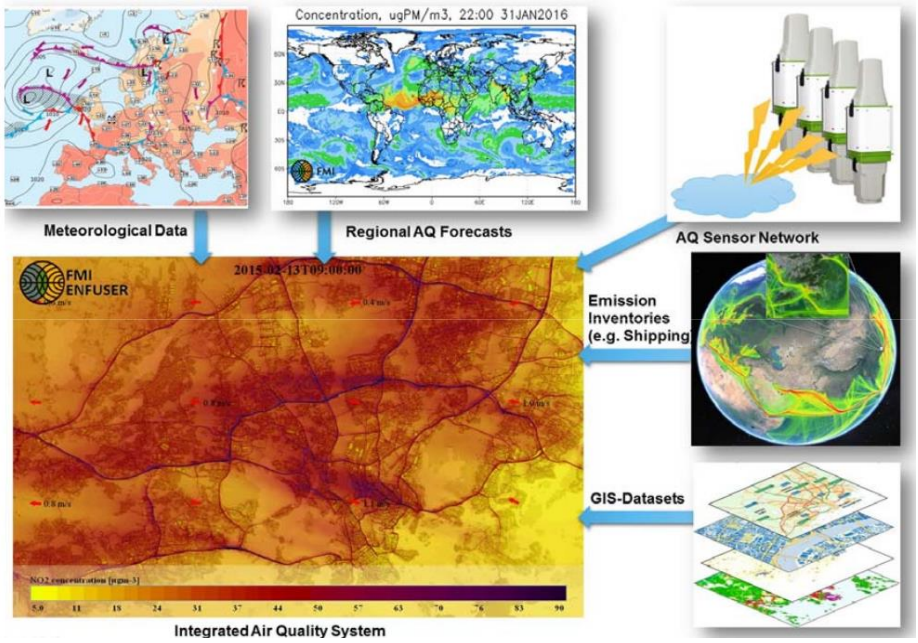

Figure 3. The core components of FMI-ENFUSER modelling system.

1.2 Intended customer base

The map is meant to be used by the general public in everyday situations such as planning their day,

work trips and outside activities as well as getting useful and interesting information about their surroundings and environmental matters. It provides an easy access, e.g. with mobile devices, to information about health risks related to air quality.

For city authorities and environmentally active people, the map serves as an easy way to visualize differences in air quality in different areas and raise questions about possible issues that need to be resolved. It is a good and simple way to raise awareness about air quality. If the data is stored over a longer period of time, time averages of the air quality can be used to support city authorities in decision making. For this purpose also, the map would be a good way to visualize the results.

The use of the map can help citizens take care of their health by avoiding areas with harmful air quality. This concerns especially people with respiratory problems, asthmatic people and so on. Thus, the map can increase the health of the citizens, leading to decreasing costs of public healthcare and raising the level of well-being in the society.

1.3 Assessment of potential

Briefly after the launch, the air quality maps were already showing on info/advertisement screens on the Helsinki Metro and trams. In the future they could possibly be spread in other screens around the city as well.

The map is an obvious possibility for wider use in cities around the world, given that all the information needed for creating it is available. This includes a sensor network as well as emission inventories etc. At the moment, HSY’s AQ map does not include data from HAQT sensors but only from HSY’s own sensor network. However, this might change in the future and it would enhance the skill of the map service.

The service could be developed further by providing not only the colour based on the AQ index but also the concentrations of PM10 and other components. For example, clicking on a certain spot on the map could open a graph that shows the respective concentrations and/or some other more detailed information.

Application/service 2: Clean air route planner

2.1 Description of the service

The clean air route planner is an application that lets the user decide the route they want to take, based on the air quality along given alternative routes. The user inputs the address they are at and the address they want to reach, as well as the means of transport (most probably bicycle or on foot). The route planner, with the help of the hourly AQ data and/or forecast, calculates route-specific exposure estimates and recommends the ”healthiest” alternative.

The application may work as a mobile app as well as a web page. As all sorts of route planners, both mobile and web-based, already exist, the air quality perspective could easily be integrated to an existing application as an additional layer. This way the user can opt to use it to support their decisions, along with the approximated duration of the trip, the length of the route, etc.

For example, in the Helsinki metropolitan area, the leading public transport route planner, www.reittiopas.fi by HSL (Helsinki Region Transport), includes HSL’s own ”city bicycles”. Various map services also provide route planners for walking and cycling.

However, if combined with a public transport route planner, the application could also suggest routes based on the air quality at or near various bus stops and stations. It could suggest the AQ-wise optimal bus stops and stations, even if this makes the walking distance at one or both ends longer. The user could choose which method of optimizing the route they prefer, and the AQ layer could also be turned off if chosen to.

2.2 Intended customer base

The product is aimed at the urban public, primarily for planning their journeys within the city on foot or by bicycle but also by public transport. The choices they make will affect their health in the long run, but also within the actual trip in the case of heavy decrease in local air quality and/or people with asthma or other respiratory illnesses.

For the provider of the service, it gives competitive advantage because urban people are growing more and more interested in air quality issues and their own health.

2.3 Assessment of potential

The basic concept of the product is simple, and it can be utilized anywhere where sufficient air quality data is available. The higher the spatial and time resolution of the data, the better prospects for the product.

The product could also be built into a sports/health/well-being application that gathers the data of routes the user has taken. The user could follow in long term what sort of pollution they have been exposed to and what that means for their health, taking into account their age, weight and other parameters. This would require a more detailed division of the AQ index into respective concentrations of the most important pollutants. The challenge here

would be how to describe the health risks caused by a certain exposure: for example, how many cigarettes would you need to smoke to inhale the same amount of nitrogen oxide as walking from point A to point B? The possibilities of other information that this kind of application could include are virtually limitless – it could be weather reports and forecasts or even news etc. Most obvious target groups for this would be people with respiratory issues and outgoing sportspeople.

Another interesting direction could be gaming: the player of the (mobile) game would try to find the healthiest route to a destination given by the app or chosen by the player. This could work either as ”just a game” on the screen of your smartphone or, more preferably, as a Pokémon Go thing where you actually have to move to reach the destination.

Application/service 3: Bad air quality warning system for risk groups

3.1 Description of the service

The mobile application or messaging service informs the user when the air quality drops below a certain level or is forecast to do so in the coming hours (up to 24 h in advance). The application can be a mobile one, or it can be based on sms, email or some other way of instant messaging that already exists. It will make use of the hourly forecasts made by the ENFUSER model.

The app may work in real time, using the location service of the user’s mobile device and warning the user when the air quality is worsening in the region where they are or even in an area they seem to be entering. Or, the user can input the places where they want the app to monitor the air quality, such as their home, workplace, school, daycare, where their outdoor activities take place and so on.

The settings could be tailored for the user. For example, the notifications could be based on the user’s choice about how bad the AQ must be for them to receive a notification.

3.2 Intended customer base

The product is intended for air quality related risk groups such as athmatics, people with respiratory problems and the elderly. Also, families with children could benefit.

The app would help all risk groups to plan their daily activities based on taking care of their health – stay indoors when the air quality is hazardous for them, select a different path if the one they were planning to use suddenly has a decrease in air quality, or work at home if possible when the air quality near their workplace worsens.

A natural benefiter is the government because the app will reduce health issues of certain risk groups and lead to a decrease in the public health bill.

3.3 Assessment of potential

This sort of services have been tested and implemented earlier in various countries. In principle, it is a very simple service, as long as a provider is found who builds and pays for it.

In Finland, the ”problem” is that the air quality is generally good; there probably would not be many warnings during a year, yet somebody would have to pay for the service anyway. There is not much business potential here, so the most probable way of implementing the service would be through public health organisations etc.

In places with generally bad air quality, the problem turns around: if there is not much variation in AQ, the system will be sending notifications all the time. This would not seem very fruitful either. So, the best conditions for the service would be found in regions where the temporal variability in air quality is large.

Application/service 4: Support for street dust management

4.1 Description of the service

Every spring, cities in Finland need to tackle a certain issue: rapidly increased amount of street dust. Street dust originates from two sources: pavement wear caused by winter tyres, and traction sanding. Both create dust that is deposited on the streets and their surroundings during winter and released in the air in spring when streets melt and dry and passing cars create turbulence.

Opening the AQ data for city authorities can support them in managing situations where urban air quality has decreased or is about to decrease due to street dust. The data, possibly visualized as a map tailored for street dust planning, would show the places where the air quality is forecasted to be the worst. It could emphasize the role of PM10 particles, as street dust mainly falls into that category. (However, that might not be necessary because in certain weather conditions, a predicted decrease in air quality will most likely be caused by street dust anyway.)

The user could insert information about which streets have already been dealt with and which parts of the city will be dealt with next[1]. This would serve as a useful planning tool.

4.2 Intended customer base

This service is intended to support the decision making of city authorities mostly during springtime when snow and ice cover melts and street dust becomes a problem. Depending on weather conditions, however, this sort of situation can emerge in late autumn or early winter as well. The service will help the authorities to plan their actions in order to manage the street dust situations as effectively as possible.

1 Getting this sort of information into ENFUSER would enhance the model’s performance in general.

Regular citizens will also benefit from this service as shortening the period with heavy street dust will make outside air less hazardous for their health.

4.3 Assessment of potential

During HAQT, the data was opened for Helsinki City Construction Services (Stara) who will likely begin to make use of it in the coming street dust seasons. Thus, any results are not available yet. At the moment Stara make their decisions concerning street dust based on data from three measurement stations only. Implementing the HAQT data will enhance their performance.

However, there are several aspects that need to be covered in future development of this sort of service. Mostly, development of the model is needed. Predicting the spreading of street dust has proven to be problematic even if the locations where it is released in the air are well known. In addition, predicting the exact time when the streets will dry and start creating street dust is difficult. This would require even more precise meteorological forecasts. A secondary subject for improvement are the HAQT sensors which could need development to better identify street dust.

Street dust created by pavement wear and traction sanding is a problem in northern countries that have snow cover in wintertime. This will restrict the possibilities of this kind of service globally.

Application/service 5: Regulating the quality of intaken air and optimizing the position of air intakes

5.1 Description of the service

Based on the highly localized air quality data, intake of air in buildings (homes, schools, public buildings, workplaces) can be regulated to optimize the quality of air inside. The regulation can be done manually or automatically. For example, when the quality of surrounding outside air is bad or is forecast to be bad within the coming hours, the ventilation can be turned off. This requires high resolution data and forecasts so that the effects of nearby roads etc. can be taken into account. Also, a possible additional feature of the system is synchronization with traffic cycles.

The actual device that is needed is a smart air intake which is controlled by the information systems of the property maintenance.

Based on data collected over a longer time period, the position of air intakes can be optimized. New intakes can be installed at certain positions within the walls of the building so that the quality of intaken air has the best possible prospects in the long run. This can be applied to new buildings as well as existing buildings.

5.2 Intended customer base

The product is aimed at constructors, property maintenance, city authorities, device manufacturers and the general public.

Many people complain about and get sick from air inside their homes, work places, schools and other buildings. While the building itself may contain sources of harmful matter (mildew etc.), it is worth keeping in mind that ventilation has an important role to play in air quality inside. If the ”fresh” air taken from outside the building is not truly fresh – i.e. the air quality outside is bad –, it may worsen the air quality inside and cause symptoms to residents, workers etc. These people may not realize that the cause of their unwellness lies outside the building, not inside. Applying this service would increase the health of citizens.

For constructors and maintenance, the system provides a tool to make better use of understanding air quality issues.

For city authorities, it provides a tool to help regulate construction. For device manufacturing companies, it is an obvious business opportunity.

5.3 Assessment of potential

This is probably not a cheap solution, which would restrict its usage. Also, the threshold to implement new solutions in existing buildings might be high. Another problem is that when constructing new buildings, there might not be sufficient data available to make this sort of decisions; new buildings affect the way the pollutants are spread, so older high-res data might become obsolete.

Application/service 6: AQ-optimized outdoor activities for elderly people, children etc.

6.1 Description of the service

This application helps the staff in sheltered homes, daycare, hospitals and other health-related institutions to optimize the timing and routing of outdoor activities. The user inputs a time slot, of possibly several hours (e.g. 1 pm to 4 pm when the group has no other activities scheduled), and a route, a certain place or a general area where they want to go. Also, the preferred duration of the walk can be given. Based on local air quality forecasts, the application tells the user what is the best time to go and the best route to take, in terms of air quality and possibly other attributes such as weather.

The product can give the user several alternatives which include information about the concentration of pollutants on the route, the estimated duration of the walk and other important factors to consider, such as height differences. Decisions about the route can then be made taking into account the preferences, features and abilities of the target

group.

The product works best if the AQ data is integrated to information systems of the institution. In this way the preferences can be optimized.

6.2 Intended customer base

The primary target group are elderly people, children and other groups that are vulnerable to bad air quality, including residents of health-related institutions. They will be able to live a healthier life and, in case of the elderly and the ill, maintain their abilities for a longer time.

For daycare centers, sheltered homes and other institutions, the service provides a possibility to develop their daily operations as well as a PR tool and an advantage in marketing: ”live with us and you live longer!”

6.3 Assessment of potential

The service is in principle global, but it makes the biggest differences in places with big temporal/diurnal variability in AQ. If there were no considerable variation, there would be no point in an application like this.

If the same service was made into a mobile application, it would be useful to e.g. sportspeople, joggers or just people who like to go outdoors. It includes an option to customize the background information and preferences of the user or target group so that the wanted factors will be stressed accordingly when calculating the optimized route and time. The amount of factors that can be taken into account are virtually limitless.

Application/service 7: Comparison tool for residential districts based on long-term AQ data

7.1 Description of the service

This web page / application provides the user with the opportunity to compare the long term air quality of different residential areas. It is basically a map that shows the air quality in a chosen location and compares it with another location – or puts given locations in the right order based on long term averages of air quality.

The user can choose to compare e.g. residential house areas in the desired region, or terraced house areas or apartment house areas, respectively. This can support their decision about where to live, where to buy a house – or possibly where to put their children to school or daycare.

The user can choose the time period of which they want to see the averages; it could be around the year, or a certain month – in case the knowledge of e.g. street dust situations is

most important to the user. They can even opt to look at AQ averages during the afternoon on weekdays, when commution peaks decrease the air quality.

Other useful information could be included, such as nearby sources of pollution, like construction sites, roads with heavy traffic, factories etc, as well as known future projects that are likely to have an effect on air quality. This should work in retrospective also – to explain why the AQ averages have e.g. increased during the last couple of years in a certain area. Also, noise from traffic and construction sites etc. can become an issue in some residential areas. Information about sources of noise could be included in the same way as about sources of pollution.

Other useful information could include climatology; mean temperatures and amounts of rainfall can vary slightly in nearby regions depending on e.g. landform.

7.2 Intended customer base

For real estate agencies, the product could be a valuable asset for marketing the properties they are selling – at least when they are selling in places with good air quality compared to other nearby areas. Generally, providing this information to their customers would be a commercial advantage.

Citizens could use the product when searching for a place to live. They might get new ideas by browsing with the application or making specified search requests. Choosing a healthy place to live will of course benefit them in the long run.

City authorities may also be interested in this kind of product because it enables them to use long term air quality data in city planning. They can easily see where measures need to be taken in order to increase the local air quality.

Entrepreneurs, such as restaurant keepers, and institutions like daycare centers etc. could also use it in marketing, given that the air quality at their premises is better than average.

7.3 Assessment of potential

The data needs to be gathered over a long period of time for this service to work. Practically at least one year is needed.

However, as urban environments are constantly changing, the average local air quality will probably change too depending on what is built in nearby areas, how traffic changes etc. This will in some cases make it difficult to construct a representative long time average. This sort of issues need to be taken into account when creating the application.