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Case Studies Involving the Use of Personal Data in a Smart City

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Abstract

This chapter, first, provides examples of how the evolving technologies, which enable the safe and secure sharing of personal data, under their own control and for re-numeration or altruistic purposes and with whom they choose, have been demonstrated. They range from usage in smart city environments through to that in an energy company and in the health arena.

And, second, it attempts to illustrate how these technologies and applications can be used to augment and give added value to those examples of the general usage of data within a smart city. We have tried to show that by safely adding the personal data coming from citizens, we can also improve the original scenarios described and augment them in a positive way.

It is not in any way attempting to be a definitive guide but merely to show what is possible and worth further investigation.

4.1 MIWenergia in the DataVaults Project

MIWenergia is an SME electricity retailer founded in Murcia, Spain. It operates in Spain nationwide with a varied range of customers: residential, industries, small and medium enterprises, and large tertiary buildings.

Providing service to more than 3000 customers with an annual energy transit of 100 GWh, MIWenergia offers clients additional services related to energy efficiency such as energy consulting and audits, design and installation of photovoltaic systems for self-consumption, electric vehicle charging stations, and energy monitoring.

The first step of all methodologies used to provide the previously mentioned services is collecting the needed data to be processed. Some data are public and others are technical ones and are indeed in the hand of the service provider, but the most important data are only known and owned by the user, such as the history of electricity consumption, number of inhabitants in the house, or the building orientation.

There are currently payment platforms for third-party access to electricity consumption data. These platforms provide monthly aggregated data per supply point; so the information is not very detailed, being almost useless for the design of a photovoltaic system or the energy prediction. A platform like DataVaults, where all the user-generated data is provided to the platform by the data owner, can give access to all the companies interested in those data, connecting the data processors, distribution system operators, or electricity retailers, and letting other energy entities use that detailed information about electricity consumption with the user's permission. MIWenergia considers a platform for accessing data like DataVaults needed due to the low quality of the platforms and data that are available now. Furthermore, the company only has access to the data of their customers; DataVaults gives the opportunity of having the data of all the platform users. MIWenergia will utilise DataVaults, to try and acquire such data directly from customers that are willing to share those, towards providing better services to them.

The role of MIWenergia in the DataVaults project is double: first, MIWenergia acts as a data provider, helping to connect the platform with their database of hourly energy consumption. Second, MIWenergia act as data seeker, testing the usability of the platform related to developing new energy services or designing better-targeted marketing campaigns.

As data providers, the data owners registered in the DataVaults personal app can share their energy consumption data with the data seekers through the MIWenergia connector. The connector accesses the MIWenergia server and collects the data. The data is collected once a week and the time interval of the data is 1 hour. The MIWenergia connector can obtain the data of our clients automatically. The client only needs to introduce her MIWenergia credentials when connecting the energy consumption source. However, if they are not our direct clients, they will need to give us permission to access their energy consumption data. With their consent, we can provide the energy consumption data of all Spanish supply points.

As data seekers, MIWenergia (or any energy services provider) can be interested in obtaining the energy consumption profiles of non-clients through the DataVaults platform in order to offer new and innovative services and targeted marketing campaigns. Within the DataVaults project, we are testing three different cases of study towards this objective.

The main goal of the first scenario is to improve the design process of a PV system for self-consumption. Normally, when designing a PV system, the companies do not have access to the energy consumption profile of the clients. In this way, the companies design the PV system based only on total consumption data, provided by the client, and then estimate the hourly consumption profile and the potential for self-consumption. Having the real historical hourly energy demand "automatically", it is possible to make more precise calculations about the percentage of self-consumption and the optimum size of the PV system. For the optimisation of this design, the DataVaults platform can be very useful, as the clients can easily share their energy consumption profile. In addition, on the same platform and at the same time, they can provide other useful information such as the location and orientation of their dwelling, available space, type of roof, etc. In this way, the process of designing the PV system is simplified and efficient.

The second case of study is related to making energy consumption classification for dwellings and sending tips to the platform users to improve their energy efficiency. When a data owner shares with the data seeker their consumption data, MIWenergia can use this information to calculate some energy-related indicators and classify their dwelling in terms of energy efficiency. In this way, MIWenergia can send them suggestions about measures and energy efficiency tips that they can follow to reduce their energy consumption and their electricity bills. At the same time, this information can be useful for the company to have the profile of the "worst" dwellings in terms of energy efficiency to design specialised energy efficiency services specifically to these sectors or profiles.

Finally, the last scenario to test is related to the demand prediction and the interests, hobbies, and habits of the customers. Having the energy consumption profile, we can predict some habits of the consumers and design targeted marketing campaigns for energy services specifically to them. For example, if we found that customers under 30 years consume more energy on the weekends, then the company would be able to design a cheaper electricity tariff in this period and a marketing campaign oriented to this profile to engage them. In addition, other companies not energy-related can also design marketing campaigns in this way. For example, if we detected families with children reduce their energy consumption on Friday nights, then a restaurant would be interested in designing a special offer for this day to these kinds of families (assuming they leave the house for leisure). Energy consumption profiling can be very useful for many marketing applications.

These scenarios are closely related to increasing the consumption from renewable sources and improving energy efficiency; so the private sector can contribute to the European goal of net-zero emissions cities. However, we need to consider that energy consumption data has much more possibilities to be used to achieve this goal and public institutions and councils can take advantage of all this information for designing smart and carbon net-zero cities. In the following sections and based on existing projects, we are going to propose some other applications in which DataVaults can be useful for the cities to access energy consumption data and add value to smart and carbon net-zero cities.

This experience can provide added value to many of the examples of current usage of data set out above in Chapter 3. For example, that of *Eilat, Israel* (Section 3.15): designing PV installations. Eilat's smart city team has developed in collaboration with the chief scientist of the Ministry of Energy, and a local startup, "Solview", a unique one-stop-shop platform for solar PV installation. It gives each house owner a rooftop view of a financial prediction of solar PV installation. The data includes calculating the potential surface, expenses, ROI of future electricity production, finding suppliers, and funding opportunities.

The DataVaults platform can collaborate with "Solview" to provide energy consumption data of the citizens which helps to optimise the designing process of a PV solar system in a similar way to the MIWenergia first case of study.

Another example of how improvements can occur by providing access to a citizen's personal data can be seen with Glasgow's "*Creating energy maps*" (Section 3.20). The city of Glasgow has created the "smart open data decision platform & central management system". This solution includes

the creation of a query-based geo-spatial "data-based decision platform" (DBDP) that will collect data related to city management (e.g., energy, air quality, traffic flow, etc.) and provide analysis of multiple datasets to enhance strategic planning in the city (including energy planning). The Glasgow City Council will utilise the existing open data platform and build DBDP around the existing ICT infrastructure.

The DataVaults platform can contribute to the DBDP by providing any personal data from citizens willing to share it. In the case of energy planning, users of the DataVaults platform can provide the energy consumption of their dwellings. This information can be useful for creating an "energy map" of the city, based on the demand of the citizens. In this way, knowing where and how much energy is being consumed in a city, the council can design specific actions for these places in which there is more energy consumption.

For example, if in a specific neighbourhood there is high consumption at midday, the council can plan to install a PV system nearby in a public space and create an energy community. People (and companies) can be interested in being part of the energy community and reducing their energy consumption in an easy way and with less investment than having their own PV system (only paying a fee for being part of the community). DataVaults can act as the platform in which citizens share their energy consumption to create the energy map and, at the same time, can be used by the council to ask for the interest of being part of energy communities when designing it. Besides, the process to apply for being part of the energy communities can be integrated into the DataVaults platform.

Similarly, advantages can be foreseen for the *Trikala, "Creating a "storage map" of a city*" (Section 3 4) application. Trikala was a demonstration site for the EU ELVITEN project – electrified L-category vehicles integrated into transport and electricity networks. All trip data of the end-users (citizens and professionals) using EL-Vs (light electric vehicles) in Trikala were collected from the project's Fleet Management Platform. All these anonymised trip data were transferred to the municipality's open data platform in order to be available to companies, organisations, universities, and cities that are planning to implement mobility projects in the near future. The types of data that were utilised included the following: trip data of electric vehicle users, vehicle speed, location data, trip times, battery level, and energy consumption.

The ELVITEN project is focused on the mobility part of the EV, but electric vehicles are also batteries that can be seen as a potential resource of the electricity grids. In this way, councils can be interested in creating a real-time "storage map" of the city. In conjunction with the information already registered by the ELTVITEN project, information on batteries

already available (not only batteries from EV but also other "steady" batteries from dwellings or industries) and electricity consumption from the citizens can be shared through the DataVaults platform. All this data can be used to improve energy efficiency and manage the variability of renewable resources. A practical example can be a citizen who has an electric car with a battery of 60 kWh. The citizen has a work schedule from 8 am to 3 pm and, during this time, his car is parked nearby his workplace. He needs the car to go back to his home at 3 pm, which is 20 km far; so he needs enough battery at 3 pm for this trip. During the rest of the hours, the battery can be connected to the grid and be manageable as the council (or distribution system operators (DSO)/ transmission system operators (TSO) wishes to increase the energy efficiency of the grid. DataVaults can be the platform in which people can register for these demand response actions (so they can say that they are willing to participate) and share the necessary information, or give the necessary permissions, to access their data in exchange for some incentives from the council or DSO/TSO (that act as data seeker). All the batteries can be aggregated and managed in a more efficient way than with the conventional individual use of the citizens.

Improving the performance of the electricity grid and the integration of renewable resources with demand response actions through batteries in Trikala will contribute to achieving their goal of net-zero emissions.

Further, a contribution could be foreseen to the *Rotterdam, "Integrating energy and storage maps"* (Section 3.8) initiative.

One objective of RUGGEDISED is to transform large districts or buildings into low carbon and resource-efficient districts through smart interaction and integration of energy systems at the district level. This requires smart management or infrastructures for electricity, heat, and cold as well as smart solutions for local energy production, storage, and exchange of energy. A representation of available open data of the district will be visualised on an open 3D platform, making it possible to monitor and communicate different information (starting with the energy performance of buildings) and enabling endless applications and scalable to the digital city level. This solution will complement the R8 "energy management system". Data on the energy use of the buildings, provided by the energy management system, will be matched and transferred into a new 3D city operations platform that will be developed.

The DataVaults platform can complement the open 3D platform for Rotterdam, helping to create the energy and storage maps that have already been described for the previous cities (Glasgow and Trikala). Citizens from Rotterdam registered in DataVaults can share their consumption data and the information about their PV systems, batteries, and/or electric vehicles in order

to integrate energy and storage maps in the RUGGEDISED 3D platform. They can also apply for being included in demand response programmes. In this way, all the energy services available in the city can be managed in an aggregated way, increasing their performance and reducing the emissions of the city.

And similar benefits might be created with additions to Umeå's "Smart Demand Management" (Section 3.5). The DataVaults platform can complement the work done in Umeå within the RUGGEDISED project, helping to create the energy and storage maps that have already been described for the previous cities (Eilat, Glasgow, and Trikala). Citizens registered in DataVaults can share their consumption data and the information about their PV systems, batteries, and/or electric vehicles in order to integrate energy and storage maps in the RUGGEDISED open platform. They can also apply through DataVaults for being included in demand response or demand side management programs or other new business models based on sharing and or storing the surplus of renewable energy. In this way, all the energy services available in the city can be managed in an aggregated way, increasing their performance and reducing the emissions of the city. The information about electric vehicles can also be useful for planning new charging stations to support sustainable mobility.

A further example of how utilising a citizen's personal data can contribute to *carbon-neutral cities* is in the example where a city is encouraging citizens to change their behaviour. In many cities, it is very common for municipalities and councils to offer grants for energy efficiency measures, such as changing lighting fixtures or photovoltaic systems. Normally, it is tedious to apply for them; so people end up not asking for them or having many problems in the process. In addition, justifying that efficiency measures have had a real impact could be difficult as the municipality does not have easy access to real energy consumption data of the citizens. The DataVaults platform can be required by the administration to make a simplified application. In this way, public entities would have access to real data verified by a platform, and the client would have easier access to subsidy management. In addition, in some places, it is compulsory to have an energy efficiency certificate of the dwelling to ask for grants or for selling a house. Councils can manage all the processes of this certificate (or other energy-related certificates) through the DataVaults platform, reducing the time and efforts spent by the council and by the citizen, as the energy consumption data and the rest of the information needed can be shared at once through the platform.

Energy consumption data in dwellings can be used to know if everything is okay in a house. By predicting energy consumption and monitoring it in real time, we can compare and analyse the deviations. These deviations

can be signals of something "not normal" happening. For example, in the PHARAON (H2020 project),[1] MIWenergia is monitoring with IoT devices the energy consumption (and other parameters) of older people who live alone to detect if something wrong is happening to react faster to potential health problems. For example, if the citizen's energy consumption is always increasing from 11 am to 1 pm because the person is preparing lunch and one day there is not any increase, an alert is shown, and they need to push a button in the app to check-in that they are okay. The DataVaults platform can be used in order to reduce the number of monitoring devices needed, as you can easily share the health and energy information with the public services in the same environment. The citizens can apply through the platform for being included in the monitoring programs from the health institutions. At the same time, the health institutions can use DataVaults to reach the potential patients to be included in the program.

4.2 Prato's Usage of a Citizen's Personal Data

Smart cities are now adopting many technological solutions able to ingest and manage a large variety of data, ranging from geographic to urban, statistical, climate, and so on, according to the big data paradigm which is able to provide different and complementary data insights to support effective planning solutions.

On the other hand, this framework is somehow missing the adoption of citizens as data source, able to provide their personal data as an additional asset to improve the public administration's knowledge on the city context. Whenever personal data is required in the planning activity, the city administration needs to turn to third parties, such as ICT operators or social networks, to pay large sums to obtain what its own citizens are generating, even without them being aware of it and getting no advantage for their contribution. The city of Prato is very interested in exploiting the opportunity of directly interacting with citizens to get their personal data in a safe, secure, and privacy-respectful way and even to provide them a reward: this will help the administration to strengthen the relationship with citizens and to reduce costs for data acquisition. The participation in the DataVaults project has been a strong incentive to such approach and three different scenarios have been conceived to foster the integration of citizens' personal data in the information framework managed by the city.

[1] "PHArA-ON - Pilots for Healthy and Active Ageing in Europe." https://www.pharaon.eu/ (accessed Jul. 25, 2022).

The first scenario is related with mobility: through the DataVaults tools, citizens will be able both to share their location and mobility preferences to augment the provision of answers to specific questionnaires sent by the administration, by getting a compensation for their data. This will enrich the information framework and improve the planning capability of the Mobility Office in the city. The possibility offered by DataVaults to get personal data (including answers to questionnaires and surveys) tuned on mobility behaviours will improve the analysis of local mobility also on the basis of short-term evolutions. In addition, this will also improve the quality of surveys and questionnaires, due to the possibility of building citizens' samples that are more coherent with planning objectives. Eventually, the DataVaults approach allows to lighten the administrative burden in managing the users' privacy since the data remains always in the full possession of individuals who are free to decide if and how to share it. On the other hand, the implementation of compensation schemas will facilitate the building of a trust and valuable relationship with data owners that will encourage them to share their personal data and participate in questionnaires and surveys pushed through the DataVaults platform.

The second scenario deals with culture: the city museums will benefit from citizens sharing data on their cultural interests, location, and participation in cultural events, to improve marketing activity and better target it on specific user categories. The DataVaults platform can be used by cultural institutions for marketing surveys and loyalty campaigns for users of cultural services, identifying samples of individuals to whom they can send information material and ask for feedbacks, also including the provision of benefits (remuneration), such as example discounts, free tickets, etc. In addition, cultural institutions can use the DataVaults platform to collect information on people's cultural consumption and build more effective questionnaires and surveys to be pushed through the platform. Individuals will be able to share answers and feedbacks according to the data sharing and compensation procedures implemented by DataVaults and this will hopefully increase the number of replies obtained by the cultural institution. Eventually, the DataVaults approach will allow the lightening of the administrative burden to manage privacy issues in the relationships with data owners, since data always remains in the full possession of the individuals.

In addition, a third scenario has been identified, related with the sharing of personal certificates for fiscal services. In the current approach, whenever requiring a fiscal service from some third party, a citizen has to procure some civil certificate in advance, by either going to the City Registry Office in person or getting it using the online service. In both cases, this represents a

burden, and, moreover, the city administration becomes aware of the reason why the certificate is requested since the citizen has to declare it (at least to a broad extent) and this is not exactly in line with the GDPR prescription.

The automatic, authorised, and regular downloading by third parties of shared personal certificates, made possible by the DataVaults tools, will reduce burdens for citizens and interested data seekers. In addition, although the certificates are always produced by the administration, the document exchange is carried out in a totally transparent and privacy-based way without the administration being aware of it, thus making the whole process more compliant with the GDPR legislation.

The application scenarios hypothesized in the DataVaults project can offer advantages in the development of many smart city applications, taking into account the fact that DataVaults offers citizens the possibility to maintain full control of their data and to be compensated for the data made available.

For example, if we consider the theme of digital twins experienced by the region of *Flanders* (Section 3.1), the city of *Pilsen* (Section 3.2), the city of *Athens* (Section 3.9), and other administrations such as *Rotterdam* (Section 3.8), this can be effectively integrated with the approach proposed by DataVaults, as it is possible to hypothesize different types of data provided directly by citizens, which can enrich the information framework managed through the digital twin application. Such data may concern, for example:

- habits related to city mobility (recurring routes, means of transport used, places of interest frequented, etc.);
- environmental data collected through specific devices worn by citizens (for example, temperature, air quality, humidity, environmental noise level, etc.);
- cultural interests (events attended, exhibitions visited, museums, etc.);
- recreational and sporting activities.

Such data can be integrated with data coming from GIS, satellite, local sensors, and other sources in order to improve the quality of the digital city model. But citizens will remain fully in possession of such data, as they can decide how and to what extent they wish to make it available, besides getting rewarded for it.

The data referring to habits related to mobility can of course also be useful for enriching specific projects in this sector, such as the one on electric vehicles developed by the city of *Trikala* (Section 3.4) in Greece. In this regard, for example, the tools offered by DataVaults can be used to administer specific questionnaires to collect feedback on the experiments carried out,

allowing the citizens who respond to obtain compensation for their support, when providing additional personal data.

Similar considerations can be applied to the experience carried out by the city of Florence: the administration is currently using a wide range of data source to improve decision-making on mobility, and the connection of the IF App to the data sharing model managed by DataVaults could even more stimulate citizens to use the app, since they could get a compensation for the data they share. In addition, specific questionnaire could be pushed to users who could even get rewarded for their replies. The same approach could also improve the policies on tourism currently adopted by the city of Florence, by helping to build more targeted services on the basis of personal cultural interests.

The scenario hypothesised by the municipality of Prato relating to the use of DataVaults tools for sharing personal certificates with third parties can be effectively generalised in all situations in which there is a need to make certifications of various types accessible to third parties that may require them. Citizens can then personally manage their certificates, professional qualifications, and other personal documents, freely deciding which types of subjects to share them with and possibly also obtaining a fee for this.

Finally, the methods of supplying questionnaires managed by the DataVaults tools can be of great use in many applications related to the development of the smart city, where it is necessary to involve citizens in requesting specific information for the creation of certain smart applications or services. Through the DataVaults tools, the administration can design specific questionnaires and deliver them to all citizens or only to specific categories, according to specific requirements, also associating compensation for those who decide to contribute to the survey. Citizens will receive the request to answer the questionnaire through the DataVaults app and will be able to freely decide whether to do so or not, obtaining the established remuneration if they decide positively to share their personal data.

This approach makes it possible to enhance the contribution of citizens, who will thus be able to feel more involved in the planning of urban services; this will improve the ability of the administration to design services and applications for the smart city on the basis of up-to-date information and to implement more effective planning actions.

The major challenge that cities are now facing is probably climate emergency: Prato is also one of the "100 Climate-neutral Cities by 2030 – by and for the Citizens", selected by the European Commission to showcase systemic transformation towards climate neutrality. This is a key commitment for the administration and citizens have a fundamental role to tackle climate

emergency; their involvement and contribution is necessary to build really effective policies to mitigate climate change effects.

The tools provided by the DataVaults project can support city administrations to improve their planning capabilities by, for example, using citizens as "gauges" to detect environmental data (air quality, pollution concentration, etc.) through either apps on their smartphone or wearable devices. Collected data will be accessed in a safe and privacy-respectful way and citizens will be encouraged to contribute by getting compensated for the data they provide. The "by and for the Citizens" motto of the 100 climate-neutral cities can then be fully exploited as one of the main pillars in the development of the smart city.

Digital twins exist as being a digital real-time representation of the physical world. DataVaults can provide access to additional data that is shared that has not been gathered in the digital twin – this can enrich what the digital twin already provides – the use and benefit of this would then be articulated in a tangible smart-city context. DataVaults can provide further insights (through a persona) using data available to DataVaults (or other sources in theory) and those personas can be used alongside digital twins again to enrich the information available to decision-makers, planners, service providers, etc., and again this benefit would have to be articulated in a smart-city context.

4.3 Piraeus's Use of Personal Data

The city of Piraeus has made several steps in the past five years towards becoming an intelligent city. As part of a larger integrated territorial investment program, the amount of approximately 6M€ was directed solely to digital actions. The aim was to make the city more attractive both to citizens and visitors, offering amongst others novel ICT services. Through this funding opportunity and based on the municipality's digital strategy, several areas of interest were touched, as cultural heritage (portal and digitisation of the city's records, library and art gallery), the city's operation monitoring (platform), information gathering through IoT sensors (climate, pollution, waste, energy, illegal parking, air quality, and more), and the destination management system (DMS platform) for tourism. More specifically for the DMS and the city's operation monitoring platform, as the main tools used by the decision-makers in the municipal authority, the amount and quality of information gathered is the crucial element of their success, as the decisions of the city planners are going to be only as good as the information they were based on.

Through DataVaults, the municipality of Piraeus aspires to renovate the way it collects, manages, and analyses the aforementioned information,

combining the existing information with citizen's/visitors' personal data and embracing novel engagement practices. The DataVaults app will allow citizens, tourists, and targeted stakeholders to provide more and richer data to the city, entailing more personalised services, always in a trusted and secure manner, respecting their privacy. The data that the municipality aims to access through the DataVaults platform, in combination with existing data, will allow the city to build better analytic reports and identify solutions that could help the local economy, strengthen retail services, improve mobility, promote the local cultural heritage, and meet the touristic engagement goals of the recently established destination management organisation (DMO).

Three different scenarios have been identified and pursued as part of the municipality's participation in the DataVaults project. For each one, we will try to explain the reasoning behind our choice and present the problem and the respective DataVaults solution.

Smart mobility services for individuals:
Piraeus is one of the largest Greek urban centres and one of the most important European ports. In Piraeus, as part of the Athenian urban complex, there are plenty of transportation means in service, i.e., buses, trolleys, suburban railway, tram, train, and underground metro while it is also connected to the central railway network of the country. The combination of sea and ground transport makes Piraeus one of the largest mobility hubs in Greece.

Given the heavy traffic in the city's main road network (40,350 daily movements) and the city characteristics, a major challenge for the local authorities is to take decisions and have accurate information regarding urban mobility. In this context, the municipality of Piraeus is currently finalising its sustainable urban mobility plan (SUMP) and aims, as a next step, to take action within the city in order to reduce traffic, promote public transport, improve air quality, reduce road accidents and safety risks, improve conditions for cyclists and pedestrians, improve mobility for persons with disabilities, and encourage e-mobility.

In the direction of informed decision-making regarding mobility, a small-scale pilot regarding the mobility plan in times of events around Karaiskaki and Peace and Friendship (SEF) Stadiums and the Olympiacos home football and basketball grounds, respectively, is foreseen through the use of personal information gathered from the DataVaults personal data marketplace.

The scenario engages both Olympiacos as a partner in the DataVaults project and the municipality of Piraeus, in order to acquire data shared by the interested citizens, as well as by the Olympiacos members. These data include location (point of origin, route, parking spot, etc.), access time,

parking time, and type of transport (bus, train, car, etc.), when someone is accessing the sport venues at the time of an event. The information gathered, along with information already available to the city planners (Municipal Police Department and Programming and Development Department), can then be effectively used to better schedule the mobility strategy and the relevant services around the area of interest.

Empowering local entrepreneurship:
Piraeus is an international cruise centre (over 12 million travellers in 2018) and the link of mainland Greece with the islands of the Aegean Sea and a main commercial hub connecting Europe, Asia, and Africa, providing services to ships and cargo of any type and size, while offering unique advantages because of its strategic position and infrastructure. The high number or travellers, either cruise passengers or commuters to the Greek islands, makes tourism a key factor for the local economy.

The municipality of Piraeus, through the destination management organisation (DMO), aspires to form a concrete plan to engage travellers with the local market. The actions considered include discounts and offerings from the local shop owners in agreement with the Local Traders Association, open markets, festivals (e.g., Piraeus Sea Days), promotion of the local cuisine, and more. The objectives are to (a) motivate cruise passengers to disembark and experience the city and (b) engage commuters with the Piraeus market and local entertainment facilities. DataVaults personal data marketplace offers an invaluable and otherwise unavailable amount of information aiming in the decision-making process. Users will be requested to share their consumer behaviour and preferences, in exchange for discounts on tickets for municipal entertainment venues, or even on specific local shops. Types of data requested from citizens and visitors include commercial preferences and needs, arrival and departure information (for tourists and visitors), location information (routes), and frequency of coming to the city of Piraeus (visitors and commuters). The aforementioned approach provides a dual benefit on the local economy as, on one hand, it helps gather the necessary information and, on the other, it initiates through the compensation mechanism and engagement between the visitors and the local market.

A secondary objective of this scenario is to also invite local entrepreneurship associations (i.e., the Piraeus Traders Association) and other interested stakeholders to join the platform either directly as data seekers or acting as second-tier data seekers, to test aspects of value generation and sharing with entities not directly using personal data but that access the derivatives of the latter.

The "empowering local entrepreneurship" scenario also aligns with the on-going activities of the municipality about the city's Open Trade Centre, associated with the improvement of the local economy through restructuring of the market infrastructures and the deployment of smart applications.

Services for personalised cultural and touristic experiences:
In the city of Piraeus, it is evident that the city has a lot to offer in a variety of areas, such as cultural heritage, entertainment, gastronomy, history, music, and sports. The "services for personalised cultural and touristic experiences" scenario aims to tailor people to the offered experiences. The municipality of Piraeus through the destination management organisation (DMO) once again aims to form a strategy in order to promote the experiences Piraeus has to offer, through actions and events within the city. The Sea Days festival held every year between the end of May and early June hosts more than 100 different events, targeting locals and tourists of different age and interests. The overall strategy and the Sea Days program are planned according to the existing information and previous experience. DataVaults can be an additional source of information, where personal cultural and touristic preferences are shared in exchange for discounts on municipal cultural venues. This information can assist the decision-making process since the DMO gets to know the city's audience and receives invaluable feedback on the events happening in Piraeus. Users will be requested to share their cultural, entertainment, and food preferences, arrival and departure information (for tourists and visitors), location information (routes), and frequency of coming to the city of Piraeus (visitors and commuters). The aforementioned approach provides a dual benefit for the city as, on one hand, it helps gather the necessary information and, on the other, it initiates through the compensation mechanism and engagement between the tourists and the municipal cultural venues. This approach provides a dual benefit also for the user as, besides the compensation scheme, the user may receive suggestions from the DMO for a personalised cultural and touristic experience in the city of Piraeus, based on his individual profile.

4.4 Olimpiacos: Interaction with the Fan-Base

In this scenario, fans and members of the club are encouraged to collect their personal data, understand what it comprises, and manage and share them through the DataVaults platform. For the fans and members, awareness on how the type and quantity of personal data relates to compensation offered from the club shall encourage the former to push forward sharing and keeping this data up to date.

For the club, this will help build a stronger relationship and interaction with the fans and members and understand their needs and offer better services, as well as incentives to share more of their personal data. The club will also be able to respond to the requests that may come from different organisations, such as sponsors, NGOs, sports federations, local authorities, etc., who want to run a campaign or host an event for the club members, fans, and athletes and to find new sponsors and partnerships.

The main goal of this scenario is to collect information related to social media activity and the preferences and likes of individuals who are already fans and members of the club. A secondary goal would be to collect location data related to the position of the individual, for example, if they were present at the stadium during the time the club's team is playing. Collecting and analysing such data could assist the club to combine personal data already existing in its systems with social media and location activity in order to engage and interact better with the fans and members. Further, such information could help reorganise the marketing plan (new market segmentation, marketing campaigns for specific target groups, finding specific sponsors, etc.), attract new sponsors based on personas (collective profiles) extracted from DataVaults, improve the services offered to the fans and members, and, finally, increase the revenues and online presence of the club.

All this, in a transparent exchange between the individual and the club, respecting and enhancing the privacy of individuals and directly compensating those who wish to be part of this incentive.[2]

During the final phase of the project's development, there is sufficient data in the DataVaults cloud platform to elaborate the personas (collective profiles) of, for example, the average season fan or the high-income fan who attends the most prestigious matches. Then, during this phase, the club enables the compensation mechanisms (e.g., in the format of perks) for the members and fans who take part in the initiative. Finally, during this phase, other data seekers will be invited to get on-board; a prominent example of this could be club sponsors who are interested to search through the personal and online activity data of members and fans of the club, in order to offer better customised and targeted products and services. The objectives being:

- to make the branded version of the DataVaults personal app available to a larger group (e.g., upload it to the prominent online app stores or directly invite individuals);

[2] "DataVaults. D6.2-Pilot Scenarios and Implementation Plan," *DataVaults Consortium*. https://www.datavaults.eu/wp-content/uploads/2021/07/DataVaults-D6.2-Pilot-Scenarios-and-Implementation-Plan-v1.00.pdf (accessed Jul. 25, 2022).

- to acquire advanced analytics from the DataVaults cloud platform;
- to have stakeholders from the club inspect the proposed personas from the DataVaults cloud platform and verify their accuracy using their experience;
- to activate the sharing compensation mechanisms and link it with perks for sharing data from the DataVaults app;
- invite club sponsors to use the DataVaults cloud platform as a data seeker.

4.5 Olimpiacos: Athletes Sports and Activity Data Sharing

The second application for Olimpiacos is in relation to their athletes' sports and activity data sharing. The club has 18 different sport departments at the competitive level and the academies which comprise a large base of 2000 professional and young athletes including important contact and medical details. In this scenario, athletes of the club are encouraged to share their personal data, athletic activity data, and ergometric and medical examination data through the DataVaults platform.

For the athletes, awareness on the type and quantity of personal data, athletic activity data, and ergometric and medical examination data belonging to one individual combined with the offering of the appropriate medical and sport equipment by the club and coupled with incentives offered from data seekers to share such data with the platform shall encourage the athletes to share not only already collected but also future athletic activity and medical data.

For the club, this will help with the better management of the sport departments, the planning of the training sections and team tactics, the opportunity to know what specific physical skills are needed when looking into players' transfers, and finally to cover the athletes' expectations by offering the appropriate medical and sport equipment.

The main goal of this scenario is to collect especially athletic activity data and ergometric and medical examination data of athletes who already belong to the club. Collecting and analysing such data could assist the club since the current portal, on the one hand, includes name, surname, address, telephone number, e-mail, date of joining the club, sports (e.g., tennis, sailing, etc.), and on the other hand, it does not allow the entry of more complicated data such as the results of the ergometric and medical examinations. The athlete's base should be also complemented by statistical reports regarding the performance of the athletes in training and during the matches. In those

areas, DataVaults could cover the club's need for accessing more complicated information and offering better analytics. All this, in a transparent exchange between the athlete and the club, respecting and enhancing the privacy of individuals. The objectives include:

- making the branded version of the DataVaults personal app available to everyone;
- acquire analytics from the DataVaults cloud platform;
- use DataVaults cloud platform as the main channel to collect athletic activity and ergometric and medical examination data from the athletes who take part in the initiative;
- invite club sponsors to use the DataVaults cloud platform as a data seeker.

The final phases include the introduction of the App to the club's athlete's community and increasing the amount of data available, covering athletic activity and ergometric and medical examination data from the athletes. Other data seekers are on-board; a prominent example of this could be athletic equipment companies who are interested to search through the athletic activity data of athletes of the club, in order to offer better customised and targeted products and services (e.g., depending on what sport each athlete does).

The types of compensation considered in return for the personal data being made available include:

- bonuses (discount coupons) on new official shirts of the multisport club;
- benefits directly related to the activities of the sponsors;
- discount coupons from our club and from other partners.

The expected impact for Olimpiacos from this demonstrator is to be seen in the following areas:

- Effective management of members' and fans' data: Olympiacos has a large base of members and fans which requires a better data management including collection, mining processing, security, and cryptography. It is very important for the club to secure the personal data protection in the best way to ensure the trust of the individuals.
- As the club develops a large range of innovative and high-quality marketing campaigns, it should emphasise on the collection of valuable insights without violating privacy principles. This database is also

beneficial for the planning and the implementation of segmented and targeted marketing campaigns, the improvement of fan engagement, and finding sponsors. For the club, it would be extremely beneficial to collect information such as user preferences, activity, and mobility data in the future and focus on the real preferences of the members and fans and improve the services and the fan engagement to ensure their loyalty.

- Number of registered club members: Olimpiacos SFP has a large base of 130,000 registered members and 60,000 registered fans. This base is growing rapidly which makes the club the largest sport one in Greece and one of the most popular worldwide. Using the customer relationship management system, the club has built a strong relationship with the member–fan base which seems to be an important issue for the sport successes.
- The data included in the base of members are compulsory to organise and coordinate procedures such as the organisation and the participation of the members in the club General Assembly and the right to vote in the administrative elections and take part in the decision-making.
- Along with the number of active club members and those who have participated in the club's advertised activities and the number of active fans in the club's activities: the number of fans who have followed the club's games in more than one sports department. This base and the satisfaction of fans are very important issues for the club as they are the most important source of revenues.
- Effective management of over 2000 athletes' sports and activity data: Olympiacos has a large base of athletes which requires a better data management including collection, mining processing, security, and cryptography.
- The athletes' base requires better management of the results of the ergometric and medical examinations and statistical reports regarding their performances in the training and the matches. This base also includes personal information, demographics, personal governmental data, and sport exercise/activity one. Better management is very crucial for the club to adapt and plan the training sections and the team tactics, make players' transfers with specific physical skills, and cover the athletes' expectations offering the appropriate medical and sport equipment.
- Revenue from sponsorships: the club organises meetings with the sponsors on a regular basis to discuss the progress of the sponsorship deals

and control the sponsor satisfaction. These meetings could include a presentation of the platform and its utility to motivate the sponsors to join it.

- Stakeholder trust: the club will encourage the members, fans, and athletes to capture, witness, and manage their personal data through this platform and undertake the decision to share them, responding to the requests that may come from different organisations. The club will make clear that the platform ensures the data protection following modern encryption techniques to guarantee privacy and total information security. The club will inform the stakeholders about the possibilities that the platform offers such as full or partial data completeness, encrypted or unencrypted data security, data privacy, etc.

The Olimpiacos use of a citizen's personal data can be shown as adding value to the practical uses of data outlined in Chapter 3, where they reflect tackling issues around mobility. For example, through their relationship with their fan base, travelling arrangements for when the supporters are attending the stadium can be shared with *Piraeus municipality* (Section 3.12) to help their strategic planning, particularly on match days. The immediate outcome of this interaction will result in a decrease in the time required to reach the sports venue and for those travelling by car, a decrease in the time it takes to park in the vicinity of the stadium.

Similar synergies occur with the Tampere (Section 3.6) example described in that chapter. Utilising smart technology (sensors, data analytics, and situation-awareness tools) enables the city to integrate big event areas in the city centre with the surrounding city infrastructure and to support collaboration between event organisers, safety authorities, and third-party actors.

The main sources of data come from city cameras collecting video footage from the city centre. The footage is streamed on a real-time basis to Insta Blue Aware (IBA) situation awareness platform. IBA is a web-based tool providing a joint view to safety authorities, event organisers and event safety services, representatives of other safety operators, as well as to the city safety management team. Based on the information provided by the camera stream, all actors safeguarding event safety and security can create operating models or act accordingly.

By enhancing the supply of data by including citizen's personal data, the result would be better support for collaboration between authorities and non-authorities and for building and sharing of the "big picture" and situation awareness.

With regard to the application concerning the personal data of the athletes at Olimpiacos, it is an answer to a controversy in the world of football in the UK. Hundreds of footballers have threatened legal action against the data collection industry, which could change how information is handled. 850 players want compensation for the trading of their performance data over the past six years. They also want an annual fee from the companies for any future use. "Letters before action" have been sent to 17 big firms, alleging data misuse. While receiving a fee for the use of their data might not have much impact on the high earners of the Premier League, it is felt strongly that those lower down the pyramid, in both the men's and women's game, would see tangible benefits. Russell Slade, a group leader, pointed out that "On one player, and I'm not talking about a Premier League player or even a Championship player, there was some 7,000 pieces of information on that one individual player at a lower league football club".

"There are companies that are taking that data and processing that data without the individual consent of that player". He drew into question other sports' similar behaviour. "A big part of our journey has been looking at that ecosystem and plotting out where that data starts, who's processing it, where it finishes and that's a real global thing. It's making football - and all sports - aware of the implications and what needs to change".[3]

This is in stark contrast to the approach being taken by Olimpiacos.

4.6 Andaman7 Health Application

Andaman7 is a patient-centric mobile tool for collaborative management of medical records between health professionals, patients, authorised relatives of such patients (parents or spouse, for example) and connected devices. Exchange and synchronisation of information are peer-to-peer, based on original concepts maximising security and confidentiality.

With the Andaman7 app, patients can:

- feed their medical records by importing health data: the platform captures data from electronic medical records, sensors, wearable, and quality of life questionnaire data.
- access their data in a structured, secure, and standardised way and consult them anytime, anywhere;

[3] "Professional footballers threaten data firms with GDPR legal action - BBC News." https://www.bbc.com/news/uk-wales-58873132 (accessed Jul. 25, 2022).

- share their file with authorised third parties: general practitioners, specialists, or family members.

It is more than "a simple mobile app". It is an advanced health IT software combining mobile applications, server processing, smart peers, and a full HIP – health interoperability platform – for the easy and efficient distribution of data, while preserving the privacy of patients and the security of the overall system.

The solution touches on a universal problem: human health and our business model are based on a wide distribution of the application in "Freemium". As such, revenues come from paid advertising and add-ons (including clinical studies apps).

The application is currently well differentiated and complementary to existing solutions and not a competing solution to electronic health records. There are more than 22.000 users registered on the Andaman7 platform coming from 35 countries. The platform is available in 22 languages, and 80% of the users are from Europe. Andaman7 is also connected to some hospitals, laboratories, and pharmaceutical companies to either send personal data to the patient or gather information from them (as in clinical trials).

In the DataVaults project, current users of Andaman7 will be able to connect to DataVaults to store all or part of their health data. This storage can be used as a backup to retrieve data when lost. This can also be used by third parties in the health sector (e.g., clinical trial, research, etc.).

The main objective for Andaman7 is to improve the general attractiveness of the application for both users and partners and thus increase the number of users and the number of services being provided by the integration of new features and creating new partnerships. This entailed developing the backup of Andaman7 content through the DataVaults platform as this is a sought-after feature by a lot of users to increase confidence towards the application and especially the storage of their data.

And, second, to develop and run a fictitious clinical study to show the potential of the DataVaults platform associated with Andaman7 and communicate to potential partners about the results. This will be measured through analytics tools integrated in the Andaman7 platform. As the project matured, the final phase for the clinical trial was based on the retrieval of such data and what we can get from the platform to help running real clinical trials and/or improve health in general. The intention is to exploit as much as possible all features provided by the DataVaults platform to provide meaningful data to clinical users, document them, analyse the results, and present it to potential data seekers. This entails the following:

- retrieval of clinical study data from a data seeker perspective with compensations mechanism with analytics and statistics data retrieved;

- documentation of results obtained from this demonstration study;
- presentation of the solution and obtained results to Andaman7 partners for on-boarding.

A second scenario related to data collection whilst improving Andaman 7. Current users of Andaman7 will be able to connect to DataVaults to collect their data (coming from various sources) and store them in Andaman7 on their smartphone. This will make the data available to patients for reviewing, learning, and using in other setups (e.g., share additional data with their doctors, hospital, etc.). Data will mostly be raw personal data but also aggregated data (e.g., result of a clinical trial, comparison to a specific group, etc.). Further objectives were added; of increasing the number of supported data types by 20%, of increasing the quantity of data available in each category and/or also increasing the number of categories.

The interest of the final user is the main goal here as getting more meaningful data from various sources to complete their record should attract more users. To achieve those goals, in this scenario, we will:

- complete the health record of patients with health data available on the DataVaults platform;
- compute some statistics based on data of the patient or other users of the DataVaults and integrate them in the health record of patients as indication to bring some intelligence to the storage of data.

This will be measured through analytics tools integrated in Andaman7.

This final phase will bring more value to the users by trying to match them with people with similarities in their medical profile, retrieve statistics/analytics data from this community, and display it to the user so that he can compare his results to others. The identification of data that will be retrieved and displayed can be sensitive as it should not be considered as medical advice. This requires:

- identification of criteria to find people that have similarities in their medical records and corresponding statistics/analytics data that could be interesting;
- development of connectors to retrieve statistics/analytics data from people that have similarities;
- retrieval, conversion, and insertion of data into Andaman7 smartphone app.

In the medical field, data seekers place great emphasis on the amount of collected data, the quality of data, and the persona of the data owner. Through the

DataVaults platform, they will be able to find and gather data more easily – data from a specific target group while reducing R&D costs. As all pieces of data are stored in the same place, they can get a huge amount of data (raw or computed) easily. Quality can also be easily checked because the owner of the data is known and can be verified by the platform.

Chapter 8 further discusses the Andaman7 involvement in this area, with a discussion of the InteropEHRate project and interoperability within the health sector.

4.7 Smart City Graz

The My Smart City Graz district is located in the vicinity of the Helmut-List-Halle. This former industrial area is located right in the centre of Graz west of the Graz main train station. The former commercial area is an important building land reserve that is being developed into a sustainable place to live and work with a high quality of life. The aim is a sustainable energy supply and resource conservation at all levels. In addition, new living space and a high-quality public space are to be created. It combines New European Bauhaus ideas with smart city progress.

At the heart of this initiative is the "Science Tower", which is a 60-m-high research tower to be erected north of the Helmut-List-Halle. The tower is an energy self-sufficient building that will house offices for Graz-based companies from the "Green Sciences" sector. The area above the offices is designed as a roof garden, with a meeting room in the middle. A roof garden was created on the upper floor.

This 60-m-high tower is located north of the Helmut-List-Halle and not only houses science and research but is itself also a research object for new building technologies. Up to the 12th floor, there are offices (approximately 44-m high), in which primarily Graz companies from the "Green Sciences" sector are rented. Together with the surrounding companies and universities, they form a "science cluster" – i.e., a combination of know-how, technologies, and ideas for an ecological and sustainable future. The area above the offices was designed as a roof garden where fruit and vegetables are grown.

Regarding the use of personal data, these companies and universities within this science cluster will be able to utilise the work of the KRAKEN project.[4] The KRAKEN project application provides an exemplar of how

[4] "Health pilot - Kraken." https://www.krakenh2020.eu/sites/kraken/files/public/content-files/2020/Kraken%20rollup-pilots.pdf (accessed Jul. 25, 2022).

personal data can enhance operations within this smart tower. The Technical University of Graz has led the development of the KRAKEN application which helps to release personal data for value creating use within the academic sphere.

Data from academic students (e.g., graduation certificates, course grades, enrolment status, etc.) is protected with privacy-preserving cryptography, authenticated using self-sovereign identity solutions, and shared in a marketplace. This is of benefit to students, recruiters, universities, and for companies in the following ways.

- For students: sharing selected academic data for job applications.
- For recruiters: identifying the top job candidates by analysing student datasets.
- For universities: exchanging students' data while ensuring their privacy.
- For companies: finding new talent more easily through greater access to student data.