

TRANSLATIONAL ARTICLE

# The value of network data confirmed by the Covid-19 epidemic and its expanded usages

Pascal Chambreuil\*, Ju Y. Jeon  and Thierry Barba

Orange Group, Orange Business Services Paris, France

\*Corresponding author. E-mail: [pascal.chambreuil@orange.com](mailto:pascal.chambreuil@orange.com)

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## Abstract

Data driven analysis is proven to create a competitive advantage to business. Governments and nonprofit organizations also turn to Big Data to harness its benefits and use it for social good. Among different types of data sources, location data collected from mobile networks is especially valuable for its representativeness, real-time observation, and versatility. There is a distinction between mobile positioning data (MPD) generated by the exchanges between mobile devices and the core network; versus over-the-top or system-level location data collecting individual GPS location. MPD is composed of all mobile network events regardless of the mobile phone brand, operating system, app usage, frequency bands or mobile generation; it is uniform and ubiquitous. Getting the best out of MPD relies on the knowledge of how to create an advanced algorithm for homogeneously processing this massive, complex data into insightful indicators. Anonymized and aggregated MPD enables the testing of multiple combinations with other data sources, fully abiding by GDPR, to arrive at innovative solutions. These unique insights can help tackle societal challenges (the state of mobile data for social good June 2017 GSMA, UN Global pulse). It can help to establish accurate statistics about population movements, density, location, social patterns, finances, and ambient environmental conditions. This article demonstrates how MPD has been used to help combat Covid-19 in Europe, the Middle East, and Africa. Furthermore, depending on the future direction, MPD and data analysis can serve powering economic development as well as working toward the Sustainable Development Goals, whilst respecting data privacy.

## Policy Significance Statement

Any treatment of personal data should have a clear purpose and be accomplished within a framework of respect for privacy. The Orange solution is fully compliant with EU and French regulations, and the current deployments in Africa also meet these requirements. Mobile operators' insights are well suited to support health and epidemic control services. A dedicated body should be responsible for gathering and processing population movement data, in liaison with health authorities, academics, or local public organizations.

## 1. Introduction: Big Data at Orange

The strategic mission of Orange is to improve the daily lives of customers and to deliver a user-friendly digital service with a purpose. Mobile signaling data have already proven their potential in different fields

(de Montjoye et al., 2013), especially in the study of human mobility (Huang et al., 2018) and road traffic (Caceres et al., 2008).

Orange takes seriously its role and responsibilities with regard to the data generated by their 266 million customers worldwide as one of the major telecommunication operators in Europe. A fundamental rule of Orange mobile big data analytics is to set up a vision governing how to responsibly harness this data. Driving the whole data process by privacy, respect, and ethical rules is one major axiom that guides the Orange data development strategy. To assess internal data, looking for new opportunities for additional value creation is the best way to capitalize on Orange's knowhow. This data also provides opportunities for different actors and sectors to incubate multiple data testing beds. Exploring more ideas reveals more about the potential for mobile data. In this article, we focus on the ability of data from mobile services to understand population behaviors and patterns of communication, to create a ground-truth dataset to support observation of Covid-19, and eventually to develop a predictive model.<sup>1</sup> The large volume of mobile data can be transformed into smart data with AI—and with a human centered vision,<sup>2</sup> can become “data for good.”

This article focuses on the use of mobile data to combat against Covid-19.

Orange has collaborated closely with health and medical research institutes in France (INSERM<sup>3</sup>) since March 2020 to assess the value of the service to help predict the spread of epidemics. The goal of this collaboration is to create a tool for predicting the spread of epidemic diseases such as Ebola within a country, based on mobility data extracted from Orange mobile networks. The principle is simple: movement flows between geographical areas are measured and epidemiological models are applied to test and to deduce, from various results, how contagious the virus is. This can be used to help forecast how the disease will spread across an area, facilitating better decision-making around health measures.

## 2. Flux Vision: Orange's In-House Data Analytics Solution

Since 2015, Orange has been providing statistical population movement analyses in the form of statistic indicators to help businesses or institutions to better understand their customers and to improve services to citizens. Owners of retail malls, festival organizers, tourism, or civil boards are keen to gain insights about where their customers come from and go to, when and where services are used, and which types of visitor attend a concert or enjoy natural parks. These analytics are also useful for construction sites, city transport organizations and for planning smart cities. Visualizing traffic and population movement helps to identify the best locations to build new supermarkets or hospitals, or plan new public infrastructure while assessing impacts on people's daily lives or businesses. Flux Vision is the name of the data analytics solution set up to create these insights, and also the business unit that handles it. Flux Vision is managed by Orange Business Services.

Orange Flux Vision fully respects privacy and abides by GDPR and e-privacy. The information provided as output is in the form of population statistics, fully anonymized and aggregated. The Flux Vision solution guarantees that individuals cannot be traced nor identified, even via reverse engineering and even during data processing. Flux Vision serves many customers in many markets in Europe and Africa where Orange operates mobile services (Flux Vision, <https://www.orange-business.com/en/products/flux-vision>).

Orange adapted the Flux Vision data production tool and accelerated the collaboration with its partners. The principle of Flux Vision is to count the mobile phones present in each area during a 1-hr timespan. The network event data set used to conduct this simple count is processed on the fly and immediately deleted. Flux Vision only retains a completely anonymized set of statistical data. Standard statistical adjustments, including an extrapolation process to obtain representative population figures, is executed based on observations made about Orange network users over the whole of France (both

<sup>1</sup> Consumer intelligence, by Mobilewalla/March, 2020.

<sup>2</sup> Mapping trajectories and flows: facilitating a human-centered approach to movement data analytics.

<sup>3</sup> Institut National de la Santé et de la Recherche Médicale is the French National Institute of Health and Medical Research.

French residents and international visitors). The indicators are calculated every day based on the 24 million users of the Orange mobile network. This includes consumer and business customers, as well as international visitors moving around France and temporarily using the networks via roaming agreements. This continuous, whole-country observation is carried out based on INSEE<sup>4</sup> breakdowns into administrative areas of around 50,000 people, and assembled in compliance with personal data regulation.

An analytical dashboard serves to monitor the mobility parameters and zoom in on regions of interest based on various levels of geographical granularity, from districts to departments.

It is essential that the inputs and outputs of the data analysis are aligned with the needs of frontline actors as accurately as possible. To ensure their relevance, the indicators brought together for the health crisis were defined in collaboration with professionals, including INSERM for health; INSEE for the distribution of the population, a prefecture, AP-HP (Assistance Publique Hôpitaux de Paris), and so forth.

Orange decided not to make its Flux Vision mobility data available to the public, and instead concentrated more efforts on addressing the needs of national and international institutions in order to maximize the benefit.

### 3. Experience in France and Europe

The announcement of the lockdown in France in response to Covid-19 triggered mass movements of people. This redistribution of population, and the unprecedented circumstances, gave rise to several unique problems for the authorities.

The first need was to reassess the population per geographical area. This was essential to more effectively size the healthcare system and determine the necessary supplies of essential equipment and consumables.

The second, ongoing need was to check the effects of the lockdown measures per geographical area. There are several important questions that can help to characterize the impact of lockdown and thus improve planning and policy-making. For example, what proportion of the population is mobile? For how long? Does the lockdown have similar effects in different geographical areas? Based on these indicators, it is possible to estimate several significant economic effects, such as the level of remote working, or employee mobility in areas with high levels of production or agricultural industries.

Early epidemiological models used air transport data to assess human mobility, which limited the predictions to very large cities. Orange's first work on Covid-19 together with INSERM was based on air transport data, and resulted in the publication in the journal *The Lancet* of a research article on the potential spread of coronavirus in Africa<sup>5</sup> ("Preparedness and vulnerability of African countries against importations of Covid-19: a modelling study"). Armed with the mobility indicators produced by Orange, the collaboration between Orange and INSERM aimed to improve this epidemic spread model by making it far more detailed, down to the level of geographical areas covering 50,000 people. This improvement in the epidemiological forecasting enabled strategic adaptations in response to anticipated developments in the disease.

The collaboration with INSERM resulted in the publication of three reports that contributed to decision-making by the French government. The first report was published on March 14, on the probable impact of the first national lockdown on the regions, particularly with the closure of schools and remote work ("Expected impact of school closure and telework to mitigate Covid-19 epidemic in France"); the second was on May 6, on the impact of various lockdown scenarios, also connected with the school situation and developments in remote work ("Expected impact of reopening schools after lockdown on Covid-19 epidemic in Île-de-France"); and the third was on May 19, a summary report on the reduction of mobility in France during the first lockdown ("Covid-2019 pandemic assessment").

<sup>4</sup> Institut National de la Statistique et des Etudes Economiques, <https://www.insee.fr/fr/information/2017499>

<sup>5</sup> Population mobility reductions during Covid-19 epidemic in France under lockdown report 11 (Pullano et al., 2020).

The near real-time data that Orange supplied through the Flux Vision analytics platform supplemented INSEE's statistical mechanisms. On April 8, INSEE published a demographic study on the first lockdown based on Orange data ("Population present on national territory before and after the start of the lockdown—Initial results").

In collaboration with INRIA, AP-HP also used Orange's assessment of population mobility before, during and after the lockdown to better anticipate excess activity in hospitals. Meanwhile, the Île-de-France Regional Health Authority used the data provided by Orange to determine areas with the highest levels of movement in order to focus epidemiological tests.

To achieve more "real-time" capability, the national gendarmerie drew on mobility data to detect road traffic congestion during the lockdown (data provided with a 30-min delay) and the Île-de-France region to measure ridership in metro stations (data updated every 15 min).

In parallel with action taken in France, Orange along with all major mobile operators agreed to provide data from affiliate countries to support the European Commission's initiatives through the JRC (Joint Research Center). Orange was the first European telecom operator to provide data from France, then Slovakia and Romania, which enabled the JRC to publish its first report based on Orange's data ("On the Role of Mobile Positioning Data Derived Mobility to Explain the Initial Spread of Covid-19: a Case Study, European Commission, Joint Research Centre," May 15, 2020).

The health crisis has strengthened many actors' perception of the value of mobility data from operators, in Orange's case through Flux Vision. To respond to the requests linked to this episode, the Flux Vision indicators were adapted in the space of a few days. The operating model was also adapted, to enable daily deliveries as often as every 15 min for a set of points of interest such as metro stations.

The experience of this crisis shows how important it is for telecom operators to make preparations to provide relevant mobility data before it is required to respond to an emergency. Ideally operators should seek to increase the number of countries covered, and to diversify mobility indicators generated in order to reach new sectors of activities (health, logistics, etc.) in addition to traditional customers such as tourism and retail business.

#### **4. Experience in Middle East and Africa**

Flux Vision was deployed in four new countries in MEA area, providing access to fully compliant anonymization methods, statistical indicator creation capabilities and advanced visualization methods.

Orange's regional activities in the Middle East and Africa are handled by a separate business entity, OMEA (Orange Middle East and Africa). In mid-March 2020, some OMEA countries' governments such as The Democratic Republic Congo, Burkina Faso, Morocco and Sierra-Leone asked for support to provide population behavioral data to help control Covid-19. One challenge was to rapidly establish a way of working that brought together expertise from national and international organizations, and from the public and private sectors—including health authorities, NGOs, UN agencies, data specialists, and mobile network operators.

Orange data specialists provided guidance to local operations in these countries and leveraged GSMA's support and influence to create a multidisciplinary project team. As a result Flux Vision could then deliver tailored analyses to health authorities and dedicated NGOs to enable pandemic modeling efforts.

##### **4.1. DRC: Leveraging GSMA and an initial project with the UN/World Food Program**

Orange and GSMA were planning to hold a major seminar in Kinshasa (DRC) in March 2020 when the Covid-19 pandemic struck. A virtual event took place instead to help DRC State and health authorities, the regulator, the UN and other NGOs to consider the use of mobile data and the benefit of such assets to monitor the emerging pandemic. The DRC vice-minister for health led the discussion and welcomed the strong engagement of Orange. The Flux Vision solution was ready to be launched in less than 3 months

thanks to preparation already in place with the UN WFP to improve the delivery of food during the Ebola crisis.

Flux Vision delivered data in mid-April and at the end of May 2020. A “control room” was set up by the DRC authorities to manage activities around the pandemic response. Orange was an active member, continuing to provide mobility indicators until the end of December 2020. These data services were offered free of charge to the DRC with the national Orange operating company donating data and central Orange Business Services (OBS) contributing analysis and visualization through its Flux Vision platform.

With the support of GSMA Orange committed to involve local resources to process the statistics provided by Orange and delivered valuable insights to health authorities. Orange DRC worked closely with a technology company, Kinshasa Digital, whose role was to create a web-based dashboard with data visualization to be used by government agencies and health authorities.

Meanwhile the GSMA with the support of Orange helped to organize the local ecosystem, clarifying options and roles to realize valuable analytics to help control the pandemic. DRC is a very good example of combined GSMA-Orange efforts to discuss, collaborate and provide data in an open and synergistic way.

#### ***4.2. Learnings from DRC and other countries in the Orange footprint unfamiliar with applying MBD analysis in decision-making***

The experience was not quite the same in all countries.

Some countries lack the capabilities and resources to utilize mobile big data. Groundwork was needed to prepare governments to harness this versatile new source of data and insight. Three major aspects need to be tackled to ensure that these initiatives are successful.

In countries with the lowest maturity in their data ecosystems, we faced a lack of understanding of the possibilities of mobile big data. In such countries it was first necessary to raise awareness of the power of mobile data and analytics among local stakeholders. To address this Orange and the GSMA conducted educational workshops and multistakeholder meetings. Orange Flux Vision’s documentation and resources explaining how the platform works. This sort of capacity building effort is an essential precursor to mobile big data projects, engaging the consumers of insights in the process and allowing them to shape the application and delivery to maximize utility.

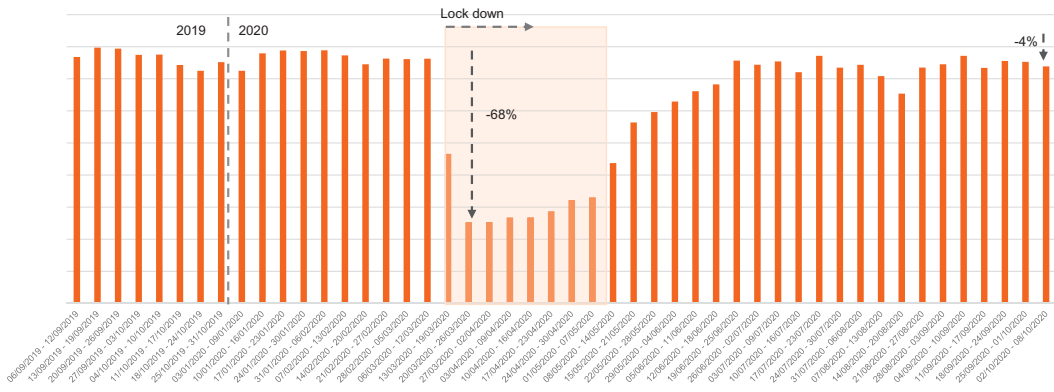
Second, following on from developing an understanding on the demand side, in order to make a long-term contribution to a sustainable ecosystem it is also vitally important to enhance the technical skills of local stakeholders on the supply side. Engaging local companies and contractors and providing assistance with the data analytics, visualization, and interpretation of outputs will help to create a healthy and productive market for data-drive insights.

Third, it is crucial to adopt best-practice in data privacy and governance from the outset—including accountability in the use of data, processes for data privacy and governance, and identification and mitigation of risks associated with handling customer data. This has been particularly significant given the urgency of the Covid-19 response and the lack of existing legal and regulatory frameworks in many LMICs.

### **5. Global Learnings: How to Serve the Anonymized Mobility Data in a Quick Service Mode to Support Crisis Management in Europe and Africa**

Once Orange group made the decision to provide mobility data to different crisis taskforce institutions in France and in other Orange countries, Orange Flux Vision adapted production to provide the necessary mobility analytics quickly for France and the European Union (JRC) in the first delivery. The required data provision to support the response to the crisis was classified as urgent and prioritized above planned deliveries from the second day after the decision was made in France (Figure 1, France movement evolution), and all other deliveries followed. Whilst facilitating the rapid provision of mobility and attendance information was important, protecting the privacy of each Orange customer was a key objective.

Weekly movement data of micro zoning and with an immobility time > 1h  
 ⇒ Impact confinement : 2/3 fewer movements  
 ⇒ Still slightly withdrawn on the beginning of October from a normal situation



**Figure 1.** Movement evolution in France. Data from weekly movements in microzones (1,400 zones), grouping municipalities of France metropolitan over the whole of France and with a mobility time > 1h. In late February, the number of journeys was reduced by more than two thirds and remained lower through to the beginning of October. Copyright: Orange. This figure has been reproduced with the permission of the copyright holder, and is not included in the Creative Commons license applied to this article.

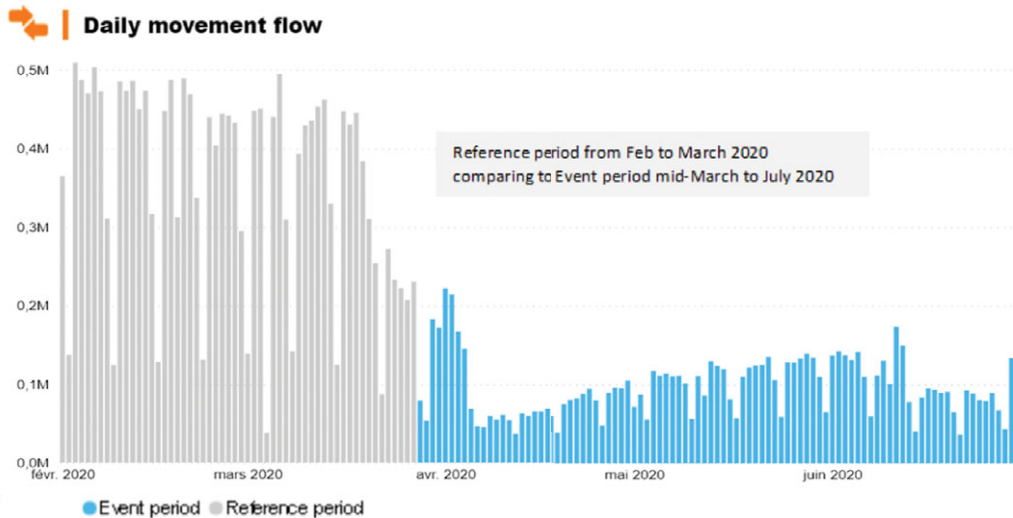
The demand from different entities involved in Covid-19 crisis management varies from one sector to another based upon their objectives, upon the situation on the ground, and upon the actions that they plan to carry out. Orange Flux Vision qualified each demand and then interpreted this into a mobility data vision. This exercise consists of enabling the technical production team to adapt the outputs to meet the application and to help the recipient to understand what kind of data would be available. This enables the end user to quickly assess data as soon as it is available, and arrive at the right decisions and actions without losing time.

In Spain and Belgium, national taskforces were combining anonymized and aggregated data from Orange with other operators' inputs to perform national observation. These initiatives allowed collaborating institutions and governments to experiment with mobility data indicators and insights and improve their understanding of the data and its potential applications. As a result, the Spanish government has started to push the data to their regions and inspired them to use more data in their decision-making and evaluation of the impact of Covid-19.

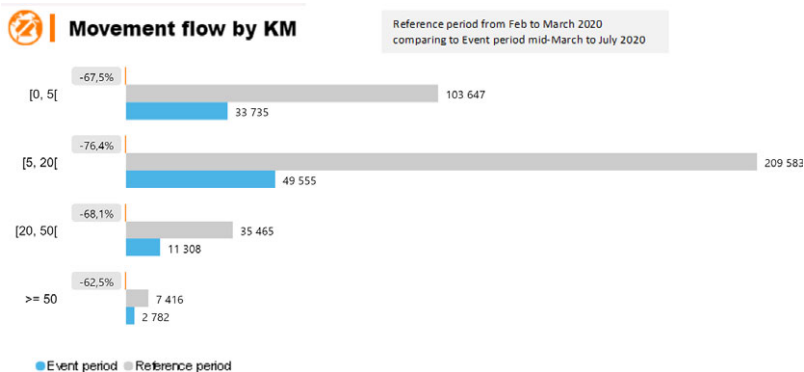
This process has also led to new applications for mobility data, like evaluating transport investments, creating predictive models for infrastructure maintenance services, and understanding the tourism sector. These actions encourage and shape the Spanish market, enhancing startups in business modeling and geolocation analysis, which will become more familiar with the use of mobility data from operators.

The same approaches were followed in MEA countries. Each country's Covid-19 taskforce team, composed of medical services and experienced data scientists and supported by various international organizations, collaborated to optimize the learning curve of mobile data users. The best-adapted use-cases to fight Covid-19 in each country arise when the local task force has a good visibility and understanding of mobility data analytics and can quickly take the right coordinated actions. Naturally, each country's taskforce has a different selection of tools, capabilities, and responsibilities. For example, some taskforces may be empowered to enact a lockdown in a certain area or set up an observation tower for a number of weeks to see how the population is behaving under lockdown or social distancing recommendations (Figure 2, case of The Democratic Republic of the Congo). To minimize the time to action, it is essential to consolidate needs and communicate them in a clear proposal for suppliers to provide the data in a certain format with specific rules. That is why it is important to find the right partner and interlocutor from the point in time at which collaboration begins within each country (Figure 3).

Observation before and after lockdown from mid March 2020 in Gombe  
 ⇒ Reference period : February to March 2020 comparing to Event period Mid-March to July 2020  
 ⇒ Still slightly withdrawn on the beginning of October from a normal situation



**Figure 2.** Observations of daily movements in and out of the Gombe region, Democratic Republic of Congo. The reference period (shown in gray) is from February to March 2020. The event period, when the pandemic struck (shown in blue) is from mid-March to July 2020. Orange Flux Vision continued to provide insights through to early October 2020, when levels of movements were still slightly below the reference period. Copyright: Orange. This figure has been reproduced with the permission of the copyright holder, and is not included in the Creative Common license applied to this article.



**Figure 3.** Observations of distances traveled in Gombe, Democratic Republic of Congo, over reference period from February to March 2020 and event period mid-March to July 2020. The numbers of journeys of all distances are drastically reduced. Copyright: Orange. This figure has been reproduced with the permission of the copyright holder, and is not included in the Creative Common license applied to this article.

Flux Vision proactively generates the most useful indicators, based on experience. These indicators capture the general but essential mobility patterns and volumes of movement in large areas, providing a helicopter view over the whole country.

Another important factor in this type of operation is the delivery lead time. Due to the urgent nature of the pandemic, very challenging lead times were required. Some countries housing new deployments of

Flux Vision have lower data maturity in general and were less aware of mobile data management or the concepts of data analytics, so it was necessary to lay the essential foundations before producing indicators and qualifying them. This foundational process can be very time-consuming. Sometimes the main challenges were not the production or qualification of indicators or results, but the stabilization of network data availability, or ensuring compliance with local data regulation.

In France, Spain, and Belgium, which were already covered by Flux Vision, the data is updated daily with a 1-day lag in the case of presence data and 3 days in the case of mobility data, and delivered to numerous partners to support a variety of apps. The Spanish Ministry of Economic Affairs and Digital Transformation asked Orange to provide data to their national institute for statistics. This data has been updated every week since April 20. In Belgium, the first mobility data was provided on March 20 and is now updated daily for the Belgium Federal Task Force.

In the MEA region, Orange decided to deliver the statistical data to local authorities requesting it, which can communicate it to the World Bank according to their terms. Orange Flux Vision mobility data deliveries have been set up for Orange in the Democratic Republic of Congo, Morocco, Sierra Leone, and Burkina Faso.

## 6. Opening to a New World using Big Data

The experience of this crisis shows how important it is to be in possession of the knowledge and capacity to exploit mobility data analytics and create predictive models to protect people's lives, while abiding by the privacy rules which protect the individual customers of the telecom operator (Arcolezi et al., 2020).

Mobile data analytics applications are becoming more familiar in the tourism, retail, transport and urban planning sectors, as well as for social good. More comprehension of mobility and attendance data will allow more innovation of diverse use-cases. In light of the major changes in the patterns of behavior brought about by this pandemic, the development of utilities services with an environmental vision will be especially important both in B2C and in B2B markets.

Nature reservations, parks, or regions that care about the preservation of their environment could set up an observation center to look over the population flows and volumes, requesting mobile data analytics accordingly. Some water supply companies intend to predict consumption, in order to improve their provisioning plans. Real-time mobility and attendance data become central data elements that they should take into account in their algorithm. Both locating optimal recharging points for electric cars and exploring the CO<sub>2</sub> emissions by transport are also interesting use-cases that Flux Vision starts looking into alongside specific customers.

Third-party data combined with mobility data and artificial intelligence could bring more benefits. The limits of mobility data have not been reached. There will be more innovation and more discovery of new use-cases. Clear data strategy and guidance should be built up, incorporating visions for the coming 5 and 10 years around Data business in the world market, in order to sustain this development around mobility data and ensure it has the maximal impact.

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**Competing Interests.** The authors are employed by Orange, a telecommunications company with a commercial interest in developing its Flux Vision product.

**Author Contributions.** Writing—review and editing: P.C., J.Y.J., T.B. All authors contributed equally to the article.



**Data Availability Statement.** The data that support this commentary are available from Flux Vision, Orange Business Service, Orange Group. Restrictions apply to the availability of these data, which were used under license for this study. Data are available on demand from OBS (<https://www.orange-business.com/en/products/flux-vision>) with the permission of Flux Vision.

**Supplementary Materials.** To view supplementary material for this article, please visit <http://dx.doi.org/10.1017/dap.2021.31>.

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