European Commission Joint Research Center's Mapping Mobility Functional Areas (MFA) with Telecom Mobility Data

THEGOVLAB

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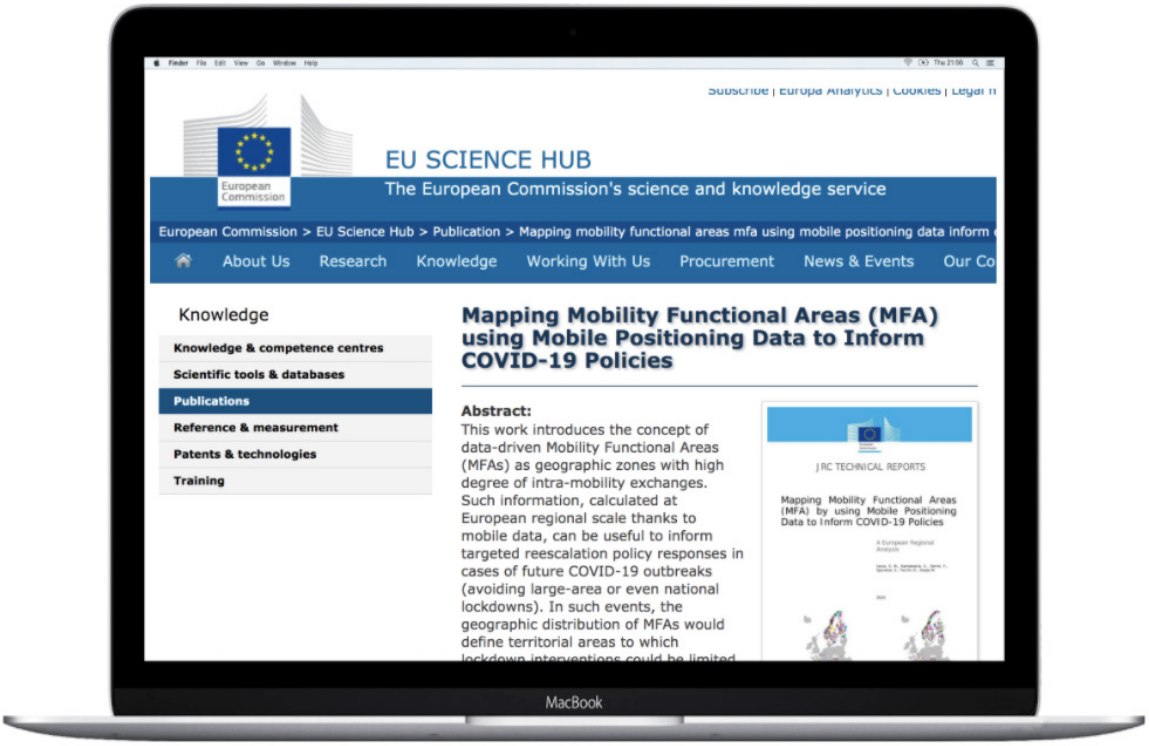
Editor's Note

To verify the accuracy of the content, an early draft of this document was made available to Richard Benjamins (Telefonica Research) and Michele Vespe (European Commission). Dominique Diouf (Open AIR) and Marijana Novak (Circle Economy) provided a peer review to a later version of this case study.



Executive Summary

In April 2020, in response to a call to action by high-level officials, the European Commission Joint Research Centre (JRC) sought to use smartphone-derived mobility data to improve the targeting of policymaking in response to COVID-19. To do so, the JRC spearheaded a data pooling collaborative together with a dozen telecom companies from across the European Union. The effort used aggregated and anonymized origin-destination matrices (ODMs)—the number of trips between certain points during a certain reference period—to define geographic units in each country that correspond with real-world mobility patterns rather than traditional administrative boundaries. These "Mobility Functional Areas" are intended to support policymakers in deploying mobility restrictions and other interventions in a manner more aligned with real-world mobility patterns instead of traditional administrative boundaries.

Problem at Hand

When the COVID-19 pandemic hit the European Union (EU) in the spring of 2020, EU bodies and national governments faced many complex decisions. Chief among these was how to institute social-distancing restrictions in a way that meaningfully slowed disease transmission while also minimizing the scope and economic impact. They also hoped to limit other negative consequences, such as strains on mental health or limits on parents' ability to successfully work from home while caring for school-aged children. EU leaders originally sought to use existing administrative areas to manage pandemic response but these static boundaries—informed by a number of historical factors, negotiations, and decisions—did not necessarily reflect the actual mobility patterns of people who lived and worked in them. Decision-makers in the EU in particular, were forced to deploy these mobility-oriented policy interventions within administrative areas that were in no way defined by real-world mobility patterns.

Project

In April 2020, Thierry Breton, the European Commissioner for the Internal Market, called on European telecom operators to collaborate with the European Union around mobility data they held to support the response to COVID-19. An official dispatch from the European Commission recommended the creation of a "common Union toolbox for the use of technology and data to combat and exit from the COVID-19 crisis, in particular concerning mobile applications and the use of anonymised mobility data."[1] Breton and other leaders at the Commission held subsequent video conference meetings with decision-makers at the telecoms to define next steps for the effort.[2]

Given the urgent need to establish a data-sharing arrangement to satisfy these official expectations and the pro bono nature of the effort, the telecoms used existing data-sharing programs—including both data for good programs and data-sharing business streams—to provide functional access to mobility data insights. After the initial call to action, -3 Group - part of CK Hutchison, A1 Telekom Austria Group, Altice Portugal, Deutsche Telekom, Orange, Proximus, TIM Telecom Italia, Tele2, Telefonica, Telenor, Telia Company and Vodafone began making aggregated and anonymized mobility data streams accessible to partners at the Joint Research Centre (JRC), the European Commission's "science and knowledge service."[3]

One of the core components of this collaboration was a study led by the JRC to create a more grounded understanding of real-world mobility patterns across the Union, examining mobility patterns across Austria, Belgium, Bulgaria, Czechia, Denmark, Estonia, Finland, France, Greece, Croatia, Italy, Norway, Sweden, and Slovenia.[4] The report from the JRC introduces the concept of Mobility Functional Areas (MFAs), defined as "geographic zones with high degree of intra-mobility exchanges."[5] These MFAs, compared to more traditional geographic zones defined by administrative borders (i.e. neighborhoods, towns, cities, and provinces), represent the aggregated movement trajectories of residents. Project organizers believed that an improved understanding of MFAs can be a useful tool for instituting non-pharmaceutical policy responses to the pandemic in a targeted way—focusing these provisions on areas

1. European Commission. Commission Recommendation (EU) 2020/518 of 8 April 2020 (EC, 2020); available at https://eur-lex.europa.eu/eli/reco/2020/518/oj
2. Scott, Mark, Laurens Cerulus, and Laura Kayali. "Commission Tells Carriers to Hand over Mobile Data in Coronavirus Fight." POLITICO, March 23, 2020. https://www.politico.eu/article/european-commission-mobile-phone-data-thierry-breton-coronavirus-covid19/.
3. hEuropean Commission. "Joint Research Centre." Text. Accessed March 22, 2021. https://ec.europa.eu/info/departments/joint-research-centre_en.
4. Iacus, Stefano Maria, Carlos Santamaria, Francesco Sermi, Spyridon Spyratos, Dario Tarchi, Michele Vespe. "Mapping Mobility Functional Areas (MFA) by using Mobile Positioning Data to Inform COVID-19 Policies: A European Regional Analysis." European Commission JRC Technical Reports. 2020. https://ec.europa.eu/jrc/en/publication/mapping-mobility-functional-areas-mfa-using-mobile-positioning-data-inform-covid-19-policies
5. Ibid..

with high levels of movement and greater potential for transmission instead of doing so based on administrative boundaries not based on human mobility. They are seen as means for ensuring more precise recommendations.

Data Assets

Telecom data informed the creation of these MFAs. Specifically, the participating telecoms provided Origin-Destination Matrices (ODMs) to support the analysis. ODMs, in simple terms, capture "aggregated inbound and outbound movements across spatial structures of a given time scale."[6] ODMs are structured as tables and quantify the aggregate number of trips between an origin and destination (e.g. between two towns) taken during a reference period.[7] An ODM's focus in terms of administrative unit (e.g. towns vs. cities vs. provinces) and reference period (e.g. hourly vs. daily vs. weekly), depended on which telecom was providing the data, and how they structured it for preexisting aggregated data sharing programs or business streams.[8]

Design

Governance Structure

Various actors within the European Commission coordinated the MFA study and the broader effort to mobilize telecom data in the response to COVID-19 in the EU. The initiation of the effort, as described above, arose from a formal letter from the European Commission to leadership at the participating telecoms. After that initial call to action, decision-makers at the JRC and the Commission's Directorate-General for Communications Networks, Content and Technology (DG-CONNECT) were instrumental in data governance processes, including efforts to identify and mitigate risks, discussed more below.

The European Data Protection Board's (EDPB) "Guidelines on the use of location data and contact tracing tools in the context of the COVID-19 outbreak," disseminated in April 2020, governed the data collaborative.[9] The effort was also informed by the Global System for Mobile Communications Association (GSMA) recommendations on "COVID-19 privacy for telecom operators," also released in April 2020.[10] Among other recommendations for protecting against re-identification or other privacy and security risks, these guidelines cautioned against activities such as analyzing mobility patterns during certain events, including religious celebrations, for example, despite the potential to derive insights on transmission and superspreader events.[11]

Operational Model

In The GovLab's data collaborative taxonomy, this project is indicative of a data pool data collaboration.[12] In this kind of collaboration companies and other data holders agree to create a unified presentation of datasets as a collection accessible by predefined parties, in this case the JRC. One of JRC's key roles was serving as an intermediary involved analyzing this data pool to create a "common denominator" that allowed for comparability across the heterogeneous ODM datasets provided by the telecom operators.[13]

6. Iacus, et al, supra note 4.
7. Ibid.
8. Benjamins, Richard. MFA Case Study. Zoom, December 11, 2020.
9. Olbrechts, Antoine. "Guidelines 04/2020 on the Use of Location Data and Contact Tracing Tools in the Context of the COVID-19 Outbreak." Text. European Data Protection Board - European Data Protection Board, April 22, 2020. https://edpb.europa.eu/our-work-tools/our-documents/ohjeet/guidelines-042020-use-location-data-and-contact-tracing-tools_en.
10. Public Policy. "COVID-19 Privacy Guidelines." GSMA, April 6, 2020. https://www.gsma.com/publicpolicy/resources/covid-19-privacy-guidelines.
11. Vespe, Michele. Andrew<>Michele MFAs Discussion. Zoom, December 4, 2020.
12. Verhulst, Stefaan, Andrew Young, Michelle Winowatan, and Andrew J. Zahuranec. "Leveraging Private Data for Public Good: A Descriptive Analysis and Typology of Existing Practices." Brooklyn, New York: The GovLab, October 2019. http://datacollaboratives.org/existing-practices.html.
13. Iacus, et al, supra note 4.

Risk Mitigation

As part of their normal operations, telecom operators conducted several automated risk-mitigation procedures before the ODMs were shared with JRC. These measures were not pandemic-specific, but rather were similarly taken prior to these ODMs being shared with partners or sold to clients for other reasons.

These measures include data being anonymized at the origin of the data, the use of differential privacy to add synthetic complexity to datasets without decreasing their utility, as well as the removal of data "singularities" through the use of thresholds. ODMs captured the number of trips in a certain region and timeframe as long they surpassed a certain threshold. To avoid using data that, though aggregated, could still create risks of reidentification or pinpointing individuals, ODMs did not record movements. If the number of trips did not reach that threshold, the ODM does not show a value for that area. the use of differential privacy to guard against reidentification without decreasing its utility.[14]

After these risk mitigation procedures occurred through automated processes in place at telecoms, ODMs were shared with the JRC through an encrypted, secure channel in a dedicated platform developed and managed by the JRC. Michele Vespe of the JRC referred to the platform as an "an extremely secure environment with lots of authentication phases," that guards against reverse engineering or analyses that could result in data analysts uncovering raw data.[15]

In line with the EDPB guidelines, the JRC also conducted further tests on the data provided by the telecom operators. These tests aimed to mitigate risks of making decisions based on faulty data. The specific components of this test are considered confidential given data protection and privacy considerations. This testing also occurred within the secure environment.[16]

Outputs and Intended Impact

Intended Impact

The JRC's technical report on the MFA project outlines two core objectives. The creation of a new MFA "common denominator" is intended to enable policymakers to limit non-essential movements and apply targeted physical distancing policies in geographic areas with high potential or realized transmission while limiting the economic impact on adjacent but lower-risk areas.[17]

The MFA analysis and platform are intended to support health ministries, research centers, immunological research centers, policy makers more generally, and other decision-makers that could benefit from an understanding of boundaries based on real-life mobility patterns rather than traditional town or city borders. The effort aims to improve situational awareness of mobility patterns and how they correlate with disease transmission and economic activity and support highly targeted policymaking and mobility containment measures that provide a "balance between epidemiological and socio-economic impact on the economy.[18]

14. Benjamins, supra note 8.
15. Vespe, supra note 11.
16. I lacus, et al, supra note 4.
17. Ibid.
18. Ibid.

Outputs and Realized Impact

The collaborative generated several new findings, many of them expected, that could inform decision-making. The report confirmed MFAs are consistently identifiable across countries, that there is an improved understanding of mobility differences on weekdays compared to weekends or holidays; there are notable shifts in mobility before and after lockdown measures; there are differences between administrative area mobility MFAs; and that persistent MFAs commonly span more than one administrative area.[19]

As of early 2020, the insights from the study have begun influencing official EC recommendations and response. For example, European Commission Communication 786: "Staying safe from COVID-19 during winter" recommends that mobility patterns be taken into account when creating targeted measures to slow disease transmission, with a reference to the MFA collaborative.[20]

The Commission also created a platform to make data dashboards and other mobility products accessible to approved policymakers and health practitioners within the EU and member states. This platform is likely the most operational output of the effort. It provides decision-makers with easy and near-real-time insight into mobility patterns and the geographic zones in which these patterns manifest.

Lessons Learned

Enabling Conditions

- **Existing "data for good" infrastructure, products and initiatives:** After a formal call to action by the European Commission, European telecom companies needed to quickly implement a secure data-sharing initiative on a pro bono basis. Each telecom already had the technical, procedural, and human infrastructure for making aggregated mobility patterns securely accessible to partners. Absent this infrastructure, the collaborative likely would have developed much more slowly, and potentially had fewer battle-tested data security and privacy processes in place.
- **Political Buy-In:** The MFA data collaborative was initiated thanks to a call to action from Thierry Breton, the European Commissioner for the Internal Market. High-level political support likely helped to ensure that CEOs and other telecom industry leaders From a public engagement perspective, the collaborative may have also benefited from Breton's central role given his perceived credibility on data security and privacy issues.[21]
- **Trusted Intermediary:** The GovLab traditionally defines a trusted intermediary data collaborative as one where third-party actors support collaboration between private- sector data providers and data users from the public sector, civil society, or academia.[22] For the MFA analysis, the participating telecoms engaged directly with the European Commission, but, despite being part of the Commission, the JRC acted as a trusted intermediary. As

19. Ibid.
20. Communication from the Commission to the European Parliament and the Council: Staying Safe from COVID-19 during Winter." Brussels: European Commission, December 2, 2020. https://ec.europa.eu/health/sites/health/files/preparedness_response/docs/covid-19_stayingsafe_communication_en.pdf.
21. See for example, Espinoza, Javier, and Sam Fleming. "EU Seeks New Powers to Penalise Tech Giants." Financial Times. September 20, 2020, sec. EU tech regulation. https://www.ft.com/content/7738fdd8-e0c3-4090-8cc9-7d4b53ff3afb.
22. Verhulst, et al. supra note 12.

Michele Vespe described, the JRC served as the "the interface between science and policy."[23] This internal center of data science knowledge and expertise possessed the capacity to engage with data providers such as the participating telecoms as a representative of the Commission, and then to translate insights from that analysis into inputs to policy decision-making. The science-focused JRC, in other words, supported the use of insights derived from the mobility to support decision-making in more policy-oriented arms of the European Commission, European Union, and member state governments.

Challenges

- **Interoperability:** The specific structure of an ODM was highly dependent on which telecom provider made the ODM accessible.[24] The JRC was faced with the task of reconciling differences in the ODMs, including the reference period for the data they represented (e.g. 8 hour aggregations vs. daily vs. weekly insights) and the administrative boundary covered (e.g. city vs. province vs. neighborhood).[25]
- **Sustainability of pro bono emergency initiatives:** The COVID-19 pandemic took many around the world by surprise. During the spring of 2020, many actors urgently mobilized to address the many consequences of a global emergency. This led to the creation of pro bono initiatives, many of which likely were created under the assumption that the emergency would end in a matter of weeks rather than months. At the time of writing, the pandemic is nearing its first anniversary, with persistent challenges and mobility-related questions. Given this extended and uncertain timeframe for the effort, there could be future contention between data suppliers and demand-side actors in the public sector absent new business models,[26] or clear regulatory guidelines and expectations, for telecoms.
- **Operationalizing new boundaries for policymaking:** MFAs can better reflect real-life mobility patterns, which can be important in issuing targeted lockdowns or other directives. They can be difficult to apply in practice, however, especially given the challenges in communicating the rationale of, for instance, directing a family residing in a high-transmission MFA stay at home for two weeks, while a family with the same postcode a few blocks away can move more freely because they live outside the boundaries of the MFA. The JRC recognizes that traditional administrative areas are "well recognized" by citizens, and that restrictions based on MFAs would require careful public communications and engagement.[27]
- **Signals During Times of Limited Mobility:** To protect against re-identification, the JRC instituted privacy controls to ensure ODMs did not represent movements that only involved a few people. This safeguard could lead to certain mobility signals not being captured, especially during peak lockdown when movements were predictably at their lowest.[28]

Conclusion / Next Steps

Going forward, the European Commission is welcoming additional telecom partners to join the initiative and increase the coverage of the MFA common denominator and mobility data platform across the European Union.[29] In addition to increasing the geographic scope and coverage, the most important next step will be seeding the uptake of MFA models and indicators for policymaking. Potential future use cases for MFA models and indicators

23. Vespe, supra note 11.
24. bid.
25. Benjamins, supra note 8.
26. Vespe, supra note 11.
27. Iacus, et al, supra note 4.
28. Benjamins, supra note 8.
29. I Iacus, et al, supra note 4.

include, for example, demonstrating how outbreak patterns correspond with MFAs. Tracking the economic impact of lockdowns. There are many opportunities going forward to use this understanding of (not the raw mobility data itself) to increase our understanding of how people's movements correlate with changes in political, social, economic, or public health circumstances throughout the response and recovery.