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Innovation during the COVID-19 crisis: Why it was more critical for official statistics than ever[1]

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Abstract. During the COVID-19 pandemic, quantitative evidence was desperately needed in order to understand and manage an unprecedented situation, and to make important national, European and international decisions. Eurostat and the national statistical institutes (NSIs) played a key role in managing the pandemic, providing society with a high quality statistical information service. In particular, the crisis accelerated innovation in statistical production, steered complex processes of change towards the use of new data sources and privately held data for official statistics, enhanced the adoption of new statistical methods, and consequently the production of experimental statistics and dashboards.
While the new data ecosystem provided opportunities for the production of official statistics, the importance of privacy preservation, data security and the development of adequate data quality frameworks remained a priority. Important strands of work for the future would be: satisfying the increased needs of users, as well as supporting decision-making and the delivery of government services in emergencies. NSIs would also do well to invest in innovation, collaborate and establish partnerships with the data providers and research communities that have worked closely with them since the beginning of the pandemic.
This article is based on the experiences of six NSIs in the Netherlands, Spain, France, Italy, Germany and Finland during the pandemic.

Keywords: COVID-19, innovation, official statistics, national statistical system, new data sources

1. Introduction

Crisis comes from the Latinised form of the Greek word κρίσις. The word's original meaning is a time of great danger, difficulty, or confusion. A time when problems must be solved or important decisions made. From the start of the COVID-19 pandemic, critical decisions had to be made, not least of which was to rely on quantitative evidence as the only way to understand and manage an unprecedented national, European and international situation.

Official statistics are statistics that are developed, produced and disseminated by a national statistical system that is composed of government departments specified by national legislation, subject to a set of principles

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and rules of conduct. Specifically, European Statistics (Regulation (EC) No 223/2009) refer to official statistics developed, produced and disseminated within and according to the rules of the European Statistical System that was built with the objective of providing comparable statistics at EU level, supporting the decision-making process and the implementation of EU policies. The COVID-19 crisis affected official statistics at both, national and European level, nevertheless in different ways.

The gravity of the situation meant that official statistics had to provide society with a high quality statistical information service. However, the pandemic has upended nearly every aspect of people's and businesses' lives. Official statistics are no exception. Let's see how.

Firstly, all statistical systems without exception had to resolve the issue of perturbed field data collections that used legacy data collection methods and adopt radically different ways of working. On the one hand, it was not possible to conduct face-to-face interviews due to social distancing, virus containment policies and lockdowns. On the other hand, it is widely acknowledged that the pandemic has accelerated digitalisation. This partially explains different trends in the impact of COVID-19, for example the ability of businesses to go digital. NSIs were equally affected. In the context of the pandemic, how prepared, flexible and adaptable were statistical systems in collecting the data that was required, using innovative methods?

In addition, during the pandemic, due to a changing data ecosystem, sometimes unexpected actors, new technologies, and increasing expectations of and demands from stakeholders for open, easily accessible and timely data, the traditional remit of statistical offices needed to be expanded. The overall goal was to increase the relevance of official statistics in order to equip them to be able to respond to future critical situations. Producers of official statistics had to demonstrate agility in order to grasp users' needs, join forces with other public authorities and innovate in order to effectively inform the public and support top-level decision-making on all aspects of the pandemic in a timely manner, while ensuring business continuity for the provision of legacy statistical products.

From a European perspective, Eurostat coordinated the efforts to provide a systematic and responsible response to the pandemic, meeting emerging statistical information requirements by providing a baseline against which the impact of the crisis could be measured. Vital data was unquestionably required to assess the social and economic impact of an unprecedented pandemic, support mitigation measures and develop recovery plans. How did the European Statistical System respond? How resilient were official statistics under these unprecedented circumstances and how flexible were statistical systems in adopting innovative processes in order to deliver information when it was needed?

It is widely acknowledged that official statistics are constantly evolving. However, changes during the pandemic happened almost overnight. Were statistical systems ready to open up to new partners, innovate and collaborate with others from the public or private sector to tap into the potential of new data sources?

During the pandemic, the use of new data sources would require statistical systems to uncompromisingly adhere to the core principles underlying the production of official statistics. How did innovation help, or how would it help, with respect to privacy preservation, quality considerations and other key principles that play a central role in corporate management as much as in day-to-day statistical operations?

This article provides an overview of the recent experiences of six NSIs in the Netherlands, Spain, France, Italy, Germany and Finland during the pandemic. It will present the overall responses to the pandemic of these countries' statistical systems within their broader public sectors and the new roles and responsibilities of the NSIs, as well as specific actions aimed at business continuity, providing information, evaluating the pandemic's impact, supporting recovery, and improving communication during the pandemic. To a certain degree, cultural, socioeconomic or other national circumstances influenced the changes that occurred in national statistical systems. However, several common aspects can be identified. These show that during the crisis period, there was a process of replacing dominant unsustainable legacy practices, while at the same time developing and mainstreaming more sustainable practices. After presenting the national cases, the article will present some of the lessons learnt. It will then link these aspects to the broader context of the future development of European statistics and the European Statistical System.

Admittedly the COVID-19 pandemic has brought data and information to the centre of policy making and public attention. Subsequently NSIs were called to play an important role within their institutional capacity. However, tracking the progress of the pandemic and the countermeasures, for example reporting on rates of infection, hospitalisations, fatality and recovery, vaccination rates etc., does not always fall under the direct remit of several NSIs. Besides collaboration activities that

were intensified or initiated with other organisations that fulfilled the specific information requirements, the article touches mainly upon innovation in the statistical production systems and in measuring the effects of the pandemic.

Beyond the extended range of challenges related to innovation in statistics during the COVID-19 times and in the future, other fundamental conceptual questions raised by the COVID-19 pandemic (e.g. effects that transform societies and economies) are not within the scope of the article.

The authors originally organised a session [1] on the same subject, at the UN World Data Forum 2021 conference, attended by more than 120 people all over the world. The session gave them the opportunity to showcase the work done by the six NSIs that are the subject of this article, and to highlight key lessons for the future. In particular, the lessons learnt by said NSIs, which responded innovatively and in similar ways to the increased expectations of and demands from stakeholders as well as to the new working conditions the pandemic ushered in. The session also provided the opportunity to link these aspects to the broader context of the European Statistical System.

This article is an extended reflection of the discussions held at the conference, covering a wide range of issues that the Dutch, Spanish, French, Italian, German and Finnish NSIs had to deal with. Each author with an affiliation to an NSI was responsible for describing the respective country's experiences.

2. Experiences of NSIs

2.1. The Netherlands

An agile mindset, innovative solutions and successful collaborations were key success factors in the Dutch management of the pandemic

After a few weeks of increasing COVID-19 infections, the Dutch Government announced on 12 March 2020 that the Netherlands would go into an 'intelligent' lockdown. In this case 'intelligent' means that the government tried to achieve a balance between the virus' impact on society and the need to control the number of people being infected and hospitalised.

The crisis led to an immediate demand for relevant and up-to-date information, including appropriate statistics. Statistics Netherlands (CBS) tried to contribute to the development of COVID-19-related government policies in two ways:

- by improving the quality of existing statistics
- by introducing new types of output targeted at understanding aspects related to the crisis.

A surge of creativity and improvisation led to a whole range of new and/or adapted statistics. Solidarity across all of society also made it possible to get access to new data sources and work with new partners.

First on the list of priorities, however, was to keep the regular production of statistics running as smoothly as possible, from data collection, through data processing and analysis, to the dissemination of statistics. All of this had to be done in a world where working from home became the new normal. The high level of digitalisation at Statistics Netherlands helped to enable a relatively smooth transition. Its IT environment had already been virtualised some years ago, when both offices in the Hague were moved to new buildings. So most of its staff were already used to working from home through 'Virtual Machine' based (VMware-based) systems, allowing them to seamlessly and securely access their IT workplace anytime and from anywhere. Solutions using Zoom and Slack were quickly implemented for internal communication; and new conventions for staying in touch digitally were established. The new Dutch data collection strategy developed in 2017 followed a web-first Computer-assisted web interviewing (CAWI) approach. New IT systems for data collection were almost complete by early 2021, and could quickly be moved into production. Thanks both to this and a limited use of Computer-assisted telephone interviewing (CATI) there were no significant hiccups in primary data collection processes. Some questionnaires could also be adapted to include COVID-19-related questions. Moreover, the heavy dependence on digital administrative (government) sources, backed by the Dutch Statistics Act, and key sources from the private sector such as scanner data made CBS less dependent on its own data collection.

While the regular production processes were adapted to deal with the new normal, a lot of thought also went into generating ideas to support policymakers and the general public in the best possible way. That was done both by discussing their needs with users and by encouraging CBS employees to launch ideas for new products.

Mortality and morbidity statistics [2] were delivered more rapidly and frequently, on a weekly basis and within a week of the week reported on. This was made possible by reviewing existing production processes and methods, with a focus on quality requirements. Another example is timely and weekly statistics on consumer behaviour using scanner data that e.g. demonstrated changes in consumer behaviour in the first weeks of the

pandemic, such as the hoarding of toilet paper and specific long-lasting food products. Both these examples, spearheaded by CBS, drew a lot of interest from both professional users and the general public.

Examples of questions from users that CBS was able to answer quickly are requests from the Ministry of Economic Affairs to provide them with information to help them decide which subsidy measures to put in place to support specific areas of the economy, as well as requests from the governmental COVID-19 taskforce to provide information on the expected effects of lockdown and other measures under consideration, e.g. how many people would be affected if street markets were closed down. Such developments, along with intensified collaboration and brainstorming with other governmental and private institutes, gave innovation a new impetus not only in terms of timeliness, but also new and more granular statistical output.

The CBS website was and still is at the time of writing, the most effective way to disseminate COVID-19-related statistics in an easily accessible and coherent way to the general public. A number of pages on the website [3] are dedicated to a set of frequently asked questions covering a wide range of topics. One topic is the medical consequences of the pandemic in the Netherlands, including the number of deaths, sickness leaves at work, the pandemic's effect on life expectancy and the pressure it puts on medical care. Another topic is its implications for society, covering criminality, overnight stays in hotels and other lodgings and the evolution in the number of asylum requests made by refugees. Other topics: economic effects, changes in mobility patterns, effects on employment and income, government finances and regional differences.

The underlying statistical information has also been organised into thematic dashboards, such as the dashboard on wellbeing during COVID-19 [4]. The accompanying Corporate News article [5] states in its introduction:

> '*Statistics Netherlands (CBS) aims to make interpretation and implementation of its figures as easy as possible for its users. This is why dashboards are increasingly being introduced in order to represent the figures graphically. A fine example is the dashboard that was launched on 5 September 2020 under the name "Welvaart in coronatijd" ("Well-being in times of coronavirus"). It has been a major success, with more than 85.000 website visitors viewing it over the past month. It was also shared 177 times through various news websites.*'

The frequently updated official COVID-19 Dashboard of the Dutch Government [6] also draws extensively on CBS statistics. The CBS website, for its part, refers to the recovery dashboard [7] and other materials developed by Eurostat.

A key success factor of statistics production in COVID-19 times has been the collaboration with both new and existing partners. For example, CBS worked closely with the National Institute for Public Health and the Environment (RIVM) to publish estimates of excess mortality due to the pandemic. Another example is the publication of weekly data on various types of electronic payment transactions and cash withdrawals, based on weekly aggregated data provided by the Dutch Payments Association (Betaalvereniging Nederland) on special request. In a number of cases, some payment service providers agreed to provide information about access to their data, in order to paint a better picture of changes in online purchasing behaviour. So far, however, coverage has been considered insufficient for publication purposes.

A further example of collaboration leading to new statistics is joint work with Translink, the company that manages electronic public transport chip card data for all Dutch public transport companies. The public transport chip card is the main system for public transport use in the Netherlands. The collaboration with Translink enabled the compilation of very detailed figures on the use of public transport. In fact the collaboration had already started some time before the outbreak of COVID-19, but the first scheduled release of the Public Transport Monitor [8] in April 2020 attracted quite some attention because of the pandemic travel restrictions in place.

Not all efforts to support policymaking through new or better statistics succeeded however. CBS had already done a fair amount of work in R&D on the statistical use of mobile phone data. Right from the start of the pandemic therefore, it would have been possible, based on the experience gained, to produce timely population densities figures (origin-destination matrices) from mobile phone data with very detailed spatial and temporal granularity, while protecting the privacy of individuals. This information could have been made available to the National Institute for Public Health and the Environment (RIVM) for it to incorporate into its models; so far they had been using data supplied by Google. The Dutch Government drafted an emergency law to support the release of statistics based on mobile phone data to help manage the pandemic, but the draft law met with so much opposition that it was not even submitted to parliament.

Social media was a mixed bag of results. Based on previous work on a Twitter-based social tension indicator, CBS developed a COVID-19 sentiment indicator [9]. The indicator shows e.g. how sentiment in the Netherlands changed after the first Dutch and European COVID-19 cases were reported. It also managed to detect social media users with COVID-19 symptoms and is still working on the analysis of social media, including web posts, to detect changes in the attitude(s) towards vaccination. However, not every idea worked in practice. An example is a study to predict the potential effect of the COVID-19 crisis on the birth rate in the Netherlands. For this study, social media and discussions on web fora were scraped to determine if and how often people (usually women) posted that they were pregnant, and the estimated date of birth. It turned out that only limited data was available with some further quality issues. No reliable birth rate indicator could therefore be developed.

2.2. Spain

Responsive, innovative and trustworthy partner in official statistics

On 15 March 2020 the Spanish Government announced the implementation of a state of alert for 15 days to control the spread of COVID-19 in the country. Overall, Spain has spent more than 8 months with different levels of restrictions. This has had a significant impact on people's lives, with an inevitable knock-on effect on statistics.

During this crisis the Spanish Statistical Office (INE) had to contend with a number of issues in order to keep the continuity of the statistical production processes in two new circumstances it could never have foreseen.

- All its staff would remain at home for a long period of time, according to the instructions given them on the basis of the declaration of the first state of alert.
- Data collection would be affected in a very serious way as many businesses remained closed and face-to-face interviews were stopped to protect the health of respondents and INE staff, especially during lockdown periods.

The unpredictability of the situation challenged INE in another way: institutions and the public had new and urgent need of information to enable them to make informed decisions and to mitigate uncertainty.

INE met these information needs in a variety of ways:

- by giving instructions to ensure the protection of the health of its staff, on a par with other civil servants;
- by reorganising statistical services using remote working procedures, while keeping up the pace of work in order to publish statistical data releases according to the scheduled calendar;
- by innovating in statistical production in order to deftly meet new user needs and provide society with the information it needed in a very timely way and with a high frequency and high level of detail or granularity;
- by communicating to users how INE was going to handle the situation and how these extraordinary circumstances could affect the production of statistics [10].

From the outset, INE was able to do the following.

- To implement a technical solution to support remote working of all its staff while enabling them to access the production system at all levels. Thanks to this solution, over 4000 people have been working on a regular basis.
- To release all its statistical outputs, especially in the case of short-term statistics, according to the previously scheduled calendar. Minor delays releasing annual statistics of some non-prioritised statistical operations occurred.
- To implement methodological solutions, in coordination with the European Statistical System, that guaranteed the quality and comparability of national and European statistical outputs. These methodological changes and their impact on data have been systematically explained to users, including in a special section in press releases referring to 'COVID-19 effects' on statistics.
- To cooperate with government in providing new data directly related with the control of the virus (national seroprevalence study, studies on the mobility of the population)
- To publish on its website a special section about COVID-19, with some specific information relevant for monitoring the COVID-19 situation in Spain in demographic, economic and health issues. This information, obtained using regular statistics, included some data from the Health Ministry as it was in charge of providing information about COVID-19 cases on a daily basis.
- To release, using new data sources, new experimental statistics providing more frequent, detailed data by using new data sources, new estimation methods and/or new dissemination systems as needed.

Experimental data have been the main way of communicating about the innovation processes at INE in different statistical domains. Below are some examples.

Population

- Deaths are estimated weekly. This figure has been shown to be very sensitive, generating as it did some controversy on the data being communicated by different national and regional authorities. INE moved from yearly to weekly releases, reviewing some agreements with data providers and applying a new estimation method. It has now become an official statistic for 2022 onward.
- Studies on population mobility using mobile phone data, processed in partnership with mobile network operators, have proved their usefulness for monitoring, almost daily, the effectiveness of the lockdown measures adopted during states of alert.

Tourism

- Distribution of the credit and debit card expenditure of foreign visitors to Spain: The study of banking transactions carried out with bank cards by non-resident visitors to Spain makes it possible to provide data on tourist spending by visitors in the location where the spending was actually done. The agreement Spain has with companies that record financial transactions makes it possible to combine this new data source with survey data from the Tourist Expenditure Survey, to give users more detailed information.
- Measurement of the number of tourist dwellings in Spain and their capacity: Using web scraping techniques and developing new deduplication algorithms has turned out to be effective in measuring the collaborative tourism accommodation economy. Users of statistics have asked for this a lot in recent years. Accommodation platforms as Airbnb, Booking or Vrbo have emerged as one of the preferred options for booking a private holiday, but traditional accommodation statistics leave out this sort of accommodation.
- Measurement of national and inbound tourism from the position of mobile phones: The purpose of this study is to obtain aggregate information, through mobile phone signalling, on the movements of resident and foreign tourists and excursionists. INE has entered into an agreement with the three biggest mobile operators to extract data from their events database and apply the methodology INE has developed for this project. This new source of information makes it possible to obtain much more detailed and disaggregated indicators of the number of tourists and to reduce the burden on respondents.

Businesses/companies

- Short-term demographics on businesses responded to the urgent need to monitor how many companies are being created/closed in the crisis, as well as recovery times, by moving from yearly to quarterly releases of results and from the regional to the municipal data level. These experimental statistics use new administrative data sources to do this.
- Daily data on large companies' retail trade are processed using new administrative data sources from the Tax Agency. It provides timely data that help the taking of decisions in the face of events that lead to changes in consumer patterns, complementing information obtained from the Index of Retail Trade Statistics.

The capacity to react quickly in these times of crisis can definitely be attributed to the fact that both INE and the whole European Statistical System had been working on modernising official statistics in order to adapt them to the EU's new data ecosystem resulting from the datafication of society.

Intensive research in the area of official statistics was carried out some years ago, into the technical possibilities offered by new technologies and new data sources and the limitations and rules governing data privacy. This work is now enabling the deployment in a number of countries of experimental statistics adapted to the needs of national users. Some of these projects pose multiple challenges for access, methods and the quality assurance of final products. Some of them also entail a significant increase in the computational cost of the statistical process, with the consequent need for new computer tools and information models.

With the worst of the pandemic seems to be behind us, it is fair to say that INE has shown its resilience in overcoming the difficulties attendant on the pandemic. Not just that; it has even improved its public image as an innovative, proactive and trustworthy organisation because it reacted so quickly to the pandemic in providing users with new and reliable data, using transparent methods and communicating about possible limitations to the use and quality of information.

The experience has also led to a change of culture in INE, giving a new impetus to work in the following areas:

- integrating remote working into general working procedures;

- stepping up continuous innovation processes;
- establishing partnerships with public and private partners to use new data, develop new statistical methods and adopt new technologies;
- improving relations with users and research collaboration with them in order to better meet future user needs.

2.3. France

Quickly adapted working methods, investment in new sources, launching exceptional surveys and studying the economic and social impacts of the pandemic

France has a well-established official statistical service consisting of the National Institute of Statistics and Economic Studies (INSEE) and 16 ministerial statistical offices. INSEE and these services share a common corporate and statistical culture supported by committed staff and an integrated governance system. It has behaved with remarkable coherence throughout the pandemic, with an unswerving main objective: to make official statistics available to decision-makers and the general public.

In this difficult context, the integration of statistical services into the ministries has enabled them to cater as well as possible to political and social demands and adapt to them in real time. Decision-makers' and the public's voracious appetite for figures throughout the COVID-19 crisis has given rise to new challenges:

- continuing to release reference statistics even though their conceptual framework or structure has been undermined by the crisis (employment statistics, price index);
- producing estimates and high-frequency data to respond to the tightness of decision-making time caused by the rapid circulation of the virus;
- designing and deploying original statistical operations in a short period of time, or appraising and using new public and private data.

The pandemic has accelerated change and innovation. It has prompted people to demonstrate their ability to adapt to a unique situation and produce new and useful knowledge in a short period of time.

Preserving the statistical base and those who produce statistics by shaking up working methods

As soon as the COVID19 crisis officially started on 16 March 2020, the priority for INSEE and the ministerial statistical offices was to adapt and adjust the production of reference statistics [11]. Working from home was generalised, with the exception of a few small, poorly equipped departments. Face-to-face surveys were suspended or switched to telephone, and the use of multimode surveys stepped up. Nearly 2 years later, the damage has been controlled and the planned major operations have been carried out or are underway.

The pandemic has also profoundly changed the habits of statisticians. In particular, it has forced them to accelerate the evolution of collection methods that was already underway. And above all, it has led them, in response to pressing political and social demands, to reconsider their quality standards and to give greater weight to timeliness, at the possible expense of accuracy. This has not always been a painless experience, nor has it been free from hesitation. The crisis also called into question the organisation of production, which had to adapt to provide the highfrequency data expected of official statistics in order to continuously shed light on the evolution of the pandemic

For its consumer price index, INSEE benefited in particular from the work already done on scanner data, used in production at the beginning of 2020 [12]. The principle was to extend the scope of its use to continue to build the price index under the circumstances of the pandemic. The scanner data were also used with new objectives, to follow the evolution of household consumption. This required a revision of agreements with retailers.

Another example is death statistics. Normally, INSEE publishes the number of births and deaths each month, as recorded the previous month by the civil registry of all French municipalities. Normally, these statistics attract little attention. But it became clear quite quickly, from mid-March 2020 onwards, that the count of hospital deaths attributed to COVID-19 would not be sufficient to account for excess mortality. From the end of March 2020, INSEE published the statistics on deaths that had occurred the previous week (the municipalities have 1 week to transmit the civil status data to INSEE) every Friday. Excess mortality could thus be estimated by comparing the cumulative number of deaths since March with the cumulative number of deaths over the same periods in previous years.

Public policy management in times of crisis with new data sources

The Health and Solidarity Ministerial Statistical Department that is the Directorate for Research, Studies, Assessment, and Statistics (DREES) of the Ministry of Social affairs, health and women's rights, is a particularly interesting example of public policy management, as it was called upon to help manage the crisis. Indeed,

data processing skills of the staff proved essential in helping to organise and structure the data coming back to the pandemic crisis centre. During the second wave, the head of DREES was also given an assignment by the Ministry's crisis management department to assess the quality and consistency of the data.

Two other examples show the extent of the achievements of French official statistics.

Among statistical institutes, INSEE has the particularity of making short-term forecasts, i.e. using business surveys and macroeconomic modelling tools to forecast the aggregates of the national accounts for the current and following quarters. The exercise, hindered by the pandemic, was tweaked in mid-March 2020 with the objective of measuring the fall in activity as best as possible in real time.

To do this, INSEE used new data from bank transactions, thanks to an agreement with France's national interbank network, the 'CB Bank card Group' (Groupement des cartes bancaires CB), about which discussions had already begun before the pandemic. The use of this data made it possible to confirm a 35% drop in GDP and household consumption (instantaneously compared to normal conditions) at the end of March. This was the first estimate of this type to be carried out and published by a statistical institute since the beginning of the pandemic, and is undoubtedly also a precursor to the use of hard data.

Mobile phone data was also used to analyse the population that was present, the evolution of this population, and home-work commuting, according to different geographical levels, especially during lockdown. This was a new type of statistical production for INSEE requiring agreements with 3 mobile telephone operators and creating new difficulties: a non-representative population, the use of aggregated data without knowing the methodology used, the problem of telephones switched off, etc.

In both cases these achievements are based on access to new data, with the exceptional agreement of private actors, that was in the making before the pandemic but would not have fully materialised so quickly otherwise. In both cases, the necessity created by the pandemic has paved the way for more extensive use of private data for public statistics than ever before. The same holds for public data.

Understanding the economic and social consequences of the pandemic

The pandemic was characterised by a profusion of unprecedented statistical operations carried out by INSEE and the ministerial statistical services.

For example, INSEE conducted a survey on the pandemic's impact on the organisation and activity of companies in autumn 2020, analysed the way companies organised themselves in times of crisis and published an estimate of the cost of virus containment measures taken by companies. At the end of 2021, INSEE published the nowcasting of the poverty rate in 2020. This was a methodological challenge given the disruption to household incomes captured through tax sources.

The statistical service of the Ministry of Labour (Dares) launched a special monthly survey on 'Workforce activity and employment conditions' (Activité et conditions d'emploi de la main-d'œuvre – Acemo-COVID-19 survey) in spring 2020 to better understand labour force activity and employment conditions during the crisis, and a survey on the 'Experience of work and unemployment during the health crisis' (Enquête sur le vécu du travail et du chômage durant la crise sanitaire – TraCov survey) on psychosocial risks and working conditions during the crisis in January 2021.

Finally, the statistical service of the Ministry of Education also conducted a survey of families with secondary school pupils and children to assess educational continuity.

All in all, many areas of economic and social life during these times of crisis have been usefully analysed by official statistics. One of the remarkable facts is undoubtedly the responsiveness of all the institutions that govern French official statistics: all these unprecedented operations were set up in a very short time, while respecting the usual quality assurance requirements and the European Statistics Code of Practice.

Conclusion: What will remain of the crisis in terms of statistical production?

The official statistical service has shown great adaptability and ingenuity during the crisis. But one wonders what will be left afterwards. On the one hand, with the termination of the agreements such as those with mobile phone operators the possibilities for accessing privately held data are coming to an end. On the other, the procedures used during the crisis to obtain data from certain public operators, data that are not always easy to access, could continue to be used, provided it is agreed to support these operators in the exercise of their data expertise and to share the results of the analysis of the data with them. The agility developed by official statistics institutions seems to have been partially preserved. Maintaining the flexibility of production chains and designing new ones of a similar nature will be a challenge, as will continuing to meet publication deadlines when the pressure of demand weakens.

2.4. Italy

To the fore of government responses to the pandemic through the innovative and accelerated use of new data sources

The state of emergency caused in Italy by the COVID-19 pandemic and the measures the government adopted to contain and mitigate the spread of the virus throughout the country, such as lockdown and social distancing, had a deep impact on the continuity and quality of official statistical production of the Italian National Institute of Statistics (Istat).

Istat implemented measures to address the pandemic according to two main strands of work:

(i) a *response phase*, where quick and immediate actions were put in place to secure statistical production;
(ii) a *recovery phase*, which included actions to evaluate the impact of the pandemic and support recovery.

In the response phase, the main issues and related actions pertained to:

- the impossibility of doing face-to-face interviews, which made it necessary to change the data collection strategies in favour of mixed-mode approaches, and in some cases, to change the sampling design and the estimation strategy, as was the case for the Labour Force Survey and the Permanent Population Census;
- high non-response rates, for which specific strategies for reducing and treating non-response rates had to be put in place.

Innovative and accelerated use of big data sources was particularly important in tackling these issues.

One example is related to the use of Twitter data. Istat increased the frequency of production of the Social Mood on Economy Index [13]. The index, published as experimental statistics on Istat's website, provides daily measures of Italian sentiment on the economy, measures derived from samples of public tweets in Italian captured in real time. In particular, the index passed from a quarterly to a monthly frequency and was included in the monthly notes on the trend of the Italian economy for March and April 2020. It was especially useful given the temporary suspension of the Consumer Confidence Survey due to the pandemic.

A second example, also related to the measures put in place in the response phase, is the use of AIS data (Automatic Identification System of vessel traffic services), particularly important for the survey on the maritime transport of goods and passengers. In March and April 2020, the lockdown brought part of passenger traffic to standstill, but the restrictions did not apply to the transport of goods. AIS data helped to understand if the reduction in observations was due to an actual decrease or to difficulty recording traffic using the traditional actors involved. AIS data confirmed the reductions observed through traditional channels, proving to be an important auxiliary source.

A third example of the importance of big data sources in the response phase is the use of scanner and web-scraped data for consumer price statistics. The regular production of these statistics was made possible thanks to these big data channels, underlining the importance of a multisource and multimode approach for the consumer price survey.

For the recovery phase, Istat has started and planned several investments for measuring the impact of the pandemic and supporting recovery. Two main courses of action were taken:

(i) new survey-based products, to take into account changes that had an impact on households and businesses, as well as to support the Italian government in containing the pandemic;
(ii) using new sources to provide new products for the recovery phase.

With respect to (ii), a first prospective project relates to the analysis of Twitter data streams in order to understand pre- and post-COVID-19 topic discussions, especially to assess social and life changes. A second prospective project relates to the use of mobile network operator (MNO)-based statistics to perform pre- and post-COVID-19 comparisons of mobility and tourism statistics.

Among these projects, there is a product Istat developed as part of the 2021 EU Big Data Hackathon [14] that won the competition. The product uses several datasets, including Google mobility data, and shows how the pandemic has influenced international trade networks in terms of products, countries, the means of transport used, and how the policies adopted by the national and European institutions to overcome the crisis have affected international trade. Istat continues to invest in the development of the product, proposed as part of Istat's experimental statistics.

Generally speaking, the emergency situation showed that NSIs have to be agile and adaptable, in order to be able to play a key role in the management of emergencies. These characteristics need to be made a permanent feature of NSIs by making dedicated investments in (i) using new sources of information such as big data,

and (ii) designing resilient and re-configurable business processes.

Nationally, the emergency also showed that NSIs can play an even greater role than they did before: not only as providers of statistics, but also providers of other relevant capabilities in emergencies. In order to do that, investments in communication and partnerships are needed to empower NSIs to be able to support national emergency policy-making.

2.5. Germany

Boost for innovation, agility and culture change in response to user needs for high quality data

The pandemic is constantly changing the environment for the production of official statistics, creating many new challenges for people working in official statistics.

During the pandemic, it was brought to light that in Europe we are not used to crisis scenarios of that kind. It takes time to reset the mind and even more time to retrieve emotional balance when it has been so shaken. However, the task of building a common European data space is still on the agenda. This means there are many areas that must be more closely examined now: health, industry and manufacturing, agriculture, finance, mobility, the European Green Deal, energy, public administration, etc.

The need for a fast-responding data system is now more relevant than ever, because political decisions that have a major impact on the lives of EU citizens are made every day. Regarding the Data Governance Act [15], that is the legislative proposal of the European Commission that aims to create a framework that will facilitate data sharing, it is obvious that it must be clearly defined what is in the public interest for fair and reliable access to new digital data sources, without infringing data protection regulations.

The Federal Statistical Office of Germany (Destatis) took time during the pandemic to reflect on standardised working procedures, including facing up to the fact that there is not always immediately clear evidence on COVID-19 or its impact. To compound this, the demands of users and their behaviour patterns have changed. The trust-building procedures between traditional users of statistical data and new users have entered territory requiring innovative approaches to providing reliable high quality data.

One remarkable change has been the increase in the use of dashboards. Destatis recognised that users were looking urgently for reliable information about the pandemic. The Destatis homepage saw an increase in the number of clicks – compared to 2019 – in March 2020, of 120%, and in December of up to 573% more clicks. This is definitely a sign that people are hungry for knowledge and need data they can rely on and trust in.

Destatis and other national authorities have managed to cope with this new demand. How? Thanks to the modernisation of internal organisational structures, working time is becoming more flexible and meets the highest standards of confidentiality in the case of people working from home.

Innovative solutions have been implemented to meet new information needs. Correlations with excess mortality were and still are of great interest, perhaps because they give people an individual explanation of how serious the situation is.

Changing indicators and correlations, coupled with different approaches worldwide, are an excellent example that using data – in short, using statistics – is a question of interpretation and that, used well, statistics can result in various policy recommendations.

For Destatis and other national authorities, one major goal is to maintain reliable statistical production. The following paragraph outlines some of Destatis' activities that developed faster during the pandemic in order to meet the changed needs of users and policymakers.

- To gauge the impact of the pandemic, Destatis is using methods such as web scrapping for price statistics. These methods result in a significant output that sheds light on economic developments, especially in times of inflation. In this context, increasing business non-response rates have been observed.
- The discussion of the timeliness of statistical results has taken on a new dimension. Bearing this in mind, Destatis will continue to develop nowcasts and flash estimates such as GDP flash estimates.
- Destatis is also providing more experimental statistics from private data sources to meet short-term data needs.
- Destatis, in a bid to take the lead regarding the necessary digital innovative solutions, is running motivating hackathons to adapt methods involving intelligent estimation methods, artificial intelligence and machine learning.
- Destatis has shown its commitment to innovation by offering a 'Hotspot monitor' to break down daily population mobility – a prime example of the potential of mobile phone data in the context of official statistics.

– Destatis supports an 'innovative open data portal' for the public, policymakers, public authorities, people working in the media, business and academics. In this spirit, it is participating in the development of 'Dashboard Germany' together with other national authorities, research institutes and owners of privately held data. The challenge is to implement a coherent quality assurance framework, indicating the category of each data producer. Metadata/quality reports must be provided. And for trust building: coherence checks for external data produced on the basis of other definitions of quality standards or other privacy frameworks.

The aim is to ensure more efficient and agile strategies together with national, European and international partners. Destatis is aware that there could be an overload while collecting data and therefore of the importance of sticking to the once-only principle. To summarise, Destatis is making sure it leaves nobody behind and that it presents high quality data, using digital applications and innovative technologies to ensure the timeliness of statistical production. Why? Because in times of crisis, official statistics must be truly representative of the state of play.

2.6. Finland

Innovative responses to urgent needs for prompter, in-depth information for evidence-based policymaking

At the beginning of the pandemic, there were a lot of concerns about the health of staff, working from home and the accumulation of source data for statistics. Fortunately, the threats of the initial phase did not materialise, and retrospectively it can be said that the pandemic gave Statistics Finland's the boost it needed.

The driver of change was the emphasis on society's information needs in exceptional circumstances. New, prompter, more in-depth information was urgently needed to deal with the crisis and understand its personal, economic and social consequences.

On the government's behalf, Statistics Finland launched the new Citizens Pulse data collection in April 2020. The survey has produced regular public opinion data on e.g. compliance with COVID-19 restrictions, trust in public authorities and respondents' confidence in the future.

The pandemic has also accelerated the production of statistics. For example, weekly data on deaths and bankruptcies have been published. In addition, the fast economic indicator developed together with Finnish research institute ETLA has also been published as experimental statistics. The recently launched national income register has also been used to produce fast information on paid wages and salaries.

There has also been a lot of demand for reviews and dashboards, which combine data from various statistical domains. For example, the economy is so complex that it is difficult to get a broad understanding of it from individual statistics. During the pandemic, Statistics Finland therefore began to produce a review on economic development, looking at the effects of the pandemic from the perspectives of the national economy, businesses, employment, consumers and public finance.

To produce more in-depth information, it is often necessary to combine expertise and sources of information from different organisations. The tourism industry is one of the areas of the economy hardest hit by the pandemic: to help understand the situation the industry finds itself in, Statistics Finland has produced scenario models of recovery in cooperation with key tourism industry players.

There has been a huge amount of information and misinformation about the pandemic and its consequences floating around. Statistics Finland has also had to put more effort into communicating, as a provider of objective information. Statistical information on the COVID-19 web service was launched with success, and releasing regular newsletters for users of statistics were also considered necessary.

Statistics Finland's task is to provide reliable and up-to-date information for the benefit of users and society. As the world changes, Statistics Finland's operations, products and services must also change in sync with world changes. Even before the COVID-19 crisis, the need to develop phenomenon-based statistical production and strengthen cooperation with various actors had been identified as strategic goals. The pandemic has accelerated Statistics Finland's trajectory in this direction.

COVID-19 Situation Room: Successful partnership with academia

Statistics Finland has also maintained a data service for researchers in the Situation Room set up by the Helsinki Graduate School of Economics (GSE) [16]. The Situation Room includes leading economists from Helsinki GSE and the Valtion Taloudellinen Tutkimuskeskus Institute for Economic Research (VATT), as well as members from several public authorities. It utilises relevant public and private data to produce regular reports for policymakers. Experiences from the COVID-19 Situation Room have been positive and the need for this type of service post-COVID clearly exists.

In addition to data sources administrated by Statistics Finland, the Situation Room also obtained access to data from the Finnish Institute for Health and Welfare, the Ministry of Economic Affairs and Employment, the Tax Authority, the Social Insurance Institution of Finland, Finnish Customs, the Bank of Finland and many other public and private sector organisations.

With this partnership with academia, Statistics Finland has enabled the extensive and fast production of information for policymaking during the pandemic. Situation Room reports provide insights into how the economy and society have fared during the pandemic. Analyses by the Situation Room have provided quick and innovative support for decision-making. Access to up-to-date data has provided insights into, for example, economic developments, employment and regional differences on short notice. The Situation Room has provided standardised reports and ad hoc analyses based on developments and needs during the pandemic, with the results primarily communicated as reports, in live webcasts and through access to the COVID-19 Data & Graph Vault.

The Situation Room has demonstrated that there is significant potential to improve fact-based decision-making by using data reserves more extensively and efficiently. Finland's high quality data registers make this possible, but additional resources are needed to develop processes that give researchers and analysts access to timely data. In addition to additional resources, a new role in data production would require modifications to existing legislation. For example, access to some register data, not used for statistical purposes, is not possible under current legislation.

3. Lessons learnt and inspirations for the future

Crises are often considered an ideal moment for change. Undeniably, the COVID-19 crisis quickly put national statistical systems on a trajectory of change. To a large extent this can be confirmed by the cases of all the countries presented in this article. In their cases, the pandemic was an opportunity to put into practice the need for structural transformations to develop more resilient and sustainable statistical practices while addressing a wide range of challenges. Moreover, these transformations signalled that NSIs were ready to move beyond adaptations towards a genuine transition i.e. to systemic changes. In this aspect, NSIs innovated and responded to both challenges, of the changed conditions of production of statistics on the one hand and providing data on the social and economic implications on the other hand.

The European Statistical System as a whole as well as individually, at Eurostat and at national level, was flexible in adapting to the changed statistical production environment brought by restrictions to mobility or personal contacts. Moreover, Eurostat, working together with the NSIs, focused on solutions that would be of direct help to official statisticians, drafting guidelines and notes on how to address the methodological issues triggered by changes in statistical production. This ensured that European statistics would continue to rest on sound foundations.

At European level, the newly created Recovery Dashboard initiated by Eurostat in close collaboration with the NSIs, and similar initiatives at national level, showed the capability of timely reactions and even proactive initiatives to pre-empt needs for statistical information that could monitor the way out of the shocks induced by the pandemic. With a focus on timely and high-frequency data, new data sources and estimation models were developed.

In this respect, ample evidence was provided in this article with respect to the responsiveness of the specific NSIs and their preparedness to change through innovation. What may be further needed would be to capitalise on the drive for change through innovation ushered in by COVID-19. European initiatives and past investments in the European Statistical System with respect to leveraging new data sources have paid off, as this provided a basis to start from in harnessing new data, using artificial intelligence and data science to produce information fit for decision-making.

As this article shows, a common characteristic was that NSIs gained in terms of visibility as trustworthy providers of official statistics by establishing important partnerships with other government services, research communities and private sector businesses. Moreover, it was obvious that beyond the institutional role for the development, production, and dissemination of official statistics, NSIs can play an even greater role as providers of relevant capabilities to other institutions or organisations who are important stakeholders within the wider data and information ecosystem. NSIs can lead on statistical methods and techniques based on sound statistical expertise, use of quality and metadata standards, and principles that underpin the work of the NSIs and of the statistical output. The enabling conditions of sustainable, trustworthy and stable channels for co-operation should be built into the NSIs' framework for roles and processes. Bringing legal certainty to cooper-

ation and partnerships with private data holders would ensure the sustainable development of high quality official statistics while protecting business interests and preserving the privacy of individuals.

Good communication at national and international level, and the cross-country exchange of experiences, have accelerated the adoption of good practices and proved the high value of broad international cooperation in the domain of innovation. The greatest challenge would now be to sustain the level of innovation and reinforce the benefits of innovative statistical processes, minimise uncertainty and obstacles and provide society with high quality statistical information.

Looking to the future, the European Statistical System has a responsibility to deploy new data sources, investigate innovative approaches to collecting data, and develop the necessary frameworks for data definitions, data standards, methodologies and data quality.

The system must rise to this challenge, by:

- ensuring the sustainable use of new data sources;
- finding ways to increase responsiveness to new needs;
- strengthening cross-border coordination;
- resolving major quality issues;
- adapting professional culture;
- building together a true data ecosystem.

The recent opportunities for innovation would need to be seen within a longer perspective of intensively using digital technologies and new data sources in a systematic, sustainable and responsible way. Indeed several challenges lie ahead.

Although the response of official statistics aimed primarily to support policy makers in COVID-19 times, official statistics enhanced communication with citizens aiming at satisfying citizen's data needs. Moreover, the use of new data sources within the context of innovation raised the need of refocusing once more on existing statistical principles, for instance, transparency, public value, privacy and ethics. Moreover, NSIs may further develop capacities on coordination and quality management and proactively provide assistance to other institutions that constitute sources of official information, as is the case in the field of health data in several Member States.

Despite the extended use of the internet, of smart devices and digital technologies, official statistics would need to ensure that a digital divide would not result to the exclusion of specific segments of the population from official statistics. The COVID-19 pandemic was an opportunity to raise awareness and consider the need of developing adequate, coherent quality assurance frameworks and metadata reporting standards when relying on new data sources. Bearing the risks of a digital divide and with the perspective of highly depending on technology solutions in the future with respect to data for statistics, official statistics should continue seeking methods for treating selectivity in order to be able to make unbiased inference for the total population as well as for populations of interest in official statistics.

Within the scope of using new data sources beyond legacy data collections methods, the increased granularity of data and subsequently statistical output would need to be coordinated or reconciled starting from developing common concepts, shared methodological reference frameworks and adequate definitions relevant to the phenomena the data represent. Therefore, efforts would need to be made towards maintaining harmonisation and international comparability.

Satisfying increased user needs, as well as supporting decision-making and the delivery of government services in emergencies, would be an important strand of work for the future. NSIs should also invest in innovation, collaborate and establish partnerships with the data providers and research communities that worked closely with them during the pandemic.

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