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**Coordination of international statistical work in the
United Nations Economic Commission for Europe region:
Outcomes of the recent in-depth reviews carried out by
the Bureau of the Conference of European Statisticians**

In-depth review of timeliness, frequency and granularity of official statistics

Prepared by Canada and Portugal

Summary

This in-depth review was mandated by the Conference of European Statisticians (CES) Bureau and discusses the importance of timeliness, frequency and granularity of official statistics. A seminar on the same topic was held during the seventy-first CES plenary session in June 2023. The review summarizes national and international efforts in responding to continued demand for more timely, frequent and granular official statistics through innovative methodologies, new data sources, statistical registers and advanced technologies, and identifies key issues and challenges related to these efforts. Section VIII summarizes the discussion by the Bureau of the Conference of European Statisticians at its meeting in February 2024.

The Conference is invited to endorse the outcomes of the in-depth review.



I. Executive summary

1. The overview of international statistical activities presented at the seventy-first Conference of European Statisticians (CES) plenary session underscored the global push for more timely, frequent and granular data. Key findings revealed a focus on enhanced timeliness through innovative methodologies, the integration of new data sources, and the use of advanced technologies across various countries. This paper summarizes notable implementations and recommendations from several countries and draws the conclusions found below.
2. At the international level, there is a need for a continuous commitment to enhancing the timeliness and granularity of statistical data. This entails a sustained focus on adapting and evolving methodologies to meet the changing demands of users and the rapid developments in available data, methods and technologies. Additionally, it is recommended to intensify efforts to strategically leverage Earth Observation (EO) data by fostering collaboration and partnerships among relevant stakeholders.
3. On the national level, the emphasis remains on a continuous commitment to improving the timeliness and granularity of official statistics. This involves not only the adoption of innovative methodologies but also the establishment of strategic partnerships and collaborations across various sectors. To ensure the quality of statistical outputs, it is crucial to develop and implement robust quality assurance frameworks that incorporate rigorous checks and transparency measures. Continuous communication and transparency should be prioritized through the dissemination of comprehensive reports.
4. Recognizing the significance of information technology (IT) infrastructure in supporting innovative statistical production, there is a recommendation to invest in IT infrastructure. This investment should be directed towards ensuring the sustainability of technological advancements, including the adoption of open-source languages, cloud computing and other emerging technologies. To drive a cultural shift within national statistical offices (NSOs) and foster an environment conducive to innovation and risk-taking, leadership plays a pivotal role. Hence, it is advised to actively promote leadership that champions an innovative culture and encourages measured experimentation. Additionally, to bridge the generation and knowledge gap, there is a need to enhance skills for innovation through training programmes and by promoting a growth mindset among the staff.

II. Introduction

5. The topic “Timeliness, frequency and granularity of official statistics” was selected for a seminar session of the seventy-first CES plenary session in June 2023, following the compelling circumstances arising from the COVID-19 pandemic that served as a catalyst, propelling NSOs to enhance the timeliness, frequency and granularity of official statistics. Early in the pandemic, many NSOs implemented new methods to produce data more quickly and to provide official statistics at more disaggregated levels. NSOs are now incorporating lessons learned from the pandemic into their methodologies and approaches. New products such as advanced indicators and ad hoc solutions employed during the pandemic, where deemed relevant and beneficial, are being considered for integration into regular processes, emphasizing sustained efficacy. NSOs are undertaking a systematic review and refinement of methods to ensure continuous improvement.
6. The CES Bureau regularly reviews selected statistical areas in depth. The aim of the reviews is to improve the coordination of statistical activities in the United Nations Economic Commission for Europe (UNECE) region, identify gaps or duplication of work, and address emerging issues. The review focuses on strategic issues and highlights concerns of statistical offices of both a conceptual and a coordinating nature. The current paper provides the basis for the review by summarizing the international statistical activities in the selected area, identifying issues and problems, and making recommendations on possible follow-up actions. Statistics Canada and Statistics Portugal co-chaired the session which featured

contributions from Canada,¹ Hungary,² Poland,³ Portugal,⁴ Spain,⁵ United Kingdom of Great Britain and Northern Ireland⁶ and the Organisation for Economic Co-operation and Development (OECD).⁷ Statistics Canada and Statistics Portugal volunteered to prepare this paper providing the main basis for the review.

7. Considering these prevailing themes, this paper takes a focused approach to address the imperatives of timeliness, frequency and granularity within official statistics, centring on four pivotal areas: methods for timely data, exploration of new data sources, effective use of registers, and strategic integration of new technology. To bolster progress in these key domains, corresponding challenges in the related areas of the cultivation of partnerships, instigation of internal cultural shifts and the assessment and communication of quality will also be addressed.

III. Scope/definition of the statistical area covered

8. The contributions from participating organizations during the seventy-first CES plenary session featured a diversity of innovations, yet several recurrent themes emerged. First, the intrinsic nature of official statistics underscores the necessity to adhere to quality standards. However, quality, within the context of this document, is delineated within a multidimensional framework, accounting for timeliness and relevance alongside accuracy. Additionally, the definition of quality extends to a fit-for-use paradigm, where data and methods align to ensure sufficient quality for the intended purposes of the statistics.

9. At the 2023 CES session and in this paper, timeliness and frequency are considered together including statistics produced more frequently (i.e., monthly in lieu of quarterly statistics) and advanced or early indicators, such as nowcasts or flash estimates. Nowcasts are characterized by estimates generated through methodologies distinct from those employed for final estimates, while flash estimates employ the same methodologies, but produce estimates sooner by often relying on incomplete collected data. Despite potential reductions in accuracy and coherence with other sources, the timeliness of advanced or early indicators, within a multidimensional definition of quality, may render them fit-for-use.

10. With the imperative for providing granular, frequent and timely data, in addition to the implementation of new methods, amplifying the utilization of administrative data holdings while seeking out and embracing new data sources, was a prevalent theme. Administrative data refers to information collected by government or other organizations for administrative and operational purposes rather than for statistical objectives. This type of data is generated as part of routine administrative processes and operations, often in the course of delivering public services or managing organizational activities. Throughout this paper, other new data sources, which sometimes may be referred to as “alternative data”, can include less

¹ The challenges in remaining a trusted and relevant data provider of timely and granular statistics, prepared by Canada: https://unece.org/sites/default/files/2023-06/CES%202023%2028_Item%209.pdf.

² Incorporating administrative data in monthly Labour Force Surveys estimation of economic activity, and Value Added Tax-based monthly estimation of foreign trade of services in Hungary: https://unece.org/sites/default/files/2023-06/CES%202023%2029_Item%209.pdf.

³ Granular and timely data – statistical response to growing user needs, prepared by Poland: https://unece.org/sites/default/files/2023-06/CES%202023%2030_Item%209.pdf.

⁴ How to keep timeliness and frequency with monthly administrative data? Prepared by Portugal: https://unece.org/sites/default/files/2023-06/CES%202023%2031_Item%209.pdf.

⁵ Statistical learning in the Industrial Turnover Index: from a use case to strategic reflections, prepared by Spain: https://unece.org/sites/default/files/2023-06/CES%202023%2027_Item%209_0.pdf.

⁶ Real-time indicators in the United Kingdom – lessons learned and next steps: https://unece.org/sites/default/files/2023-06/33_Rev.1_Item%209_Timeliness_United%20Kingdom_0.pdf.

⁷ Organisation for Economic Co-operation and Development and United Nations Statistical Division’s Multinational Enterprise Information Platform: https://unece.org/sites/default/files/2023-06/CES%202023%2032_Item%209.pdf.

traditional data sources such as Earth Observation (EO) data, web-scraped data or financial transaction data. These sources may be less complete and may hold other challenges.

11. The adoption of new technologies and robust IT infrastructure also emerged as crucial components in leveraging new data and methods. In-scope under new technologies are the data platforms used, software used to manipulate data and cloud computing.

IV. Overview of national and international statistical activities

12. The seventy-first CES plenary session highlighted numerous instances of enhanced timeliness in data releases, leveraging various administrative and new data sources for more granularity. Keynote speaker Steve MacFeely from the World Health Organization emphasized the pivotal role of population and statistical registers, particularly during crises, in delivering timely and detailed data. The integration of new technologies emerged as a prevalent theme across countries, all striving for increased timeliness, frequency and granularity in data production. Subsequent subsections delve into illustrative examples from countries and institutions, focusing on four key domains: a) timely statistics, b) use of new data sources, c) utilization of registers, and d) use of new technologies.

A. Production of timely data

13. The onset of the pandemic accelerated the advancement and deployment of methodologies aimed at generating more timely data, responding to significant shifts in economic indicators that profoundly affected both businesses and individuals. The Office for National Statistics (ONS) in the United Kingdom proactively transitioned to increased frequency in data collection for their Opinions and Lifestyle Survey. Furthermore, they established near real-time economic indicators. Over the past three years, the real-time project at ONS underwent continuous evolution and adaptation to address additional challenges prevalent in society and the economy. Presently, ONS boasts an extensive suite of real-time indicators spanning diverse areas such as business insights, workforce dynamics, consumer behaviour, transport and energy. These indicators are selectively featured in publications, rotating in and out based on policy requirements.

14. Statistics Canada released its inaugural advance indicator estimates for March 2020, with additional flash estimates for retail sales, wholesale trade, and manufacturing commencing with the April 2020 reference month. These advance indicators were computed based on a reduced set of survey and administrative data – a methodology previously demonstrated, through Statistics Canada studies, to outperform nowcasting methods relying on an aggregate modelling approach. The adoption of these methods successfully curtailed the lag for an initial estimate from 50 days to a more agile 20 days following the reference month. Based on user demand, Statistics Canada has continued the dissemination of advance economic indicators and recently subjected the results to a comprehensive quality review, affirming their fitness for use.

15. Statistics Portugal undertook a series of initiatives aimed at enhancing timeliness, frequency and granularity. Notably, StatsLab emerged as a significant endeavour, accessible through the Statistics Portugal portal, showcasing innovative statistical products in various stages of development. The primary objective was to harness the potential of novel data sources and methodologies. One theme explored in this portal was the “birth of the first child” with the availability of electronic invoices (e-invoice) being used before and after the birth of the first child of households, as well as other administrative sources and records to explore as the profound impact this event has on family life.

16. Spain explored the trade-off between timeliness and accuracy in the context of the Industrial Turnover Index. Their statistical learning models were applied to survey microdata, allowing for dissemination dates before the end of data collection and editing. They demonstrated that this approach could have far-reaching implications for the statistical production process. They highlighted the importance of complementarity between different units within the organization and the investment in advanced statistical skills, IT infrastructure, and the development of standard protocols for experimental statistics.

17. Hungary took a proactive approach to improve timeliness in the estimation of economic activity. Recognizing that quarterly samples were insufficient for estimating monthly employment and unemployment figures, the Hungarian Labour Force Survey (LFS) integrated administrative data, including tax records, social security information, and registered jobseekers' data to provide reliable, monthly LFS estimates. This integration not only improved timeliness but also enhanced the overall quality of the data.

B. Use of new data sources to produce timely, frequent and granular data

18. As touched upon in the subsection above regarding timely data, several countries undertook initiatives to explore administrative and novel data sources, aiming to either supplant or augment conventional methodologies employed in official statistical processes. These additional data sources, particularly large data sources, were found to facilitate providing more granular data. The utilization of satellite and Earth Observation (EO) data was documented in reports from Canada, the Netherlands and Poland. Steve MacFeely further proposed in his keynote address to unify efforts across countries to have standardized approaches to the use of EO data that could also benefit from joint collaborations. ONS, along with OECD, presented their web scraping techniques. Additionally, diverse data reservoirs, including financial data, scanner data and unstructured text data, were integrated into the substantive fabric of official statistics, contributing to both their production and validation.

19. Statistics Netherlands actively engages in numerous international studies focused on the utilization of EO data. These studies primarily centre on applications in the domains of agriculture, biodiversity, land use and, to a certain extent, air quality. While anticipating that EO data can enhance certain European Green Deal⁸ indicators in terms of timeliness and granularity, Statistics Netherlands acknowledged that it is not a comprehensive solution for official statistics. The encountered challenges encompass establishing extensive partnerships and collaborations, as addressed in Section V.

20. At Statistics Poland, the successful implementation of remote sensing in agriculture statistics has significantly alleviated the burden on respondents and reduced labour input while enhancing granularity, timeliness and cost-effectiveness of surveys estimating crop area and predicting yields. Despite partial utilization of EO data, Statistics Poland mentions that it faces challenges in fully realizing its expected extent, especially in the application of EO methods for detecting anthropogenic objects and acquiring data on urbanized areas. The adoption of cloud computing for EO introduces additional challenges related to statistical confidentiality.

21. ONS in the United Kingdom is actively delving into the utilization of thermal imaging EO data to acquire detailed environmental insights. This initiative aims to generate granular data crucial for bolstering the production of local area public health statistics, particularly in understanding the impact of environmental factors. As well, as part of the ONS International Development Strategy, collaborative efforts with the United Nations Population Fund (UNFPA) involve harnessing high-resolution satellite imagery to identify internally displaced populations in Somalia, thereby supporting an upcoming census. This endeavour plays a pivotal role in informing census preparations, such as the development of sample frames, and providing initial estimates for hard-to-count populations.

22. ONS also responded to the pandemic by accelerating its methods, incorporating data science techniques such as web scraping, and integrating additional data sources. Notable additions to statistical outputs included aggregate data from the Clearing House Automated Payments System (CHAPS), tracking credit and debit card payments, and data from OpenTable, a restaurant reservation dataset. ONS achieved significant advancements through multiple sophisticated business cases, integrating real-time indicators into the quality assurance and production processes for the National Accounts.

23. Similarly, OECD, mirroring ONS, explored web scraping as a source for timely data. Their collaborative initiative with the United Nations Statistics Division (UNSD) led to the creation of a platform housing a global register of the largest 500 multinational enterprises,

⁸ The European Green Deal: See <https://www.consilium.europa.eu/en/policies/green-deal/>.

coupled with a digital register of their web presence. This initiative provides a comprehensive understanding of global economies and value chains, despite challenges related to extensive data validation and manual extraction from inconsistent web sources.

24. Statistics Canada utilized high-resolution satellite imagery and scanned financial statements, incorporating unstructured text data on product descriptions. Successful applications include modelling crop yields using satellite information and crop insurance data, as well as enhanced representation of household consumption through scanner data in the Consumer Price Index (CPI). Challenges persist in managing costs associated with obtaining and housing certain new data sources, such as EO data, and integrating these new sources with traditional data for more comprehensive datasets.

25. Statistics Portugal leveraged the increased use of non-statistical data sources, such as admin data, within the landscape of official statistics production. The strategic integration of electronic invoice data marked a noteworthy evolution, transitioning from a conceptual framework to practical implementation. This transformative step was underpinned by the mandatory nature of e-invoices for all companies in Portugal, mandating a monthly reporting frequency. The comprehensive coverage of commercial transactions involving goods and services further underscored the significance of this data source. Importantly, the data gleaned from electronic invoices has become integral to a multitude of official statistical operations, contributing substantively to the robustness and relevance of the produced results.

C. Statistical registers in the production of timely, frequent and granular data

26. In his keynote address, Steve MacFeely highlighted the pivotal role registers play in providing current and pertinent information, serving as a foundation for establishing linkages and facilitating data replacement in the realm of statistical products. The statistical offices of both the Netherlands and Norway have demonstrated advanced methodologies and applications in harnessing the potential of their respective statistical registers. Colombia also applies rigorous quality standards to all data outputs, including those from administrative registers.

27. In Norway, Statistics Norway manages an array of registers, each encountering unique challenges. Notably, a recent modernization initiative led by the tax authorities has elevated the data quality of the population register to a level surpassing international standards. The agility in registering demographic events and the continuous updates to the register contribute significantly to its quality. However, persistent concerns underscore valuable insights for countries embarking on similar modernization endeavours. Challenges include the identification of groups beyond the target population, such as illegal inhabitants, asylum seekers without granted asylum, and individuals relocating from Norway without registering their emigration. Within the target population, defining households and families encounters challenges, manifesting in imperfect housing placement and harmonization against the cadastre.

28. Statistics Norway produces approximately 100 annual reports on the quality of various administrative data used in statistics, attesting to the overall high quality of the data. However, recurring issues include validating unique identification numbers for certain data deliveries and addressing measurement errors, inconsistent values and missing values in others.

29. In the case of Statistics Netherlands, a strategic incorporation of both business and social registers underpins the production of official statistics. Four key quality challenges related to administrative data have been identified, encompassing variations in population coverage, unit types, variables and the temporal dimension between the administrative data and the intended statistical use. Estimation and derivation methods are employed to align administrative data outcomes with the intended statistical use.

30. Furthermore, Statistics Netherlands considers the administrative practices involved in data recording, acknowledging decentralized organizations' registration habits. Issues related to administrative delay are addressed by assessing bias in gradually filling registers and

evaluating consistency. Challenges arise in handling corrections submitted by respondents to their earlier data or the inclusion of corrections for previous periods, requiring careful disentanglement. A deeper understanding of the administrative data and the significance of specific variables to the data provider is emphasized, recognizing that variables of lesser importance to the data holder may exhibit lower quality. A recent article by Delden and Lewis (2023) covers many of these challenges, particularly on the business side.

31. In Colombia, adherence to a set of Technical Standards of Statistical Quality is imperative for official statistics, guided by the Department of National Statistics (DANE). To ensure fitness for use, rigorous quality checks are implemented across various phases. During the collection phase, data from administrative registers undergo scrutiny, encompassing coverage, completeness and consistency indicators tailored to each topic. Hyperdimensional checklists based on Statistics Netherlands' work are applied to administrative registers (Daas et al, 2009). The process phase involves detecting missing, atypical and inconsistent values, validated against the data source, with imputation techniques applied when necessary.

D. Leveraging new technology in the production of timely, frequent and granular data

32. The Office for National Statistics (ONS) of the United Kingdom is actively engaged in the implementation of Reproducible Analytical Pipelines (RAPs), employing automated analytical processes facilitated by state-of-the-art open-code software, including Python and R. These pipelines are designed with elements of software engineering best practices, ensuring attributes of reproducibility, auditability, efficiency, and high quality. In tandem, ONS is executing a legacy reduction programme, replacing non-fit-for-purpose software with strategic cloud-native technologies. This strategic shift enables innovation at a rapid pace and substantial scale, contributing to advancements in the referenced quality dimensions.

33. Statistics Poland employs technology based on Google Earth Engine and utilizes toolboxes grounded in R, SNAP and Python. The organization actively monitors the evolution of EO technologies, asserting that the development of a local data processing infrastructure alone is not a sustainable long-term solution. Consequently, the focus lies in constructing infrastructure on a broader scale. Embracing open data products such as Google Earth and Microsoft solutions, Statistics Poland also recognizes products developed by the European Space Agency (ESA). The organization is steadfast in its belief that the growing demands for data processing can be met through scalable cloud solutions, providing ample computing power.

34. Statistics Netherlands adheres to an office automation architecture complemented by two additional environments dedicated to massive statistical calculations. Greenplum is employed for handling larger datasets, while DGX serves as the data science platform catering to operations demanding enhanced computing power. In instances requiring even greater computing power for research endeavours, Statistics Netherlands leverages a supercomputer, operationalized under the ODISSEI Secure Supercomputer (OSSC) working method.

35. In its exploration of integrating unstructured and semi-structured data (e.g., news articles, company financial statements) into existing statistical programme areas, Statistics Canada has found the key challenge lies in securing access to an environment equipped with adequate computing power and relevant technologies, particularly for training and developing models required for data mining. As part of its strategic evolution, Statistics Canada is transitioning to open-source software like R and Python, concurrently exploring data platform options to effectively support future data engineering needs.

36. In pursuit of its revolutionary vision, Statistics Portugal created the National Data Infrastructure (IND) as a strategic objective, integrating the operating logic of the statistics production process, including organizational rearrangements to change the production chain to a data-based perspective. Statistics Portugal recognizes that the convergence of DataOps, R, GitLab, reproducibility and data pipelines represents a powerful paradigm shift in data science and statistical processes. Consequently, it has effectively adopted combinations to

promote collaboration, increase the efficiency of data workflows, and ensure the reproducibility of results in the dynamic and fast-paced reality of data-driven decision-making.

V. Issues and challenges

37. The impetus to produce more timely and granular data, emphasized in both the 2023 CES plenary session and the preceding sections of this paper, compels the adoption of cutting-edge methodologies, exploration of novel data sources, integration with administrative data and registers, and the utilization of technologies such as cloud computing and open-source software. Each of these realms inherently introduces challenges.

38. The crucial initial step of acquiring or receiving new data from a source can prove challenging. Added to that, the introduction of new methods, coupled with new data sources, introduces potential quality challenges. Stakeholders and data users may grapple with understanding the implications of these changes. Moreover, the themes covered in this paper signify substantial transformations for national statistical offices as organizations. These changes are intricately linked to the anticipated demands for continuous evolution while addressing existing and potentially escalating demands for more frequent and detailed official statistics. The subsequent subsections provide an exploration of these challenges:

- (a) Obtaining and using new data sources;
- (b) Assessing and communicating quality;
- (c) Internal culture change.

A. Obtaining and using new data sources

39. The utilization of new data sources has emerged as a pivotal strategy for delivering more timely and granular data. However, the acquisition of these new data sources presents several challenges. While certain data may be publicly available, as in the case of web-scraped data, others require collaboration and partnerships with external data holders, spanning governing bodies, financial institutions and the private sector. Establishing partnerships across governments and with key stakeholders becomes imperative in this scenario. These partnerships should embody a mutually beneficial relationship, where data providers ideally perceive the relationship as advantageous either through enhanced insights into their datasets or, where warranted, through potential remuneration. For example, the NSO may pay for the data processing or transmission costs or the NSO may leverage its competitive advantage through the integration of the data source with other data holdings to provide new data and insights back to the data provider.

40. In forging these partnerships to access new data sources, the key element is the establishment of trust. Data holders often are protective of their holdings and will seek clarity on how the data will be used. They will require assurances, possibly protected through legal agreements, ensuring that the NSO acts as a responsible data steward. Frameworks to safeguard the data from reception to dissemination should be implemented to protect the privacy and confidentiality of the data. Moreover, building these partnerships is not a one-time effort; they need to be sustained, especially if the NSO will be reliant on the partner for the data in the long-term, establishing the data as a foundation for its statistical outputs.

41. The NSO must also consider public perception and put in similar concerted efforts in building trust with its citizens through transparency and a demonstration of high ethical standards. This is particularly true as the data and methods evolve and in light of increased mistrust in governing bodies and the rampant spread of disinformation.

42. In the context of EO data, purchasing or storing high-resolution data might be cost-prohibitive for specific projects and for the NSO. Partnerships for utilizing a dataset across various purposes, benefiting multiple organizations across departments, government levels, or even geographic regions and countries, can prove advantageous.

43. Regardless of their origin, new data sources may also harbour quality concerns. While this aspect will be explored more extensively in the next subsection, even when data, such as administrative or satellite data, may be more accurate and complete than traditional sources obtained from surveys, integration with other sources becomes necessary to add supplemental variables. This introduces significant challenges related to data linkages, unit definitions, and concepts between the different data sources.

B. Assessing and communicating quality

44. NSOs rely on public trust. Trust in official statistics is critical for trust in government. For these reasons, the quality of official statistics is of utmost importance. Several quality implications have been identified through the use of registers, new data sources and new methods to produce more timely, frequent and granular official statistics. Therefore, quality safeguards must be established, new methods must be tested to establish statistical validity and transparent communication must be provided about provisional estimates.

45. The utilization of registers presents many opportunities but poses several significant challenges in ensuring the quality of statistical products (Bakker et al, 2012). Challenges in register management may persist pertaining to identifying groups beyond the target population, such as illegal inhabitants and unregistered emigrants. In addition to these population coverage challenges, there can be challenges related to unit types, variables and their definitions and temporal dimensions. For unit types, the data may be collected at a level different than the unit of analysis. For example, administrative data may be at the unit level, posing challenges for family and household statistics. The concepts of the data in the administrative data may have a different definition than international standards or those commonly used in the statistical sense. And the administrative data used in registers may be subject to time lags, that may not even be consistent across sub-jurisdictions. Furthermore, administrative practices of the data providers, decentralized registration habits, and the handling of data editing pose additional complexities. Rigorous checks during the collection and process phases will help to address issues of coverage, completeness and consistency.

46. All data is subject to certain assumptions and quality issues, but it may be further pronounced through the integration of different datasets and the use of new methods. Quality issues can arise from data intake to data dissemination. To mitigate these concerns, quality monitoring activities need to be seamlessly integrated into the statistical practices, incorporating metadata on the statistical processes, quality check activities, and relevant indicators. During the collection phase, comprehensive quality checks, including coverage, completeness and consistency are essential. For some data sources, the NSO may have little-to-no control over data collection which underscores the need for close relationships with the data provider and/or close scrutiny in the following steps. Data may be missing, atypical or inconsistent, and these types of errors must be addressed through a processing stage. The final data may yet contain quality issues and as with traditional approaches, it must be checked for coherence against other data sources and at various levels of disaggregation.

47. Even if the new data and methods have been found to meet NSO and international standards of quality as fit-for-use, there remain challenges related to communication. Without clear and transparent communication, there can be a degradation of trust in the data and methods. The body of quality of assessments and checks, along with quality indicators must be made available along with the data to demonstrate transparency and confidence in the data. Furthermore, with the adoption of new methods for timely data there may be impacts on the accuracy of data. While these data may be deemed as fit-for-use (meeting certain standards allowing for release) they may not be fit for all purposes. For example, if data users need highly accurate data, flash estimates may not be appropriate. Direct communication with major users and stakeholders may be necessary. Transparent communication for early/advanced indicators includes clear labels, disclaimers and explanations of provisional estimates. Many NSOs allocate separate spaces for disseminating experimental data.

C. Internal culture change

48. The integration of new data, methods and technologies within a NSO often presents formidable challenges in navigating internal cultural shifts. One prominent hurdle lies in the resistance to change among longstanding staff members who may be accustomed to traditional methods. The openness to explore and test innovative technologies and methodologies might encounter scepticism or apprehension, requiring effective change management strategies to instil a culture of openness and adaptability. Reorganization to create specialized teams with a focus in the area for development may centralize skills and support sustained momentum. Encouraging collaboration and knowledge-sharing across different teams is also crucial to breaking down silos and fostering a collective understanding of the benefits and implications of the proposed changes.

49. Additionally, there may be a notable generation gap within the NSO, with younger, tech-savvy staff embracing new approaches more readily than their more experienced counterparts. Bridging this gap necessitates effective communication strategies to convey the advantages and relevance of adopting new data sources and methodologies. Leadership plays a pivotal role in driving cultural change by championing the benefits of innovation, providing adequate training and development opportunities, and creating an environment that encourages experimentation and learning from failures. Balancing the preservation of institutional knowledge with the infusion of fresh perspectives becomes a critical aspect of successfully navigating cultural change within the NSO.

50. Furthermore, the adoption of new technologies and methodologies may necessitate a paradigm shift in the organization's approach to decision-making and risk tolerance. Traditional bureaucracies might face challenges in embracing a more agile and adaptive culture that accommodates experimentation and iterative development. The fear of potential errors and data inaccuracies may hinder the adoption of advanced technologies. Building a culture that employs the scientific method and views setbacks as learning opportunities and encourages continuous improvement is essential to fostering an environment where staff members feel empowered to explore and implement innovative approaches to statistical production. The NSO may need to invest significant resources to support the growth mindset for continued culture change.

VI. Conclusions and recommendations

51. Taking into consideration the advancements in recent years, the continued demand to provide timely, frequent and granular official statistics and challenges identified in this paper and at the seventy-first CES plenary session, the following recommendations are made at the international and national levels:

52. At the international level the following is recommended:

(a) **Continuous emphasis on timeliness and granularity.** Recognizing the ongoing need to produce more timely and granular data in response to evolving user demands and the continued rapid change in available data, methods and technologies, a future check-in should be made to assess recent adaptations, new evolving challenges and advancements in quality frameworks that address these new areas.

(b) **Increase the strategic use of Earth Observation (EO) data.** Explore opportunities for collaboration and partnerships in utilizing EO data, especially in cases where purchasing or storing high-resolution data may be cost-prohibitive. Leverage EO data to enhance certain indicators' timeliness and granularity and build infrastructure on a broader scale to meet growing demands.

53. At the national level the following is recommended:

(a) **Continuous emphasis on timeliness and granularity.** Recognizing the ongoing need to produce more timely and granular data in response to evolving user demands and the continued rapid change in available data, methods and technologies, a future check-in should be made to assess recent adaptations and new evolving challenges.

(b) **Build strategic partnerships and collaborations.** Establish and nurture partnerships across governments, private sectors,⁹ and key stakeholders for accessing new data sources. Where appropriate, these relationships should also be forged internationally. Foster mutually beneficial relationships to enhance insights and ensure sustained collaboration. Emphasize transparency and build trust through legal agreements and frameworks safeguarding data privacy.

(c) **Implement quality assurance frameworks.** Develop or implement a comprehensive quality assurance framework integrating metadata on statistical processes, quality check activities, and relevant indicators that can be applied to new data sources and methods. Implement rigorous checks during data collection and processing phases, addressing issues of coverage, completeness, and consistency. Ensure the quality assurance framework is publicly available.

(d) **Continuous communication and transparency.** Emphasize clear and transparent communication to address potential challenges related to the adoption of new data sources and methodologies. Engage citizens through clear communications on safeguarding data privacy and in adhering to high ethical standards to establish and build trust in government. Provide comprehensive reports on overall quality. At a minimum include disclaimers and explanations of provisional estimates, and consider allocating separate spaces for disseminating experimental data to foster transparency and increase interpretability of data.

(e) **Invest in IT infrastructure.** Recognize the importance of robust IT infrastructure to support the adoption of new technologies. Allocate resources to meet the demands of open-source languages, cloud computing and other technological advancements. Consider the long-term sustainability of infrastructure to support innovative statistical production.

(f) **Leadership for innovative culture and risk-taking.** At senior management levels, spearhead cultural change by championing innovation, providing robust training, and fostering an environment that encourages measured experimentation. Establish specialized teams, promote collaboration, and employ effective change management strategies to instil a culture of openness and adaptability, embracing calculated risks for progress. Encourage a growth mindset within the NSO, endorsing continuous improvement and adaptability. Foster a culture that sees setbacks as learning opportunities and supports experimentation. Allocate resources to uphold a growth mindset, ensuring staff feel empowered to explore and implement innovative approaches to statistical production.

(g) **Skill enhancement for innovation.** Bridge the generation and knowledge gap by investing in skill development and training programmes. Create collaborations with academics. Hire new staff with skills and knowledge in desired areas. Provide staff, including experienced members, with the necessary knowledge to work effectively with new technologies, open-source languages, and innovative methodologies.

VII. Acknowledgements

54. Statistics Canada and Statistics Portugal would like to thank all contributing NSOs and international organizations from the seventy-first plenary CES session in June 2023 and those that responded to the questions sent in the fall of 2023. Thank you for sharing your experiences, expertise, and best practices. These include Colombia, Hungary, Italy, the Netherlands, Norway, Poland, Spain, Switzerland, the United Kingdom and OECD.

55. A special thank you is also given to Steve MacFeely, keynote speaker, who provided a unique international perspective highlighting both opportunities and gaps based on his experience at the World Health Organization.

⁹ For more information, see the in-depth review on collaboration with private sector data providers: https://unece.org/sites/default/files/2022-10/ECE_CES_2022_11_2230719E.pdf.

VIII. Summary of the Conference of European Statisticians Bureau discussion in February 2024

56. The Bureau reviewed in depth the topic of timeliness, frequency and granularity of official statistics based on a paper prepared by Canada and Portugal. Countries and organizations who contributed to the in-depth review include Colombia, Hungary, Italy, the Netherlands, Norway, Poland, Spain, Switzerland, the United Kingdom, and OECD.

57. A seminar on this topic was held during the seventy-first CES plenary session in June 2023. The paper summarized the key findings from the CES seminar and incorporated further inputs and responses collected through a questionnaire to present a thorough overview of the subject and formulate recommendations for further steps.

58. The following points were made during the discussion:

(a) Many NSOs have been striving to produce more timely, frequent and granular data. An important challenge for NSOs in addressing the evolving data needs lies in effectively obtaining and using new data sources.

(b) The new data sources should be considered as important as traditional sources, considering both their advantages and associated risks. This requires an internal culture change to foster innovation and risk-taking, and leadership with strategic foresight.

(c) It is crucial for NSOs to ensure the reliability, regularity and sustainability of data to be able to build the new sources into a regular production cycle. The new sources have cost implications and possible limitations on their use, but they may allow for obtaining new data and achieving timeliness, frequency and granularity that were not possible before.

(d) Collaboration and knowledge sharing within the organization, as well as effective communication and strong partnerships with data providers are needed. NSOs can opt to establish a dedicated unit for innovation which could be more open to experimentation. At the same time it is important to integrate innovation across the organization. For example, communities of practice can generate a lot of enthusiasm and grass-roots innovation.

(e) It is essential to maintain a steady and regular supply of granular data not only during emergency situations like earthquakes and pandemics but also during normal times. There is a rising demand for local data by local leaders to inform local decision-making processes.

(f) The use of new data sources often requires investment and may be costly to put in place, even when the data are or seem to be accessible for free. However, there are not many other options to meet the increasing data needs and improve data timeliness, frequency and granularity.

(g) It was suggested to merge the recommendations at international level and at national level into one section in the paper, as they are interconnected and relevant to all statistical organizations.

(h) The issues raised in the paper are relevant to all domains of official statistics. Therefore, the paper should be also brought to attention of the current expert groups working under CES.

59. In conclusion, the CES Bureau supported the recommendations in the paper. Canada and Portugal were invited to update the paper to take into account the points raised in the discussion. The paper will be sent for electronic consultation to all CES members in March–April 2024.

IX. References

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