

Annex A: The Cultural and Creative Cities Monitor methodology in ten steps

1. Conceptual framework

The conceptual framework of the Cultural and Creative Cities Monitor (hereinafter ‘the Monitor’) – as expressed in its main **Cultural and Creative Cities Index (hereinafter ‘C3 Index’)**, **three sub-indices, nine dimensions and 29 indicators** – was developed by the JRC in consultation with policymakers, academics and practitioners in the field of culture and creativity.

Overall, the Monitor covers three major facets of a ‘Cultural and Creative City’, namely:

- **‘Cultural Vibrancy’**, which measures the cultural ‘pulse’ of a city in terms of cultural infrastructure and participation in culture;
- **‘Creative Economy’**, which captures how the cultural and creative sectors contribute to a city’s economy in terms of employment, job creation and innovation;
- **‘Enabling Environment’**, which identifies the tangible and intangible assets that help cities attract creative talent and stimulate cultural engagement.

2. Data selection

The selection of **quantitative** data for the 2019 Monitor respects the following **five criteria**.

- **Coverage.** Data that allow city-level performance to be assessed and compared vis-à-vis peer cities, whenever available for at least 50% of the cities in the sample¹.
- **Relevance.** Data that are relevant to assess culture- and creativity-related factors, as suggested in the relevant literature².
- **Accessibility.** Data that is publicly available: peer-reviewed scientific data, data compiled by international organisations or data available from the web.
- **Quality.** Data with a quality that can be controlled and which represent the best measure of a domain currently available in Europe.
- **Timeliness.** The most up-to-date datasets available, with data selected from 2010 to 2019.

Eight main sources were used to collect the relevant data: (i) Urban Audit, Eurostat (city level); (ii) Regional Statistics, Eurostat (NUTS 3 level; good approximation for cities with more than 150 000 inhabitants, corresponding to 75% in the sample); (iii) Eurobarometer Survey on quality of life in cities, jointly prepared by the European Commission’s Directorate-General for Communication, the Directorate-General for Regional and Urban Policy and the market research company TNS (city level); (iv) Directorate-General for Regional and Urban Policy (city level for transport indicators, NUTS 2 and NUTS 1 and NUTS 0 level for governance indicators, which is deemed to represent a good approximation of ‘system indicators’ such as governance); (v) university rankings (QS, Shanghai, Leiden, Times) (city level); (vi) European Tertiary Education Register (ETER) (city level); (vii) TripAdvisor (city level); and OpenStreetMap (city level)³.

Qualitative data have been retrieved from a number of web sources, notably websites of city councils and tourism offices, the URBACT programme website⁴ and European projects’ websites (e.g. ROCK⁵, Culture for Cities and Regions⁶), where official information provided by

city administrations can be found. In particular, desk research helped identify online cultural calendars published either by online tourism/city portals or local magazines (including independent ones). Qualitative data are integrated in the main report and in the ‘Did you know that...?’ sections of the Cultural and Creative Cities Monitor Online’s city pages to help illustrate the quantitative evidence⁷.

3. City selection

The **city selection** in the Monitor followed the three following fundamental criteria.

1. Cities which have been or will be **European Capitals of Culture** up to 2019, or which have been shortlisted to become a European Capital of Culture up to 2023: **98 cities** (meaning five more compared to the 2017 edition).
2. **UNESCO Creative Cities** (including the most recent winners in 2017⁸): excluding overlap with the European Capitals of Culture, a further **33 cities** (meaning 11 more compared to 2017).
3. Cities **hosting at least two regular international cultural festivals**⁹ running until at least 2018: a further **59 cities** (that is six more compared to 2017).

The 2019 C3 Index consequently includes 190 cities, roughly 90% of the European cities which have been designated under these three different criteria, as Cultural and Creative Cities. Eleven cities have been included in the Monitor but not in the final rankings¹⁰ because they did not meet the data coverage criterion, meaning at least 45% data coverage at the index level and at least 33% for the ‘Cultural Vibrancy’ and ‘Creative Economy’ sub-indices, or because they were located in countries outside the EU (namely Switzerland and Norway). The rankings and the analysis presented are therefore always based on a total of 179 cities, but qualitative information is provided for the full sample of 190 cities in the city pages of the Cultural and Creative Cities Monitor Online.

4. Data treatment

Most of the Monitor indicators are denominated in per capita terms¹¹. This approach is primarily intended to enable cross-city comparability. Furthermore, if the distribution of an indicator deviated significantly from the familiar bell-shaped (‘normal’) distribution, winsorisation was employed to trim the extreme values in the data (or outliers). If the skewness¹² of an indicator was greater than 2 and the kurtosis¹³ was greater than 3.5, the outliers of the indicator were winsorised, meaning that extreme values for each indicator were assigned the following highest value in the distribution¹⁴. This was the case for 20 indicators, which each exhibited one to seven outliers, as can be seen in more detail in Table A3 of ‘Annex C. Statistical assessment of the Cultural and Creative Cities Index 2019’, available for download on the online tool. Data were checked for reporting errors by using the interquartile range.

5. Missing data estimation

The minimum data coverage threshold for a city to be included in the C3 Index was set at 45% at the main index level and at least 33% for the ‘Cultural Vibrancy’ and ‘Creative Economy’ sub-indices. Ideally, data coverage of 75-80% would have been preferred. However, adopting a more stringent criterion for a city’s inclusion would have resulted in cities such as Venice being left out. We opted therefore for a more inclusive approach to allow a sufficiently large set of cities to be covered in the Monitor, while not compromising

the accuracy of the findings. The majority of cities have very good data coverage on the index and the underlying sub-indices (namely: 79% of cities have 75% data coverage on the C3 Index, 66% have 75% data coverage on the Cultural Vibrancy sub-index, 58% have 75% data coverage on the Creative Economy sub-index, and 80% have 75% data coverage on the Enabling Environment sub-index).

Missing data for each city were estimated using a refined and at the same time simplified two-step approach, compared to the previous edition¹⁵. In the first step, the national average is used for missing values in the perception-based variables related to foreigners and trust. This first step made it possible to fill in 37% of the 1 064 values missing in the dataset. In a second step, the last remaining missing values were replaced with the *k*-nearest neighbor (*k*-NN) method, using the average of the values of the three nearest (or statistically closest) neighbors. These were identified using the triplet population-GDP-employment rate, based on continuous values rather than the attributed group (i.e. categorical value from '1' to '5' for the five population-GDP-employment rate groups) (¹⁶). This second step made it possible to fill in 63% of the 1 064 values missing in the dataset.

6. Normalisation

To make it possible to aggregate and compare diverse data on a common scale, the raw data were normalised on a 0-100 scale, meaning that the total scores of the index, sub-indices and indicators range on a scale of 0 to 100, where 0 is the lowest performance in the dataset and 100 the highest. The normalisation was based on the min-max method, whereby the minimum and maximum of the indicator serve as the lower and upper bound of the normalised data, respectively. The minimum and maximum values for each indicator are presented in 'Annex E: The Cultural and Creative Cities Monitor data – 2019 edition', available for download on the accompanying online tool together with an interpretation of the scaled scores.

7. Weighting and aggregation

The normalised indicator scores were aggregated and weighted into nine dimensions. A city's dimension score is calculated from the simple average of all its underlying normalised indicator scores. Within a dimension, a scaling coefficient of 0.5 or 1.0 was assigned to the indicators with the aim of arriving at dimension scores that were balanced in their underlying indicators¹⁷. As a result of this analysis, 3 out of 29 indicators – Sights & landmarks, Museums, and Tourist overnight stays – were assigned half-weight while all other indicators were assigned a weight of 1.

The sub-index scores are calculated from the weighted average of the relevant dimensions, namely:

- The 'Cultural Vibrancy' sub-index is the weighted average of D1.1, Cultural Venues & Facilities (50%) and D1.2, Cultural Participation & Attractiveness (50%).
- The 'Creative Economy' sub-index is the weighted average of D2.1, Creative & Knowledge-based Jobs (40%), D2.2, Intellectual Property & Innovation (20%), and D2.3, New Jobs in Creative Sectors (40%).
- The 'Enabling Environment' sub-index is the weighted average of D3.1, Human Capital & Education (40%), D3.2, Openness, Tolerance & Trust (40%), D3.3, Local & International Connections (15%), and D3.4, Quality of Governance (5%).

The main C3 Index score is calculated from the weighted average of the three sub-indices. In particular, 'Cultural Vibrancy' and 'Creative Economy' are each assigned double the weight (40%) of 'Enabling Environment' (20%) to reflect the importance of measuring primarily culture and creativity in the C3 Index. Weights for the nine dimensions and the three sub-indices were obtained after consultation with about fifteen experts, including policymakers, academics and practitioners, using the budget allocation method¹⁸.

8. Conceptual and statistical coherence

The conceptual framework, once populated with data, was subjected to a series of tests to identify possible biases and errors. Statistical coherence was tested to assess the reliability of the results, following the recommendations of the *OECD–JRC Handbook* (OECD–JRC, 2008¹⁹). 'Annex C: Statistical Assessment of the Cultural and Creative Cities Index 2019' – available for download on the accompanying online tool – details the analysis and key findings. Overall, the analysis of statistical coherence reveals that the statistical structure of the C3 Index 2019 is coherent with its conceptual framework, given that all indicators have good-to-strong correlations with their respective dimensions. Furthermore, all dimensions correlate strongly with the three sub-indices and the C3 Index itself, and are fairly in line with the expert-based weights, all of which indicates that the framework is well balanced.

9. Uncertainty and sensitivity analysis

Uncertainty and sensitivity analysis was undertaken to assess the impact of the choices on the scores and ranks, and to provide a confidence interval for each ranking following a robustness assessment of the modelling assumptions. 'Annex C: Statistical Assessment of the Cultural and Creative Cities Index 2019', available for download on the accompanying online tool, illustrates the analysis and main findings. The C3 Index and all three sub-indices are relatively robust to methodological assumptions related to the normalisation method and the dimension weights. It is reassuring that for about 80% of the cities included in the C3 Index, the overall and sub-index ranks are the result of the underlying data and not of the modelling choices. Consequently, inferences can be drawn for most cities within their peer group, although caution may be needed for a few cities.

10. Visualisation and communication of results

The data were organised into country fact sheets, infographics, tables and figures to facilitate their presentation and interpretation. These can be explored through two main channels: the interactive online tool and the analytical report.

The Cultural and Creative Cities Monitor Online²⁰ offers a full package of interactive functionalities and tools to support cities' interpretation and use of the Monitor for their culture-led development policies and advocacy strategies. For instance, it invites users to browse each of the 190 selected cities, offering both quantitative and qualitative evidence of their performance. To give a fairer picture of a city's performance that takes into account the level of development in relation to GDP, employment or population size, a mark indicating the peer-group average for each of the 29 indicators is included in the city profiles.

The 'Cultural and Creative Cities Monitor: 2019 edition' report (available on the online tool and including a more exhaustive description of Cultural and Creative Cities Monitor Online's possible uses) presents the project's rationale and methodology and discusses relationship patterns within the data itself, highlighting major findings and policy insights.

Endnotes

- 1** An exception was made for four indicators with data available for only one third of the sample, as they were considered highly relevant by the consulted experts and based on the revised literature: Satisfaction with cultural facilities, Tolerance of foreigners, Integration of foreigners and People trust.
- 2** For the review and discussion of the relevant literature, see the academic paper accompanying this work Montalto, V., Moura, C. J. T., Langedijk, S., & Saisana, M. (2019). Culture counts: An empirical approach to measure the cultural and creative vitality of European cities. *Cities*, 89, 167-185.
- 3** See the Lexicon in the 'Cultural and Creative Cities Monitor: 2019 Edition' report for an explanation of technical terms and abbreviations, available on the online tool: <https://composite-indicators.jrc.ec.europa.eu/cultural-creative-cities-monitor/>
- 4** <https://urbact.eu/>
- 5** <https://rockproject.eu/>
- 6** <http://www.cultureforcitiesandregions.eu/>
- 7** For most cities, the local tourism/municipality portal is the best option to stay informed on cultural events. When this is not the case, local magazines promoting cultural events have been identified. The two sources are not necessarily comparable but give a good overview of local cultural dynamics. For future editions of the Monitor, relevant Facebook pages could be retrieved to help complete the picture, especially for those cities that do not have official online pages for cultural events.
- 8** 65 European cities are Unesco Creative Cities. Of the 65, 18 have been included under the 'European Capital of Culture criterion' and 33 under the 'Unesco criterion'. The remaining 14 have been excluded due to poor data coverage.
- 9** In order to apply the festival criterion in a coherent way across Europe, only Europe-wide comparable data sources have been used, notably the Europe for Festivals, Festivals for Europe platform (<https://www.festivalfinder.eu/>) and a Wikipedia page on film festivals in Europe (https://en.wikipedia.org/wiki/List_of_film_festivals_in_Europe). See the Lexicon in the 'Cultural and Creative Cities Monitor – 2019 Edition' report for more details.
- 10** These are: Basel, Bern, Geneva and Zurich (Switzerland), Nicosia and Limassol (Cyprus), Luxembourg (Luxembourg), Valletta (Malta), Bergen, Oslo and Stavanger (Norway).
- 11** Whenever the correlation between an indicator and population size was considered noteworthy (Pearson's correlation > 0.35), the indicator was divided by the city population, except in two cases: i) the indicator Average appearance in university rankings, because it is considered a qualitative indicator of university excellence. A similar approach has been adopted by the developers of the Global Innovation Index (<https://www.globalinnovationindex.org/Home>), reaching its 12th edition in 2019, and of the Global Talent Competitiveness Index (<https://gtcistudy.com/>), now in its sixth edition. ii) The indicator Accessibility by road was not denominated by the city population because it is actually population-weighted (i.e. it measures the population accessible within 1 hour 30 minutes, expressed as a percentage of the population that lives in a 120 km radius around the place of departure).
Based on the approach adopted by the Monitor, if an indicator shows a noteworthy correlation with the population, the indicator is denominated in order to obtain reliable and relevant aggregate measures (e.g. dimensions' and sub-indices' scores) that do not depend on the city size. The correlation between the aggregate measures – more than the single indicators – and the population should therefore not be higher than 0.35, excluding outliers. This condition is met for dimensions D3.1, Human Capital & Education (Pearson's correlation = 0.25), while the correlation between D3.3 Local & International Connections and population size is only slightly above the proposed threshold (Pearson's correlation = 0.38).
- 12** The asymmetry in a graph of a statistical distribution, in which the curve appears 'distorted' either to the left or to the right.
- 13** The peakedness or flatness in a graph of a distribution in which the values are far from the mean value.
- 14** Only for two indicators (i.e. ICT patent applications and Accessibility by rail), values slightly above 2 and 3.5 have been accepted with a view to find a reasonable balance between the skewness and kurtosis values and the total number of winsorised values. In any case, the use of less stringent thresholds for these indicators does not introduce any bias in the correlation structure.
- 15** In order to make 2017 and 2019 scores fully comparable, this new approach has also been used to recalculate missing data for the 2017 edition.
- 16** Cities having quite different population sizes, GDP per capita or employment rates may ultimately belong to the same group. The use of continuous values (e.g. EUR 30 000) instead of the categorical value of the group that a city belongs to (e.g. 1, 2, 3, 4 or 5) allows more precise imputations to be made.
In order to run imputations based on continuous values, the GDP for Swiss cities had to be estimated. To do so, we assumed that these cities were similar to the city of Luxembourg, as they usually share the same 'outlier' character compared to all other European cities in terms of economic performance. We thus 'assigned' Luxembourg's GDP per capita value to all the Swiss cities in the sample.
- 17** Becker et al. (2017) and Paruolo et al. (2013) show that, in weighted arithmetic averages, the ratio of two nominal weights gives the rate of substitutability between the two indicators and hence can be used to reveal the relative importance of individual indicators. This importance can then be compared with ex-post measures of variables' importance, such as the non-linear Pearson correlation ratio. See: Becker, W., Saisana, M., Paruolo P., & Vandecasteele, I. (2017), 'Weights and importance in composite indicators: closing the gap', *Ecological Indicators*, Vol. 80, pp. 12–22, and Paruolo, P., Saisana M., & Saltelli, A. (2013), 'Ratings and rankings: voodoo or science?', *Journal of the Royal Statistical Society, Series A*, Vol. 176, Part 3, pp. 609–634.
- 18** In the budget allocation method, experts are given a budget of N points, to be distributed over a number of indicators (or dimensions), paying more for those indicators whose importance they want to stress. The budget allocation method can be divided into four different phases: (a) selection of experts for the valuation; (b) allocation of budget to the indicators; (c) calculation of the weights; (d) iteration of the budget allocation until convergence is reached (optional).
See <https://composite-indicators.jrc.ec.europa.eu/?q=10-step-guide/step-6-weighting>
- 19** OECD. (2008). Handbook on Constructing Composite Indicators Methodology and User Guide. Château de la Muette. © European Union, 2019
- 20** <https://composite-indicators.jrc.ec.europa.eu/cultural-creative-cities-monitor/>