

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 – as expressed in its main **Index, three sub-indices, nine dimensions** and **29 indicators** – was developed by the JRC in consultation with policy makers, academics and practitioners in the field of culture and creativity.

Overall, the Cultural and Creative Cities 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 **data selection** for the Cultural and Creative Cities Monitor 2017 respects five criteria:

- **Coverage:** Data that allows for the assessment of city-level performance and for a comparison between cities. Indicators that were available for at least 50% of the cities in the sample were included.¹
- **Relevance:** Data that is relevant to assess culture and creativity-related factors, as suggested in the relevant literature.
- **Accessibility:** Data that is publicly available – either peer-reviewed scientific data or data compiled by international organisations or experimental data.
- **Quality:** Data whose quality 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 2016.

Seven 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 76% in the sample); (iii) Eurobarometer Survey on ‘Quality of life in cities’, jointly prepared by the European Commission Directorate-General for Communication (DG COMM), the Directorate-General for Regional and Urban Policy (DG REGIO) and the market research company TNS (city level); (iv) DG REGIO (city level for transport indicators, NUTS 2, NUTS 1 and NUTS 0 level for governance indicators, which represent a good approximation for ‘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)².

3 City Selection

The **city selection** in the Cultural and Creative Cities Monitor followed three fundamental criteria:

1. Cities which have been or will be **European Capitals of Culture** (ECoC) up to 2019, or which have been shortlisted to become an ECoC up to 2021 – **93 cities**;
2. **UNESCO Creative Cities** (including the most recent winners in 2015³) – excluding overlap with the ECoC, a further **22 cities**;
3. Cities **hosting at least two regular international cultural festivals**⁴ running until at least 2015 – a further **53 cities**.

The 2017 Cultural and Creative Cities (C3) Index consequently includes 168 cities, roughly 90% of the European cities which have been designated, under different approaches, Cultural and Creative Cities. Thirteen cities have been included in the Monitor but not in the final rankings 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 155 cities, but qualitative information is provided for the full sample of 168 cities.

4 Data Treatment

Most of the C3 indicators are denominated in per capita terms. 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 skewness⁵ of an indicator was greater than 2 and the kurtosis⁶ 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 distribution. This was the case for 14 indicators, which each exhibited one to three outliers. 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. Yet, 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. Consequently, for 75% of the 155 cities included in the calculation of the Index, data coverage is very good (at least 81% at the index level, at least 89% for the ‘Cultural Vibrancy’, 100% for ‘Creative Economy’, and at least 75% for the ‘Enabling Environment’). Almost 70% of available data refer to 2013–2015.

Imputation was conducted in three steps: 1) missing values in the variables Tolerance of foreigners and Integration of foreigners were replaced with the national average, assuming that the national average based on the scores of the included cities could be a relatively good proxy for this kind of opinion-based variables; 2) remaining missing values were then imputed using the triplet population–GDP–employment rate (with five groups for each var-

iable⁷), based on data for peer cities; 3) 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) neighbours.

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 0 to 100 scale 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 the Annex C available for download on the Cultural and Creative Cities Monitor Online⁸ 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 indicators.⁹ As a result of this analysis, 3 out of 29 indicators — Sights & landmarks, Museums, 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 1.1, Cultural Venues & Facilities, (50%) and 1.2, Cultural Participation & Attractiveness, (50%).
- The 'Creative Economy' sub-index is the weighted average of 2.1, Creative and Knowledge-based Jobs (40%), 2.2, Intellectual Property & Innovation (20%), and 2.3, New Jobs in Creative Fields (40%).
- The 'Enabling Environment' sub-index is the weighted average of 3.1, Human Capital & Education (40%), 3.2, Openness, Tolerance & Trust (40%), 3.3, Local & International Connections (15%), and 3.4, 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 policy makers, academics and practitioners, using the budget allocation method¹⁰.

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 (2008)¹¹. Annex B - available for download on the Cultural and Creative Cities Monitor Online¹² - details the analysis and key findings. Overall, the analysis of statistical coherence reveals that the statistical structure of the C3 Index 2017 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 B, available for download on the Cultural and Creative Cities Monitor Online¹³, details the analysis and key 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 over 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 (see Annex B).

10 Visualisation & Communication of Results

The data were organised into country fact sheets, infographics, tables, and figures to facilitate their presentation and interpretation. The interactive Cultural and Creative Cities Monitor Online platform¹⁴ invites users to browse each of the 168 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 report (also available online) includes an analysis of the prevailing economic and demographic factors in the selected cities and discusses relationship patterns within the data itself, to enrich the perspectives on the cities.

Endnotes

- 1** An exception was made for four indicators with data available for only one-third of the sample: Satisfaction with cultural facilities, Tolerance of foreigners, Integration of foreigners and People trust.
- 2** See the Lexicon in the Cultural and Creative Cities Monitor Report for an explanation of technical terms and abbreviations available at: <https://composite-indicators.jrc.ec.europa.eu/cultural-creative-cities-monitor>
- 3** Forty-four European cities are UNESCO Creative Cities. Of the 44, 16 have been included under the 'ECoc criterion' and 22 under the 'UNESCO criterion'. The remaining six have been excluded due to poor data coverage.
- 4** In order to apply the festival criterion in a coherent way across Europe, only Europe-wide comparable data sources have been used, notably: Platform EFFE (Europe for Festivals, Festivals for Europe) and a Wikipedia page on film festivals in Europe.
- 5** The asymmetry in a graph of a statistical distribution, in which the curve appears 'distorted' either to the left or to the right.
- 6** The peakedness or flatness in a graph of a distribution in which the values are far from the mean value.
- 7** The five city groups based on population, GDP per capita (in comparable € or Purchasing Power Standards, PPS) and employment rates are as follows: 'XXL': more than one million; 'XL': between 500,000 and one million; 'L': between 250,000 and 500,000; 'M': between 100,000 and 250,000; and 'S': between 50,000 and 100,000; 'Very high': more than €35,000 (40 cities); 'High': €30,000–35,000 (26 cities); 'Medium': €25,000–30,000 (38 cities); 'Low': €20,000–25,000 (27 cities); 'Very low': less than €20,000 (37 cities); 'Very high': more than 74%; 'High': between 71% and 74%; 'Medium': between 68% and 71%; 'Low': between 65% and 68%; 'Very low': less than 65%.
- 8** <https://composite-indicators.jrc.ec.europa.eu/cultural-creative-cities-monitor>
- 9** 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*, 80, 12–22; and Paruolo, P., Saisana, M. & Saltelli, A. (2013). Ratings and rankings: voodoo or science? *Journal of the Royal Statistical Society Series A*, 176(3), 609–634.
- 10** 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>
- 11** OECD-JRC (2008). *Handbook on Constructing Composite Indicators. Methodology and User Guide*. Paris: OECD
- 12** <https://composite-indicators.jrc.ec.europa.eu/cultural-creative-cities-monitor>
- 13** Ibid.
- 14** Ibid.

