METHODOLOGY AND PRINCIPLES OF ANALYSIS

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This document introduces the methodology used by the IMD World Competitiveness Center to develop the IMD World Competitiveness Ranking, the IMD World Digital Competitiveness Ranking and the IMD World Talent Report. Although the methodology is intended to be general, ranking- specific examples are mentioned throughout. This does not mean, however, that the principle under discussion is not applicable to the other rankings. The specificities of each ranking are introduced in the tables, as indicated.

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What is the IMD World Competitiveness Yearbook?

The IMD World Competitiveness Yearbook (WCY), first published in 1989, is a comprehensive annual report and worldwide reference point on the competitiveness of countries. It provides benchmarking and trends, as well as statistics and survey data based on extensive research. It analyzes and ranks countries according to how they manage their competencies to achieve long-term value creation. An economy's competitiveness cannot be reduced only to GDP and productivity because enterprises also have to cope with political, social and cultural dimensions. Governments therefore need to provide an environment characterized by efficient infrastructures, institutions and policies that encourage sustainable value creation by the enterprises.

The IMD World Competitiveness Rankings emphasize a long-term trend highlighted in past editions – that the countries on the top of the list each have a unique approach to becoming competitive.

The Yearbook provides extensive coverage of 63 economies, chosen based on the availability of comparable international statistics and our collaboration with local Partner Institutes, which contribute to the collection of survey data and ensure that all data are reliable, accurate and as up-to-date as possible. This year, we have the privilege of collaborating with a unique global network of 56 Partner Institutes.

The World Competitiveness Ranking is based on 337 competitiveness criteria selected as a result of comprehensive research using economic literature, international, national and regional sources and feedback from the business community, government agencies and academics. The criteria are revised and updated on a regular basis as new theory, research and data become available and as the global economy evolves.

Who uses the IMD World Competitiveness Yearbook?

The WCY is an invaluable, dynamic and constantly updated benchmark for decision makers. The business community uses it to help determine and validate investment plans and to assess locations for new operations. Governments find important indicators to benchmark their policies against those of other countries, to evaluate performance over time and to learn from the "success stories" of economies that have improved their competitiveness. Academics also use the exceptional wealth of data in the WCY to better understand and analyze how countries (and not only enterprises) compete in world markets.

How does the IMD World Competitiveness Yearbook measure competitiveness?

Over the past two decades, the methodology used to assess the competitiveness of countries has been fine-tuned to take into account the evolution of the global environment and new research. In this way, the WCY keeps pace with structural changes in national environments and the rapidly changing technological revolution. We make these changes gradually so that we can preserve the comparability of results from year to year and highlight the evolution of an economy's performance relative to the competitiveness of others. Based on analysis made by leading scholars and on our own research, all criteria is grouped into sub-factors. Each sub-factor does not necessarily include the same number of criteria (for example, it takes more criteria to assess Education than to evaluate Prices).

Sub-factors, irrespective of the number of criteria they contain, have the same weight in the overall consolidation of results. In the case of the World Competitiveness Ranking, for example, the weight of each sub-factor is 5% (20 x 5 = 100). This allows us to "lock" the weight of the sub-factors regardless of the number of criteria they include. We believe that this approach improves the reliability of the results and helps ensure a high degree of compatibility with past results. Statistics are sometimes prone to errors or omission, locking the weights of sub-factors has the same function as building "fire barriers"; it prevents problems from spreading in a disproportionate way.

The WCY uses different types of data to measure quantifiable and qualitative issues separately. Statistical indicators are acquired from international, national and regional organizations, private institutions and our Partner Institutes. These statistics are referred to in the WCY as hard data. The hard data represent a weight of two-thirds in the overall rankings. Additional criteria are drawn from our annual Executive Opinion Survey and are referred to in the WCY as survey data. The survey questions are included in the Yearbook as individual criteria and are also used to calculate the overall rankings, representing a weight of one-third.

Executive Opinion Survey

Our Executive Opinion Survey complements the statistics we use from international, national and regional sources. While the hard data show how competitiveness is measured over a specific period of time, the survey data measures competitiveness as it is perceived by market participants. The survey is designed to quantify issues that are not easily measured, for example: management practices, corruption, adaptive attitudes and the agility of companies. The survey responses reflect present and future perceptions of competitiveness by business executives who are dealing with international business situations. Their responses are more recent and closer to reality since there is no time lag with the year under consideration, which is often a problem with hard data, which show a "picture of the past."

The Executive Opinion Survey is sent to mid- and upper-level managers in all the economies studied. The sample of respondents is representative of the entire economy, covering a cross-section of the business community in all economic sectors. In order to be statistically representative, we select a sample size that is proportional to the GDP breakdown of economic sectors of the economy. The survey respondents are nationals or expatriates, in domestic or international enterprises who have

resided at least a year in the economy under consideration. They are asked to evaluate the present and future competitiveness conditions of the economy in which they work, drawing from their domestic and international experience. The surveys are sent in February and are returned in April. All responses returned to IMD and are treated as confidential. In 2020, we received more than 6,000 responses from the 63 economies worldwide.

The respondents assess the competitiveness issues by answering the questions on a scale of 1 to 6. The average value for each economy is then calculated and converted into a 0 to 10 scale. Finally, the survey responses are transformed into their standard deviation values, from which the rankings are calculated.

How are the rankings computed?

The essential building block for the rankings is the standardized value for all the criteria (i.e., STD value). The first step is to compute the STD value for each criterion using the data available for all the economies (see the next section Data Processing Methodology for more detail). We then rank the economies based on the criteria that are used in the aggregation: a combination of hard and survey data. Additional criteria are presented for background information only; they are not included in the aggregation of data to determine the overall rankings. Details on the type and number of

criteria used in the calculation of each of the rankings are presented in **Table 3.** In most cases, a higher value is better, for example, for Gross Domestic Product; the economy with the highest standardized value is ranked first while the one with the lowest is last. However, for some criteria the inverse may be true, where the lowest value is the most competitive, for example, Software Piracy. In these cases, a reverse ranking is used: the economy with the highest standardized value is ranked last and the one with the lowest is first.
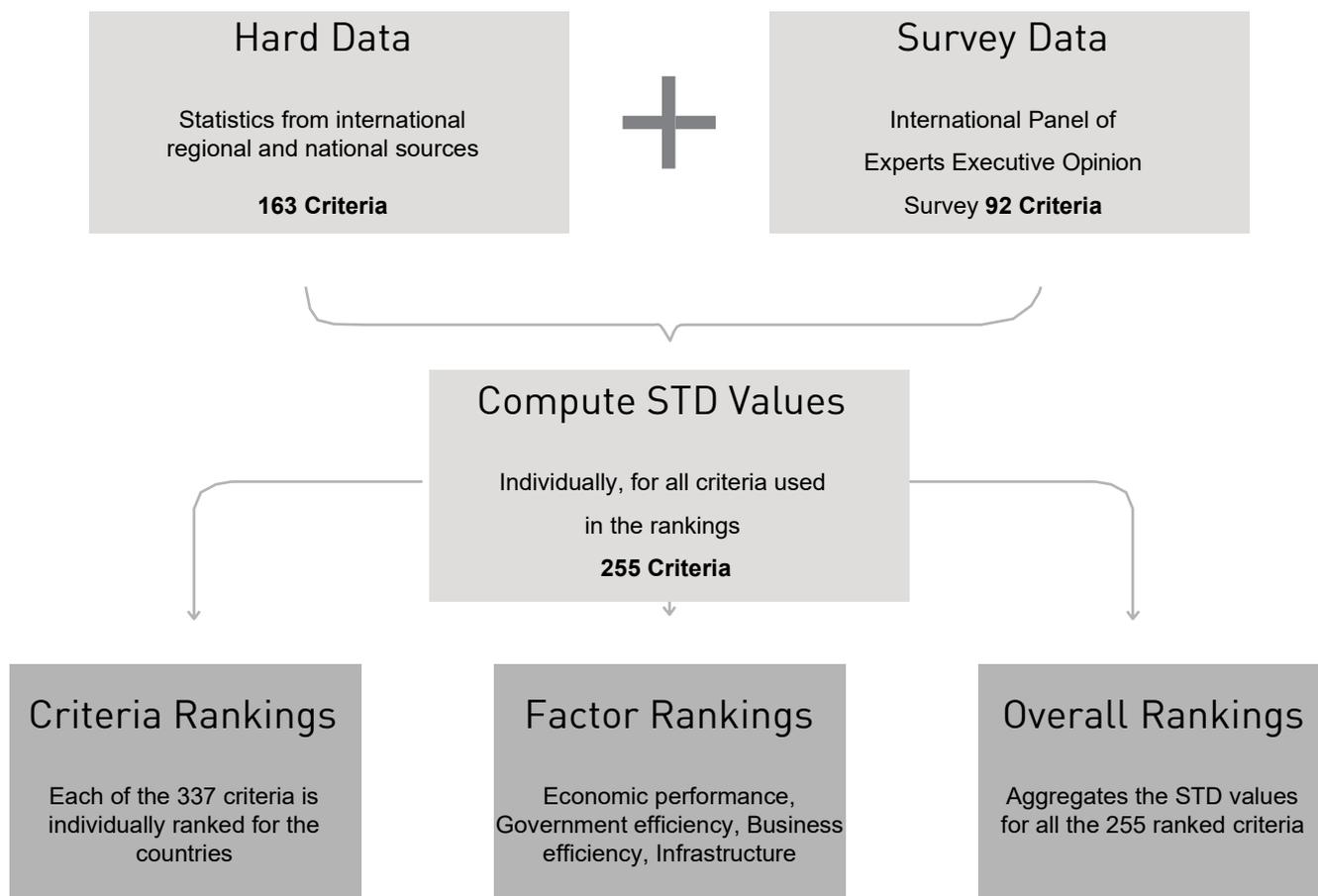
Table 3. Criteria Details

Ranking/Report	Criteria			
	Hard Data	*Survey*	*Background*	*Total*
World Competitiveness	163	92	82	337
World Digital Competitiveness	31	20	NA	51
World Talent	15	17	NA	32

Since all economies' statistics are standardized, they can be aggregated to compute indices. We use these index values, which we call "scores," to compute the following rankings: the overall ranking, competitiveness factor rankings and sub-factor rankings. When data is unavailable or too old to be relevant for a particular economy, the name of the economy

appears at the bottom of the statistical table for the criterion being measured and a dash is shown. In the aggregation of the statistics, all missing data are given STD values imputed from the average of existing data within the sub-factor (see **Figure 1**).

Figure 1. Computing the Rankings

Hard Data		Survey Data
Statistics from international regional and national sources	**+**	International Panel of Experts Executive Opinion Survey **92 Criteria**
163 Criteria		

Compute STD Values

Individually, for all criteria used in the rankings
255 Criteria

Criteria Rankings	Factor Rankings	Overall Rankings
Each of the 337 criteria is individually ranked for the countries	Economic performance, Government efficiency, Business efficiency, Infrastructure	Aggregates the STD values for all the 255 ranked criteria

Data Processing Methodology

Standard Deviation Method

As distinct criteria exhibit different scales and units, a comparable standard measure – the Standard Deviation Method (SDM) – is used to compute the overall, factor and sub-factor results. It measures the relative difference between the economies' performances, resulting in a more accurate assessment of each country's relative position in the final rankings.

First, for each criterion, we compute the average value for the entire population of economies. Then, the standard deviation is calculated using the following formula:

$$S = \sqrt{\frac{\sum (x - \bar{x})^2}{N}}$$

Where:
x = original value
$\bar{x}$ = average value of all the economies
N = number of economies
S = standard deviation

Subsequently, we compute each of the economies' STD values for the all the ranked criteria. The STD is calculated by subtracting the average value of the 63 economies from the economy's original value and then dividing the result by the standard deviation.

The STD value for criteria i is calculated as follows:

$$(\text{STD value})_i = \frac{x - \bar{x}}{S}$$

Aggregation of Data and Rankings

In the WCY some criteria are provided as background information only and are not included in the determination of the rankings. Some background data, however, are presented in ranking order while others are shown alphabetically.

STD values are calculated for each individual criterion, based on the STD method described above. All hard data indicators are reviewed to determine the shape of the distribution. Non-normally distributed data are normalized by taking the log. The STD is then calculated using the logged values.

The sub-factor rankings are determined by calculating the average of the STD values of all criteria comprising the sub-factor. All the hard data have a weight of 1. The survey data are weighted so that the survey accounts for one-third in the determination of the overall ranking. When data are unavailable for a particular economy, the missing values are replaced by STD values that are imputed from the average of existing data within the sub-factor. Taking the average for each sub-factor enables us to "lock"

the weight of all the sub-factors irrespective of the number of criteria they contain so that each sub-factor has an equal impact on the overall rankings.

Next, we aggregate the sub-factor STD values to determine the factor rankings. Only ranked criteria are aggregated to obtain these rankings. The STD values of the factors are then aggregated to determine the overall rankings. All the ranked criteria comprised in the factors are thus included in the consolidation of data.

Since all the statistics are standardized, they can be aggregated to compute indices. We use these index values, which we call "scores," to compute the Factors and the Overall Rankings. It should be noted that across the factors, only one economy has a value equal to 100 and one economy a value equal to 0. To calculate the overall rankings, we take the average of the factors' scores of the respective ranking (Competitiveness, Digital or Talent) and then convert them into an index with the leading economy given a value of 100.

Survey Criteria

Each year we conduct a survey to quantify issues related to competitiveness for which there are no hard statistics. The survey is an in-depth 92-point questionnaire sent to middle and upper level managers in the economies included in the rankings. The distribution reflects a breakdown of industry by sectors: primary, industry/manufacturing and services/finance.

In 2020 we received more than 6,000 responses for an average of approximately 95 replies per economy. The target list is determined by IMD and has been developed over many years with the collaboration of our Partner Institutes worldwide. Confidentiality is ensured and the list is updated every year. Respondents answer only for the economy in which they have worked and resided in the past year. Results, therefore, reflect widespread knowledge about each economy and draw on the wealth of their international experience.

The respondents assess the competitiveness issues by answering the questions on a scale of 1-6, with 1 indicating a negative perception and 6 indicating the most positive perception. The WCY calculates the average value for each economy, then the data is converted from a 1-6 scale to a 0-10 scale, using the formula below.

Finally, the survey responses are transformed into their standard deviation values, from which the rankings are calculated.

$$(x * 2) - 2$$

where X = average value.

Trends

A trend or growth rate offers a more dynamic assessment than absolute values. The formulas used to calculate trends and growth rates are explained below:

1. Annual real growth rate (i = inflation rate):

$$\left(\frac{value_{Year}}{value_{Year-1}\left(1 + \frac{i_{Year}}{100}\right)} - 1 \right) \times 100$$

2. Average annual percentage growth rate (n = number of periods):

$$\frac{\frac{value_{Year} - value_{Year-1}}{value_{Year-1}} + \frac{value_{Year-1} - value_{Year-2}}{value_{Year-2}} + \dots}{n-1} \times 100$$

Growth formulas, however, may have shortcomings. The average annual growth rate fails to reveal the real extent of changes, as it flattens or inflates year-to-year growth rates. For example, an average growth rate over two years might be calculated at 15%, while in reality there was 5% growth between the first and second years, and 25% between the second and third years. The average annual growth is used only when data vary widely in the middle years of a period, and less widely between the first and last years of the period. It is also used in cases where it is impossible to combine negative and positive initial and final values. This approach gives a more accurate picture than the compound rate under these circumstances.

Deflated Values

The following formula is used when calculating real growth rates from nominal values, because it takes into account cumulative inflation (e.g., real growth in Household Consumption Expenditure). The final deflated value is then used to obtain the annual real growth rate.

Taking a five-year time span as an example:

Deflated final value (i = inflation rate):

$$\frac{value_{Year}}{\left(1+\frac{i_{Year-4}}{100}\right)\times\left(1+\frac{i_{Year-3}}{100}\right)\times...\times\left(1+\frac{i_{Year}}{100}\right)}$$